



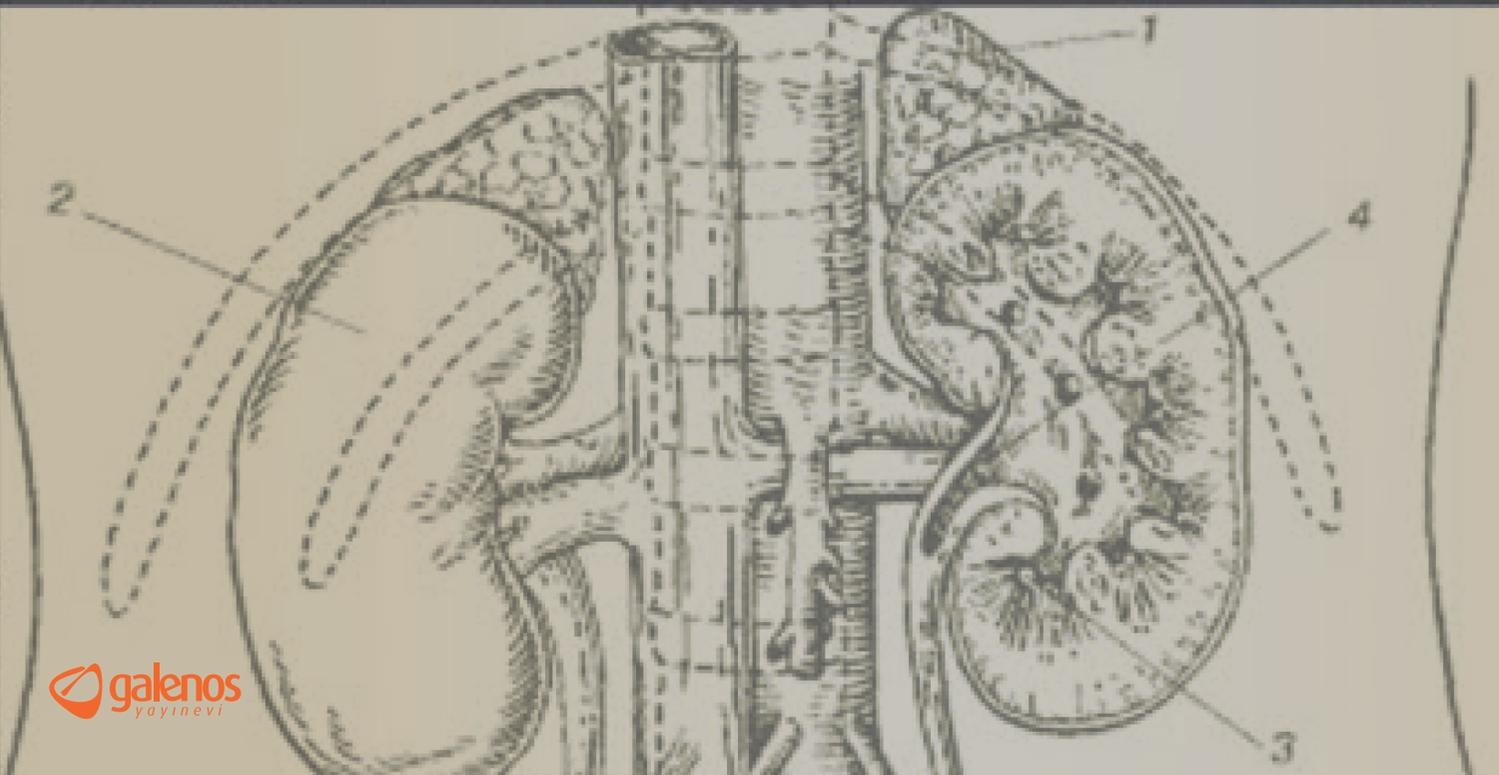
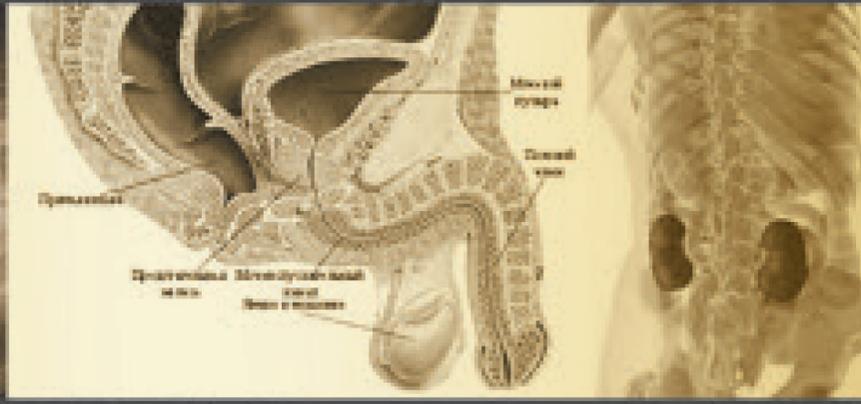
Society of  
Urological  
Surgery  
in Türkiye

E-ISSN 2148-9580

# JOURNAL OF UROLOGICAL SURGERY

Volume 13 / Issue 1 / March 2026

[www.jurolsurgery.org](http://www.jurolsurgery.org)



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# Investigating Normal and Abnormal Features of Plastibell Ring Circumcision: Case Report and Review of Evidence

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## Abstract

Plastibell ring circumcision may be associated with some complications. In this article, we aimed to illustratively address the abnormal and normal features of plastibell ring circumcision. PubMed and Embase were searched for plastibell ring circumcision. Pictures were taken of circumcised children with plastibell rings. The normal post-procedure course of healing, may resemble abnormal complications such as infection and dehiscence. It was revealed that subcutaneous hematoma, blister, and crust on glans, inflammatory penile shaft erythema and swelling, inflammatory penile discharge, and skin-mucosa gap are normal post-circumcision features of plastibell ring circumcision. In contrast, infectious penile shaft erythema, swelling, and discharge, as well as ring impaction, preputial adhesion, and meatal adhesion, were found to be abnormal features. Adverse events of the plastibell ring circumcision are rarely noticed by parents. Therefore, the necessary measures are not taken, and the child suffers serious complications as a result of circumcision. Sometimes, natural features are observed after circumcision, causing parents' anxiety due to ignorance. Providing a pamphlet illustrating common normal and abnormal features of plastibell ring circumcision will decrease family stress, emergency referrals, and preventable complications in this common procedure.

**Keywords:** Circumcision, plastibell ring, complication

## Introduction

Circumcision, as with any other surgery, carries the risk of complications (1). However, there are also some features of the normal healing process that can mimic complications. Approximately 25% of emergency visits immediately after circumcision are due to concerns attributed to normal healing (2). These appearances may cause intense parental anxiety, highlighting the importance of parental education.

On the other hand, there are easily missed abnormal healing features in ring circumcision, which may result in additional procedures (1). In this article, we aimed to present the most common features of a normal and abnormal course of plastibell ring circumcision to decrease unnecessary referrals, additional procedures, and parental concerns.

## Materials and Methods

The PubMed and Embase databases were searched up to March 2022 for relevant articles regarding plastibell ring circumcision. Only manuscripts about the complications of plastibell ring circumcision were used. Pictures of ring-circumcised children were taken by their parents and were sent to the authors to monitor the child's health. The parents consented to have images used anonymously for educational purposes and publishing.

## Results

Based on the findings of previous studies, acute complications of circumcision include bleeding, infection, loss of penile skin, and proximal migration of the ring. Delayed complications consist of meatal stenosis, incomplete circumcision, and preputial adhesion of the glans (3).

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**Received:** 17.09.2024 **Accepted:** 15.11.2024 **Epub:** 12.05.2025 **Publication Date:** 02.03.2026

**Cite this article as:** Akhavizadegan H, Ghorbani A. Investigating normal and abnormal features of plastibell ring circumcision: case report and review of evidence. J Urol Surg. 2026;13(1):1-5.

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Complication rates have been reported from 7% to 20% for the plastibell ring (3), which is higher than conventional circumcision, with complication rates averaging 1.5% (range 0 to 16%) (4). However, not only has the popularity of the plastibell ring increased (5), but it has also been shown in some studies that the plastibell ring reduces circumcision complications (6). These inconsistencies may be due to over- or under-diagnosis of adverse outcomes (3).

## Cases Presentations

### Local Anesthesia Injection Hematoma

The incidence of this complication is highly worrisome to parents and is common to all types of circumcision (7). This happens when a vessel is injured inadvertently during injection, and the injury appears immediately. Most of these hematomas (Picture 1) spontaneously resolve, but occasionally they require a pressure dressing.

Crust- and vesicle-like lesions (blisters), (Picture 2) on the glans have been reported in 3% of cases (2). They are skin erosions caused by the ring and do not need any treatment.

### Swelling and Redness of Penile Shaft

The most challenging subject in the postoperative care of circumcision is the diagnosis of infection. Due to the rich blood supply of the penis, the infection rate is very low in circumcision (1), with the incidence estimated between 0.4% and 1.42% according to several studies (6,8). However, the rate of swelling and redness has been reported to be as high as 37.1% and 25.7%, respectively. This may result in the false diagnosis of infection in an emergency setting in up to 26% of boys who will then receive unnecessary antibiotics (2).

The mechanism of falling off the ring is based on pressure necrosis by the firm ligature of skin in the plastic device. Relative

ischemia in the distal portion of skin near the ring produces inflammatory reactions, such as redness and swelling, which are fairly common (Picture 3).

Significant pain on palpation of a red or swollen area, fever, and systemic symptoms are important factors that can differentiate infection from inflammation (1,9). The presence of these symptoms necessitates immediate antimicrobial therapy to avoid necrotizing fasciitis (1).

However, redness and swelling without warning symptoms do not need antimicrobial treatment. Improper antibiotic use for circumcision has been reported to increase bacterial resistance, allergic reactions, and diarrhea (10).



Picture 2. Crust, blister, and vesicles at 3 and 6 o'clock of Glans



Picture 1. Subcutaneous hematoma after local anesthetic injection



Picture 3. Swelling and redness of penile shaft

### Penile Discharge

A physiologic yellow discharge is visible after the 3<sup>rd</sup> day of the ring placement up to 2 days after it falls off (Picture 4). As mentioned earlier, skin inflammation proximal to the plastibell ring is responsible for this exudate and has been reported in 6% of cases (2). This only requires irrigation. This inflammatory discharge can be differentiated from an infectious type using the above-mentioned criteria. Because of the contaminated diaper environment and the microbial flora in the genital region, swab cultures from the discharge rarely help in this situation (1).

### Non-epithelialized Gap Between Skin and Mucosa Immediately After Ring Fall Off

The plastibell ring induces necrosis by putting pressure on the prepuce against the plastic device, which causes gradual sloughing (6). When the ring starts to separate, a gap (Picture 5)



Picture 4. Normal penile discharge following ring circumcision



Picture 5. Non-fused skin and mucosa after ring fall off

will appear between the mucosal cuff, and the penile shaft skin. This defect will be filled in 48 hours by secondary intention.

### Ring Impaction

According to the literature, 70% of rings fall spontaneously in the first 10 days following plastibell circumcision (6). In cases where spontaneous improvement does not occur, the child should be evaluated for possible interventions to break and remove the rings.

There are two causes for delayed ring falling, including impaction (with the ring extruding distally onto the glans) (Picture 6) and delayed separation due to older age, with a prevalence of 2.2% and 0.7%, respectively (5).

The ring is more useful in younger infants when the foreskin is thin and can be easily compressed by a ligature (6). Older boys have thick skin, and the necrosis, therefore, takes longer.

With timely diagnosis, the impacted ring is removed, leaving only an indentation on the glans, which gradually improves. However, if left undiagnosed, it can cause irreversible injuries, such as disfigurement (5), complete or partial necrosis of glans, and urethrocutaneous fistulae (11).

### Preputial Adhesion

During healing, the incised portion of skin can adhere to the glans and create an epithelialized skin bridge. The mild and fresh adhesions (Picture 7) can be separated by the physician easily with minimal pain. However, severe cases or missed adhesions that turn into an epithelialized bridge require a urological referral and surgery (1). Skin bridges are mostly a cosmetic matter that can sometimes be bothersome due to smegma entrapment, penile curvature, and painful erections (12).



Picture 6. Ring impaction after 10 days

## Meatal Adhesion

Post-circumcision erythema and inflammation of the external meatus can cause meatal adhesion (Picture 8) and meatal stenosis in 0.2 to 20% of cases. With early diagnosis and simple dilation, other surgical procedures can be avoided (13). Applying an ointment such as petroleum jelly to the meatus after circumcision decreases the incidence of complications (14).

Normal and abnormal features of plastibell ring circumcision are summarized in Table 1.

## Discussion

This study aimed to present the normal and abnormal features of plastibell ring circumcision. It was revealed that subcutaneous



Picture 7. Preputial adhesion after ring circumcision



Picture 8. Meatal adhesion after ring circumcision

hematoma, blister and crust on glans, inflammatory penile shaft erythema and swelling, inflammatory penile discharge, and skin-mucosa gap are normal post-circumcision features of plastibell ring circumcision. In contrast, infectious penile shaft erythema and swelling, infectious penile shaft discharge, ring impaction, preputial adhesion, and meatal adhesion were found to be abnormal features.

The clinical applications of this study include providing information on the normal and abnormal features of plastibell ring circumcision. By identifying and categorizing these features, healthcare professionals can better assess and diagnose post-circumcision complications. This knowledge can aid in distinguishing between normal healing processes and abnormal conditions, allowing for timely intervention and appropriate management. The study's findings can contribute to improving patient care by helping healthcare providers make informed decisions regarding treatment options and potentially reducing the need for unnecessary surgical procedures. Additionally, the study serves as a valuable resource for educating both medical professionals and patients about the expected post-circumcision outcomes and potential complications associated with the plastibell ring technique.

The unfamiliarity of parents with the misleading appearances of the normal post-procedure course of plastibell ring circumcision results in higher referrals to hospitals and emergency departments. On the other hand, silent progression of abnormal features that are not noticed early can lead to additional procedures.

The strengths of your study include the combination of conducting a case series and reviewing previous studies, which allows for a comprehensive analysis of the normal and abnormal features of plastibell ring circumcision. Including multiple cases and reviewing existing literature can enhance the reliability and generalizability of our findings. However, it is important to consider that the generalizability of the findings of this case series to larger populations may be limited, as it primarily focuses on a specific group of patients. Further research, such as prospective studies or randomized controlled trials, may be necessary to validate and expand our findings, as well as to address any potential confounding factors.

**Table 1. Normal and abnormal features of plastibell ring**

	Condition	Timing	Description	Recommendation
Normal conditions	Subcutaneous hematoma	Immediately during procedure	Blue swelling after anesthetic injection	Reassurance
	Crust, blister, and vesicles on glans	24 hours after ring placing to 48 hours after falling	Adjacent to ring edges on gland	Reassurance
	Inflammatory Penile shaft erythema and swelling	24 hours after ring placing to 48 hours after falling	Without pain, fever or restlessness	Reassurance
	Inflammatory penile discharge	72 hours after ring placing to 48 hours after falling	Without pain, fever or restlessness	Reassurance
	Skin-mucosa gap	After ring falling to 48 hours	Visible only with skin retraction	Reassurance
Abnormal conditions	Infectious penile shaft erythema and swelling	From ring placing to 48 hours after ring falling	With pain, fever and restlessness	Antibiotics
	Infectious penile shaft discharge	From ring placing to 48 hours after ring falling	With pain, fever and restlessness	Antibiotics
	Ring impaction	More than 10 days after ring placing	Significant portion of glans out of ring	Ring cutting
	Preputial adhesion	48 hours or more after ring falling	After-glans deflection is not visible	Office based separation
	Meatal adhesion	48 hours or more after ring falls	Meatal erythema, none-separable edges	Meatal calibration

## Conclusion

We recommend providing a pamphlet to the parents containing information about these conditions to educate them about circumcision. This will decrease family stress, emergency referrals, and preventable complications in this common procedure.

## Footnotes

### Authorship Contributions

Concept: H.A., A.G., Design H.A., A.G., Data Collection or Processing: H.A., A.G., Analysis or Interpretation: H.A., A.G., Literature Search: H.A., A.G., Writing: H.A., A.G.

**Conflict of Interest:** No conflict of interest was declared by the author.

**Financial Disclosure:** The author declared that this study received no financial support.

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# Long-term Outcomes of Modified Indiana Pouch Urinary Diversion in Pediatric-onset Lower Urinary Tract Disease

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## What's known on the subject? and What does the study add?

Indiana pouch is effective in adults; pediatric long-term data are limited. Very long-term pediatric outcomes, highlighting high stone risk.

## Abstract

**Objective:** Lower urinary tract dysfunction in pediatric patients can lead to reduced bladder capacity, high intravesical pressures, hydronephrosis, renal deterioration, and incontinence. While bladder augmentation with clean intermittent catheterization is the standard approach, some patients are unsuitable candidates or experience failure. In these cases, continent urinary diversion using the modified Indiana pouch (IP) may provide protection of the upper urinary tract and social continence. Although the IP procedure has been extensively studied in adults, long-term data in pediatric populations remain limited. We present our 23-year single-center experience with pediatric-onset IP urinary diversion.

**Materials and Methods:** We retrospectively reviewed medical records of all patients undergoing IP diversion between January 1996 and January 2019. Twelve patients received the procedure; one adult with post-traumatic pelvic injury was excluded, leaving 11 with pediatric-onset pathology. Data collected included demographics, indication for surgery, perioperative complications, renal function, hydronephrosis, continence status, stone events, and long-term complications. Patients were followed with ultrasonography, biochemistry, and clinical evaluation every 3-6 months. Descriptive analysis was performed.

**Results:** Median age at surgery was 15 years (range 7-28), and median follow-up was 122 months (20-243). Indications included bladder exstrophy (n=9), neurogenic bladder secondary to radiotherapy for rhabdomyosarcoma (n=1), and complex urogenital anomaly with bilateral renal dysplasia (n=1). Early complications included five febrile urinary tract infections (45%), one late urinary tract infection, and three cases of hemorrhage requiring transfusion. Hydronephrosis improved in 66% of patients. Median preoperative glomerular filtration rate (excluding transplant cases) was 112 mL/min/1.73 m<sup>2</sup> (27.8-129), declining to 71.1 (20-123) at final follow-up; three patients developed chronic kidney disease, but none required dialysis. Nine patients (82%) achieved both daytime and nighttime continence, one achieved daytime continence only, and one remained incontinent. Stones developed in 7 patients (63%), requiring 16 surgical procedures: 5 open, 7 endoscopic, and 4 percutaneous. One open procedure resulted in pouch-skin fistula. Ostomy revision was required in three patients. No patient developed metabolic acidosis, B12 deficiency, or secondary malignancy.

**Conclusion:** The IP is a safe and effective long-term option for pediatric-onset lower urinary tract dysfunction, providing renal preservation and high continence rates. Stone formation is a frequent late complication, highlighting the importance of lifelong irrigation, surveillance, and multidisciplinary follow-up.

**Keywords:** Indiana pouch, pediatric, pediatric urology, reconstructive surgery

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**Received:** 21.06.2023 **Accepted:** 20.10.2025 **Epub:** 23.02.2026 **Publication Date:** 02.03.2026

**Cite this article as:** Aşçı A, Albayrak E, Altan M, Doğan HS, Tekgül S. Long-term outcomes of modified indiana pouch urinary diversion in pediatric-onset lower urinary tract disease. J Urol Surg. 2026;13(1):6-10.

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## Introduction

A healthy bladder has the capacity and compliance to store urine in a low-pressure environment while enabling voiding in a socially acceptable manner, thereby protecting the upper urinary tract and providing social continence. Patients with lower urinary tract pathologies may have low capacity, hypo-compliant bladders leading to higher filling pressures, upper urinary tract deterioration, and incontinence. This is a more prominent problem in the pediatric patient group. As children have a longer life expectancy, it is paramount to obtain a low-pressure urinary tract and protect renal function. Providing social continence is also crucial for the healthy psychosocial development of juveniles, as it has an immense impact on their quality of life (1).

Bladder augmentation techniques in conjunction with clean intermittent catheterization (CIC) may help these patients to protect the upper urinary tract and achieve social continence. Nevertheless, in some cases augmentation procedures may fail, or the present structure of the bladder may not be suitable for augmentation. A continent urinary diversion procedure may be performed in end-stage bladder dysfunction or lower urinary tract disease, where reconstruction is not feasible and preservation of continence is desired. The modified Indiana pouch (IP) method was described in 1991 and has gained popularity with long-term studies including many adult patients (2-4). As IP requires lifelong self-catheterization and follow-up, patient selection is crucial. Cognitive and manual ability to reliably perform CIC, or having a caregiver who can perform this task are essential. Adequate renal function is required as acid-base and fluid-electrolyte alterations can occur after continent urinary diversions. The patient must have a sufficient ileo-cecal segment without any contraindications such as short-bowel syndrome or inflammatory bowel disease. Normal liver function is also required, as patients with liver disease are more prone to metabolic derangements. The absence of severe comorbidities is likewise necessary. Finally, motivation for this procedure is important, especially in patients with pediatric-onset diseases as patients will commit to lifelong stoma care and CIC.

IP has been extensively performed in adult patients; however, literature on the utilization of the IP technique for pediatric patients is scarce. We aimed to share our 23 years of experience in continent urinary diversion using the IP procedure, performed for pediatric urogenital pathologies.

## Materials and Methods

Hospital medical records were retrospectively examined to identify patients who underwent an IP, continent urinary diversion surgery between 01 January 1996 and 01 January

2019. A total of 12 patients received IP surgery in this period, and had long-term outcomes available, of which 11 had pediatric-onset urogenital pathologies. The other patient was an adult with a history of pelvic trauma and was excluded from the study. All surgeries were performed according to the original method proposed by the Indiana University group, which is also described in detail by Chowdhary et al. (5). All patients were hospitalized at least 2 days before surgery. Patients were started on a clear diet two days prior to surgery, and gut irrigation was performed on the day before surgery.

Nine patients had bladder exstrophy 1 had neurogenic bladder due to radiotherapy for paratesticular rhabdomyosarcoma, and 1 (patient A) had urogenital sinus anomaly, bilateral multicystic dysplastic kidney, and a hypoplastic bladder.

Hacettepe University Ethics Boards and Commissions, Non-Interventional Clinical Researches Ethics Board; acceptance number: GO15/621, date: 07.10.2015, date: 07.10.2015.

## Statistical Analysis

All patients received concurrent cystectomy, while patient A, also received a bilateral nephroureterectomy. One patient with a history of bladder exstrophy had prior renal transplantation with a ureterocutaneostomy (patient B). In the postoperative period, patients were scheduled for follow-up examinations every 3 to 6 months; routine follow-up protocol included renal and urinary ultrasonography, serum biochemistry, along with evaluation of patients' symptoms. The patients' demographics, primary etiologies, preoperative and postoperative hydronephrosis status, postoperative early and late complications, stone complications, postoperative metabolic and continence status, were noted. Descriptive statistics were obtained using SPSS version 25.

## Results

The median patient age at the time of surgery was 15 (7-28) years and the median follow-up period was 122 (20-243) months. Five patients developed febrile urinary tract infections (UTIs) within the first month, and one patient developed a late postoperative febrile UTI. There were no grade 3 or higher complications according to the modified Clavien-Dindo scoring system. Hemorrhage requiring transfusion occurred in three patients.

Nine patients (except Patients A and B) had preoperative hydronephrosis, which resolved completely in 2 patients (22%) and partially in 4 patients (44%) postoperatively. Preoperatively, 1 patient had grade 1, 2 patients had grade 2, and 6 patients had grade 3 hydronephrosis. At the last follow-up, two patients had no hydronephrosis, one patient had grade 1 hydronephrosis, five patients had grade 2 hydronephrosis, and one patient had

grade 3 hydronephrosis. All patients, except for four who had relatively shorter follow-up periods (22, 32, 85, and 96 months), developed stones in the pouch (63%). No association was found between hydronephrosis status and stone development. Only 3 patients experienced calculi within 5 years, whereas the other 4 presented 164 to 240 months after surgery. In these 7 patients, a total of 16 stone surgeries were performed, consisting of 5 open stone removals, 7 endoscopic stone removals (via the continent stoma), and 4 percutaneous stone surgeries. One open stone surgery led to the development of pouch-skin fistulae, and required a secondary surgery for repair.

One patient developed a stricture in the left ureterocolonic anastomosis and underwent a re-implantation at postoperative month 85. One patient in the early postoperative period required ostomy revision due to leakage. Two patients in the late postoperative period (postoperative 12 and 140 months, respectively) required ostomy revisions due to stenosis.

Only one patient had chronic kidney disease preoperatively, aside from two special cases: Patient A, who received a renal transplantation 6 months after IP surgery, and Patient B, who had already received a renal transplantation. The preoperative median glomerular filtration rate (GFR) was 112 mL/min/1.73 m<sup>2</sup> (range 27.8-129), excluding patients A and B. In the postoperative period, 3 patients eventually developed chronic kidney disease, but no patient required renal replacement therapy. At the last follow-up, the median GFR was 71.1 mL/min/1.73 m<sup>2</sup> (range 20-123), excluding data from patients A and B. All patients had normal liver function at the last visit. No patient reported chronic diarrhea, and no patient had significant electrolyte anomalies.

In the postoperative period, all patients performed CIC 4 to 6 times a day. Nine patients have achieved continence day and night via CIC. One patient achieved continence during the day but reported nighttime overflow incontinence requiring one to two urinary pads. Patient A remained incontinent day and night, and used a urostomy bag on the stoma tract.

## Discussion

In adults, the IP procedure following cystectomy for malignant bladder conditions is widely performed (2-4). However, literature on the utilization of the IP for pediatric patients is scarce, with relatively few studies, short follow-up periods, and most studies published before the 2000s (6,7). In 2014, Chowdhary et al. (5) published the results of a 15-year prospective study on the IP procedure in children, shedding light on the subject by stating that the procedure is safe and reliable with favorable outcomes in the pediatric population. Nevertheless, their median follow-up period is only 24 months. Based on these findings, we aimed to share our 23 years of experience with IP in pediatric lower

urinary tract pathologies, with a median follow-up of 122 months.

## Complications

The procedure proved to be safe, with no mortalities and no grade 3 or above complications according to the Clavien-Dindo classification. Five (45%) of the patients developed febrile UTI in the acute postoperative period, despite proper bowel preparation and perioperative antibiotic prophylaxis. They were successfully treated with wide-spectrum IV antibiotics and discharged accordingly. This rate appears high compared to adult IP (23%) and pediatric augmentation cystoplasty (29.4%) series (8,9). Chowdhary et al. (5) report 16.6% cases of febrile UTI during the early period in 12 pediatric IP patients. Our higher early infection rate may be caused by the local resistance profile of colonizing bacteria in the urinary tract. Türkiye has historically had high antibiotic use and higher rates of antimicrobial resistance compared to the rest of Europe (10,11). This may have rendered perioperative prophylaxis ineffective. It should also be kept in mind that the cohort consists of only 11 patients. Small sample size may have exaggerated the rate of infection. During follow-up, three patients required intervention due to ostomy complications (27%), similar to the literature's values (15-20%) (5).

Hydronephrosis improved in 66% of patients, supporting the goal of providing a low-pressure, high-capacity reservoir. Only three patients developed chronic kidney disease over a prolonged follow-up period, and none required dialysis. No patient developed vitamin B12 deficiency.

## Continence

Continence outcomes were favorable: Nine patients (82%) achieved both daytime and nighttime continence, one achieved daytime continence with nighttime leakage, and one remained incontinent. This aligns with reported continence rates of 85-100% (5,6,12).

## Stone Formation

Stone formation occurred in 63% of patients, which is higher than previous reports. Chowdhary et al. (5) reported no stones; Kaefer et al. (7): 14%; and Surer et al. (13) 26%. This discrepancy may be due to our longer follow-up period of 122 months, compared to 24, 62, and 72 months, respectively, in the previously mentioned papers. Another possible cause of our high calculi rates may be a lack of patient cooperation. Patients are advised to undergo routine saline irrigation of the pouch at least once a week. Over time, waning adherence may allow mucus aggregation and calculi formation. Symptoms such as new-onset incontinence should prompt evaluation for stones. In patients lost to follow-up, stones may reach excessive sizes, reducing pouch capacity.

## Stone Surgery

Another important consideration in the management of pouch stones is the choice of surgical technique. Conventional open stone removal offers the advantage of complete clearance in a single session and is often used in patients with very large stone burdens (14). However, open surgery carries significant risks, particularly in patients with a history of multiple prior operations, including intestinal injury, wound complications, pouch-skin fistulae, and impaired healing, which can result in subsequent urine leakage.

Endoscopic management is increasingly favored as a less invasive alternative. Use of the stoma for stone fragmentation and extraction may be appropriate only when the calculi are small and the overall stone burden is limited, since excessive manipulation risks iatrogenic damage to the stoma and future catheterization difficulties. Our preferred approach is combined stomal entry with percutaneous access under direct endoscopic guidance after filling the pouch with saline. A similar technique has been reported by Öztürk et al. (15) with favorable outcomes and no major complications. Lam et al. (16) described a hybrid endoscopic-laparoscopic method with similarly safe results, and even transvaginal approaches have been explored in isolated cases (17).

Despite these advantages, endoscopic surgery has limitations. Longer operative times and the need for multiple sessions are not uncommon, particularly with large calculi. Because stones cannot be removed en bloc, residual fragments may persist and act as a nidus for recurrence. Szymanski et al. (18) found no significant difference in recurrence rates when comparing open, percutaneous, and endoscopic approaches. Nevertheless, our experience, consistent with the literature, suggests that minimally invasive techniques reduce morbidity and are effective even for large stone burdens, provided patients are monitored for recurrence.

## Cancer Risk

Secondary tumor development is a recognized risk after urinary diversion procedures: ureterosigmoidostomy poses the highest risk (2.58% to 10%) (19,20). Nitrosamines, carcinogenic compounds that are produced when feces and urine are mixed, are blamed for this excessively high risk. Adenocarcinoma development in procedures where isolated gut segments are used is very scarce. Kälble et al. (19) found a risk of 0.14% in ileocecal pouch patients.

Some authors have speculated that secondary cancers developing in ileocecal pouches in patients who have been treated for bladder cancer, may be related to an underlying genetic predisposition, such as familial cancer syndromes (20,21). Whereas the underlying mechanism may still be a matter of debate, authors propose regular endoscopic evaluations of the pouch 10 years

after diversion or in the case of symptoms such as hematuria or difficulty with catheterization. In our clinical practice, routine yearly cystoscopy was advised for the patients after 10 years of follow-up. Fortunately, we did not have any secondary cancer development in our cohort. This may partly be related to the fact that none of the patients, excluding one patient with rhabdomyosarcoma, had primary malignant conditions, adhering to the hereditary cancer syndromes theory.

## Study Limitations

We acknowledge several limitations to our study. Due to the nature and scarcity of the condition in the pediatric population, the number of patients we have is low. For that reason, only descriptive statistics were presented because it is not feasible to perform statistical analyses. Routine saline irrigation of the pouch was advised to all patients, but as we do not have the means to know how well they have complied with regular irrigations, we cannot make a conclusion as to the benefits of pouch irrigations for preventing stone formation. Saline irrigation of a pouch structure might not be as effective as it would be in a normal or augmented bladder. This study also, does not present any data on patients' subjective quality of life, but our clinical impression shows high patient acceptance of the procedure. Furthermore, we present objective data on the protection of the upper urinary tract and incontinence, which are the main aims of this surgery. Because of the chronic nature of the disease, patients' compliance with follow-up decreased over time, and patients became reluctant to continue follow-up and searched for medical advice as problems developed. All these limitations aside, we believe this study presents an acceptable number of patients who have received IP surgery for pediatric lower urinary tract disorders and includes a very long follow-up period.

## Conclusion

In patients in need of reconstructive surgery due to pediatric-onset lower urinary tract pathologies, the IP procedure is safe and effective, providing renal protection and high continence rates. Most patients tolerate the procedure well, with acceptable complication rates. Stone formation is a significant long-term issue. Lifelong irrigation and vigilant management are essential. The surgery also seems effective in preserving renal functions in the long term.

## Ethics

**Ethics Committee Approval:** Hacettepe University Ethics Boards and Commissions, Non-Interventional Clinical Researches Ethics Board; acceptance number: GO15/621, date: 07.10.2015, date: 07.10.2015.

**Informed Consent:** Retrospective study.

## Footnotes

### Authorship Contributions

Surgical and Medical Practices: A.A., E.A., M.A., H.S.D., S.T., Concept: A.A., E.A., M.A., H.S.D., S.T., Design: A.A., E.A., M.A., H.S.D., S.T., Data Collection or Processing: A.A., E.A., M.A., H.S.D., S.T., Analysis or Interpretation: A.A., E.A., M.A., H.S.D., S.T., Literature Search: A.A., E.A., M.A., H.S.D., S.T., Writing: A.A., E.A., M.A., H.S.D., S.T.

**Conflict of Interest:** Serdar Tekgül MD is section editor in Journal of Urological Surgery. He had no involvement in the peer-review of this article and had no access to information regarding its peer-review.

**Financial Disclosure:** The authors declared that this study received no financial support.

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# The Role of HALP Score and Other Inflammatory Indices in Risk Stratification for Testicular Germ Cell Tumors

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## What's known on the subject? and What does the study add?

Systemic inflammatory and immuno-nutritional indices such as neutrophil-to-lymphocyte ratio and systemic immune-inflammation index (SII) have been associated with advanced disease in testicular cancer. However, comparative data regarding the predictive power of various indices remain limited. This study demonstrates that hemoglobin, albumin, lymphocyte and platelet, SII, and inflammatory burden index are independent predictors of advanced-stage testicular germ cell tumors. By identifying the most accurate and accessible biomarkers, this research enhances the utility of inflammation- and nutrition-based scores in clinical risk stratification.

## Abstract

**Objective:** Systemic inflammatory and immuno-nutritional indices have emerged as promising tools in cancer prognosis. This study aimed to evaluate the predictive value of hemoglobin, albumin, lymphocyte and platelet (HALP), neutrophil-to-lymphocyte ratio (NLR), systemic immune-inflammation index (SII), C-reactive protein lymphocyte ratio (CLR), inflammatory burden index (IBI), and systemic inflammation response index (SIRI) for advanced-stage disease in testicular germ cell tumors (TGCTs).

**Materials and Methods:** We retrospectively analyzed 143 patients with TGCTs who underwent orchiectomy between 2015 and 2023. Preoperative laboratory values were used to calculate HALP, NLR, SII, CLR, IBI, and SIRI. Associations with clinical stage were examined using Kruskal-Wallis tests, logistic regression, and ROC curve analysis.

**Results:** Higher values of HALP, SII, CLR, NLR, and IBI were significantly associated with advanced clinical stages ( $p < 0.001$ ), while SIRI showed limited predictive value. HALP demonstrated the highest discriminative ability [area under the curve (AUC)=0.742], followed by SII (AUC=0.731) and IBI (AUC=0.676). Multivariable logistic regression identified HALP, CLR, and IBI as independent predictors of advanced disease.

**Conclusion:** HALP, SII, CLR, and IBI are accessible, cost-effective biomarkers with significant potential for risk stratification in TGCTs. These indices may support clinical decision-making by identifying patients at risk for advanced-stage disease.

**Keywords:** Testicular germ cell tumors, HALP score, systemic inflammatory index, inflammatory burden index, immuno-nutritional markers

## Introduction

Testicular cancer is the most common malignancy among men aged 15 to 40 years, representing approximately 1% of all male cancers globally (1). Although the disease is rare, its incidence has been steadily increasing, particularly in developed regions,

making it a critical area of oncological research (2,3). Despite the high cure rates achieved with multimodal treatments, including orchiectomy and cisplatin-based chemotherapy, patients with advanced or recurrent disease often face poorer outcomes (3,4). This underscores the need for enhanced prognostic tools to stratify patients effectively and guide clinical decision-making (5).

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**Received:** 16.05.2025 **Accepted:** 25.06.2025 **Epub:** 30.06.2025 **Publication Date:** 02.03.2026

**Cite this article as:** Kayar K, Kayar R, Karabay E, Genç BB, Tosun Ç, Yücebaş ÖE. The role of HALP score and other inflammatory indices in risk stratification for testicular germ cell tumors. J Urol Surg. 2026;13(1):11-18.

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Cancer is recognized not only for causing localized symptoms in the affected organ but also for inducing systemic manifestations, which are indicative of the inflammatory processes associated with malignancy (6). Inflammation plays a pivotal role in regulating oncogenesis and neoplastic proliferation, particularly during the resistance phase, a critical period for the immune system to exhibit its functional efficacy (7). However, excessive or dysregulated immune responses may lead to immunopathological damage, resulting in necrosis. This can transition into the tolerance phase, which is characterized by systemic symptoms (6). During this phase, macrophages and other myeloid-derived cells, such as neutrophils, are central to the pathophysiology (8). These cells secrete cytokines, chemokines, and reactive oxygen species, which not only promote immunosuppression and the progression of neoplastic cells but also contribute to systemic effects (6). A comprehensive understanding of these "repair" phenomena sheds light on the pathogenesis of thrombophilia, anemia, sarcopenia, and disruptions in iron metabolism frequently observed in patients with advanced-stage malignancies (9).

The role of systemic inflammation in cancer development and progression has been well-documented. Chronic inflammation fosters processes such as tumor initiation, angiogenesis, immune evasion, and metastasis (10-12). In the context of testicular germ cell tumors (TGCTs), systemic inflammatory markers such as neutrophil-to-lymphocyte ratio (NLR), systemic immune-inflammation index (SII), and systemic inflammation response index (SIRI) have shown significant associations with disease burden and progression. Elevated levels of these indices have been linked to advanced tumor stages and poorer survival outcomes (13-15). In addition, indices such as inflammatory burden index (IBI) and C-reactive protein (CRP) lymphocyte ratio (CLR) -though less commonly investigated in testicular tumors- have been associated with advanced cancer stages and poor prognosis in other malignancies, including lung, colorectal, and gastrointestinal cancers (16,17).

Similarly, nutritional status plays a critical role in modulating cancer progression and patient survival (18,19). Comprehensive immuno-nutritional indices, such as the hemoglobin, albumin, lymphocyte, and platelet (HALP) score and the prognostic nutritional index, provide a robust assessment of systemic inflammation and nutritional health. Previous research has shown that HALP scores were significantly lower in patients with testicular cancer compared to healthy individuals (20). Studies have demonstrated that lower values of these indices correlate with advanced disease stages and larger tumor sizes, further supporting their potential utility as non-invasive, easily accessible tools for risk stratification (21,22).

This study aims to evaluate the relative prognostic significance of inflammatory and immuno-nutritional indices in testicular

cancer. By comparing the predictive capabilities of these parameters, this research seeks to determine whether inflammatory or nutritional markers offer superior utility in understanding disease progression.

## Materials and Methods

This study protocol was reviewed and approved by Haydarpaşa Numune Training and Research Hospital, Scientific Research Ethics Committee on September 17 2024, approval number HNEAH-BAEK/KK/2024/119. Study activities adhered to the principles outlined in the Declaration of Helsinki. All participating patients, who agreed to the anonymous use of their data, signed the informed consent in writing.

Two hundred and fifty-two patients who had orchiectomy surgery at our tertiary referral urooncology clinic between January 2015 and December 2023, were enrolled. 109 patients with benign pathology (n=45), undescended testicle (n=25), non-germ cell testicular tumors (n=21), testicular torsion (n=14), or surgical castration (n=4) were excluded from the study. Following these exclusions, our study group comprised 143 patients.

Demographic information (age) and clinical parameters were collected. The data of orchiectomy surgery, postoperative pathology results, stage, primary type, tumor size, presence of rete testes invasion and presence of lympho-vascular invasion (LVI) were collected from the hospital database. The staging has been carried out according to the testicular cancer section of the TNM classification of malignant tumors, Union for International Cancer Control, 8<sup>th</sup> edition (23). Preoperative biochemical markers, including CRP (mg/L), albumin (g/L) and complete blood count values (hemoglobin, lymphocyte, monocyte, neutrophil, platelet) were recorded within a two-week window surrounding surgery. The following calculated indices were derived from the collected data: hemoglobin x albumin x lymphocyte/platelet as HALP, neutrophil/lymphocyte as NLR, CRP/lymphocyte as CLR, CRP x NLR as IBI, monocyte x NLR as SIRI, platelet x NLR as SII.

## Statistical Analysis

Statistical analyses were performed using IBM SPSS version 25 (IBM Corp, Armonk, NY, USA). Continuous variables were expressed as median (interquartile range) according to the data distribution. Categorical variables were presented as frequencies and percentages.

The Kruskal-Wallis test was used to compare non-parametric continuous variables across groups. Pairwise comparisons were performed using the Mann-Whitney U test. Chi-square tests were applied to analyze categorical variables. Logistic regression analysis was employed to evaluate the association between clinicopathological parameters and inflammatory/immuno-

nutritional scores. Odds ratios (OR) with 95% confidence intervals (CI) were calculated.

Receiver operating characteristic (ROC) curve analysis was conducted to assess the discriminative ability of inflammatory and immuno-nutritional scores for advanced clinical stages. The area under the curve (AUC), optimal cut-off values, sensitivity, and specificity were reported. Logistic regression analysis was performed to identify independent predictors of advanced disease, with results expressed as adjusted odds ratios (aOR) and 95% CIs. A p-value of <0.05 was considered statistically significant for all analyses.

## Results

A total of 143 patients were included in the study, with a median age of 36 years (interquartile range: 28-43). Among the cohort, 61 patients (42.7%) were diagnosed with seminoma, while 82 patients (57.3%) had non-seminomatous germ cell tumors. Clinical stage distribution revealed that 76 patients (53.9%) were in stage I, 34 (24.1%) in stage II, and 31 (22%) in stage III. Tumor size was ≥4 cm in 83 patients (59.3%) and <4 cm in 57 patients (40.7%). Rete testis invasion was observed in 86 patients (60.1%), while LVI was present in 65 patients (45.5%) (Table 1).

Patients with higher clinical stages exhibited a higher prevalence of pathological risk factors. Logistic regression analysis identified that rete testis invasion significantly increased the likelihood of advanced disease (stage II/III) with an OR of 2.611 (95% CI: 1.290-5.286, p=0.008). Similarly, LVI was significantly associated with advanced disease stages, with an OR of 2.128 (95% CI: 1.083-4.182, p=0.028) (Table 2).

Inflammatory and immuno-nutritional scores demonstrated significant differences across clinical stages. Median HALP

scores were significantly lower in stage I [34.64 (24.85-57.84)] compared to stages II and III (p<0.001). Similarly, median SII scores were markedly higher in stage III [1378.36 (806-1883.43)] compared to stage I [804.55 (643.37-1037.33), p<0.001]. Other markers, including IBI, CLR, and NLR, also showed significant upward trends with advancing disease stages (p<0.05). However, the SIRI did not exhibit statistically significant differences among the stages (p=0.193), indicating a less robust role of SIRI in differentiating disease severity (Table 3).

ROC curve analysis revealed that HALP and SII scores had the highest discriminative abilities for advanced clinical stages, with

Variables	Number of patients, n=143 (%)
Age	36.8 (18-69)
<b>Tumor type</b>	
Seminoma	61 (42.7)
NSGCT	82 (57.3)
<b>Clinical stage</b>	
I	76 (53.9)
II	34 (24.1)
III	31(22)
<b>Tumor size</b>	
<4 cm	57 (40.7)
≥4 cm	83 (59.3)
<b>Rete testes invasion</b>	
Yes	86 (60.1)
No	57 (39.9)
<b>Lymphovascular invasion</b>	
Yes	65 (45.5)
None	78 (54.5)
NSGCT: Non-seminomatous germ cell tumors	

Variables	Stage I (n=76)	Stage II (n=34)	Stage III (n=31)	p <sup>1</sup>	
Age <sup>2</sup>	38.2 (20-69)	34.6 (22-64)	35.9 (18-62)	0.227	
Variables	Stage I n (%)	Stage II n (%)	Stage III n (%)	OR (95% CI)	p <sup>3</sup>
<b>Tumor size</b>					
<4 cm	31 (41.9)	13 (39.4)	13 (41.9)	0.949 (0.481-1.873)	0.880
≥4 cm	43 (58.1)	20 (60.6)	18 (58.1)		
<b>Rete testes invasion</b>					
Yes	38 (50)	25 (73.5)	22 (71)	2.611 (1.290-5.286)	0.008
No	38 (50)	9 (26.5)	9 (29)		
<b>Lymphovascular invasion</b>					
Yes	28 (36.8)	15 (44.1)	21 (67.7)	2.128 (1.083-4.182)	0.028
None	48 (63.2)	19 (55.9)	10 (32.3)		

<sup>1</sup>Kruskall-Wallis, <sup>2</sup>Mean (minimum-maximum), <sup>3</sup>Logistic regression, OR: Crude odds ratio, CI: Confidence interval

AUC values of 0.742 and 0.731, respectively ( $p < 0.001$  for both). HALP demonstrated a sensitivity of 61.3% and specificity of 84.5% at a cut-off value of 38.39, while SII showed a sensitivity of 54.8% and specificity of 90% at a cut-off value of 1346.75. Other markers, including IBI, CLR, and NLR, also demonstrated moderate discriminative abilities, with respective AUC values of 0.676, 0.646, and 0.698 (Table 4, Figure 1).

Significant associations were observed between inflammatory and immuno-nutritional scores and clinical stage. Patients with advanced stages (stage II/III) demonstrated higher levels of HALP, SII, IBI, CLR, and NLR ( $p < 0.001$  for all). HALP scores were notably higher in patients with stage I disease, indicating its association with better nutritional and inflammatory status in less advanced stages. Tumor size ( $\geq 4$  cm), LVI, and rete testis invasion were associated with elevated inflammatory markers; however, these associations did not achieve statistical significance for all scores. Tumor size ( $\geq 4$  cm) is associated with lower levels of HALP ( $p = 0.049$ ). LVI and rete testis invasion were associated with lower levels of HALP, however, this association did not achieve statistical significance (Table 5).

The significant predictive power of inflammatory and immuno-nutritional scores demonstrates the risk of developing clinically advanced disease. Both crude (OR1) and aOR (OR2) indicate a strong association between elevated score levels and increased risk, even after controlling for tumor size ( $\geq 4$  cm), LVI, and rete testis invasion. Logistic regression analysis identified HALP (OR: 4.4, 95% CI: 1.919-10.089,  $p < 0.001$ ), SII (OR: 3.778, 95% CI: 1.532-9.313,  $p = 0.004$ ), CLR (OR: 5.043, 95% CI: 1.986-12.806,

$p < 0.001$ ), IBI (OR: 2.22, 95% CI: 1.046-4.721,  $p = 0.035$ ), and NLR (OR: 3.12, 95% CI: 1.234-7.876,  $p = 0.021$ ) as independent predictors of advanced clinical disease. These findings underscore the utility of inflammatory and immuno-nutritional scores, including HALP, SII, CLR, IBI, and NLR, in stratifying patients by disease severity. The IBI showed the highest adjusted OR (OR<sub>2</sub>=11.504, 95% CI: 3.508-37.725,  $p < 0.001$ ), emphasizing its robust predictive value. Similarly, the CLR and HALP also demonstrated strong associations, with adjusted ORs of 6.687 (95% CI: 2.446-18.278,  $p < 0.001$ ) and 5.079 (95% CI: 2.074-12.436,  $p < 0.001$ ), respectively. SII and NLR also showed significant adjusted odds, indicating their relevance in predicting disease progression, with SII (OR<sub>2</sub>=4.339,  $p = 0.003$ ) and NLR (OR<sub>2</sub>=3.581,  $p < 0.001$ ). These findings underscore the utility of these scores as non-invasive tools for risk stratification and clinical decision-making in patients with germ cell tumors (Table 6).

## Discussion

This study investigates the prognostic significance of systemic inflammatory and immuno-nutritional indices in TGCTs, highlighting their potential role in risk stratification and clinical decision-making. By evaluating key markers such as HALP, SII, NLR, CLR, and IBI, this research contributes to the growing evidence supporting the integration of inflammatory and nutritional biomarkers into oncological practice.

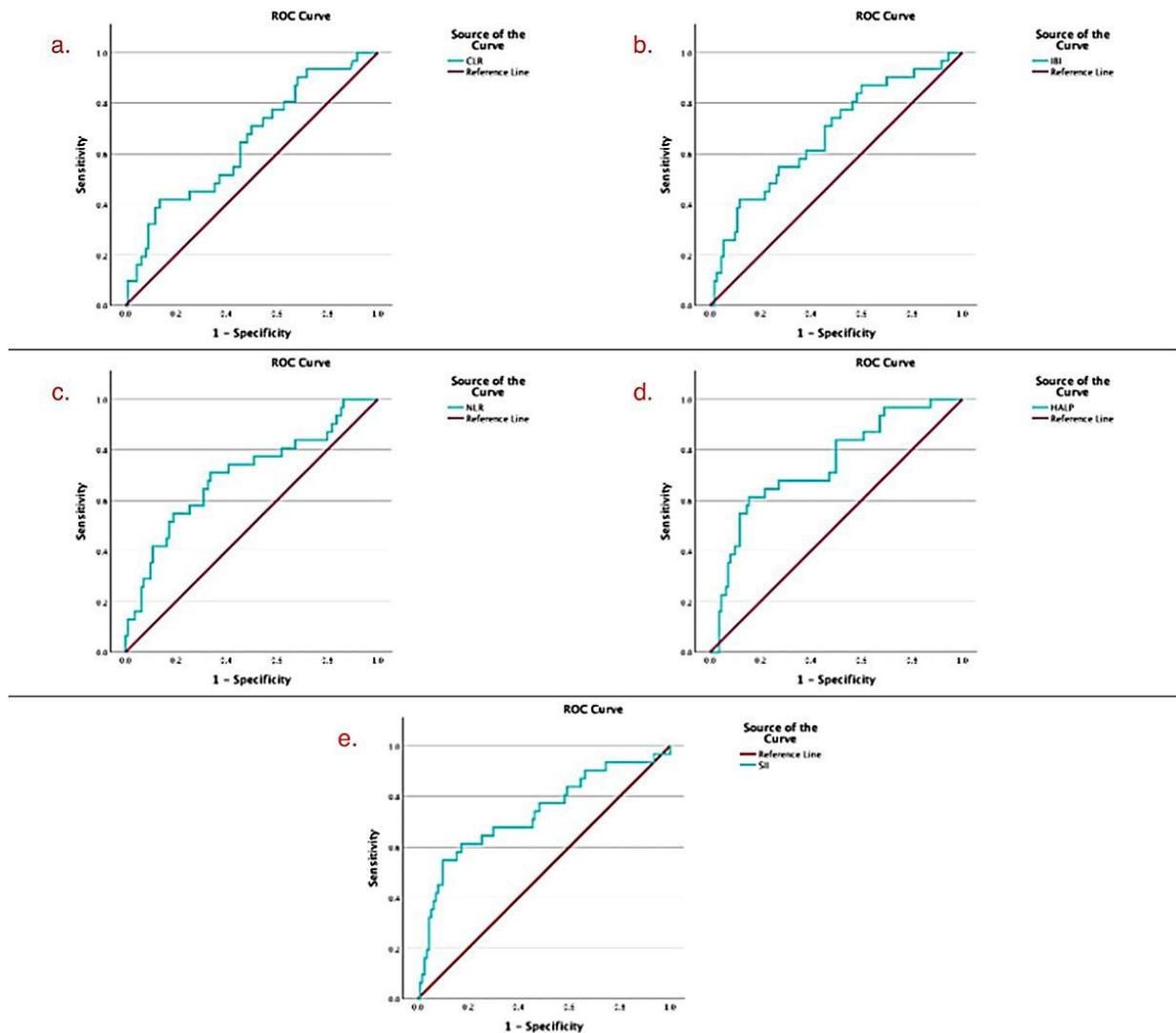
Results from this study demonstrate that elevated levels of HALP, SII, CLR, IBI, and NLR are significantly associated with advanced

Scores	Stage I	Stage II	Stage III	p <sup>1</sup>
HALP	59.37 (21.46)	62.73 (29.11)	62.73 (20.92)	<0.001
SII	920.72 (528.80)	1087.99 (1426.76)	1628.35 (1232.10)	<0.001
SIRI	1.49 (1.08)	2.06 (3.34)	2.00 (1.46)	0.193
IBI	10.68 (53.62)	13.46 (27.82)	22.19 (38.18)	0.001
CLR	1.67 (6.76)	2.06 (2.64)	3.20 (5.23)	0.002
NLR	2.68 (1.54)	3.07 (2.36)	4.88 (4.19)	0.003

<sup>1</sup>Mann-Whitney U test, HALP: Hemoglobin, albumin, lymphocytes and platelets score, NLR: Neutrophil lymphocyte ratio, SII: Systemic inflammatory index, SIRI: Systemic inflammation response index, IBI: Inflammatory burden index, CLR: C-reactive protein lymphocyte ratio, GCT: Germ cell tumor

Scores	Cut-off points	AUC	p	95% CI	Specificity (%)	Sensitivity (%)
HALP	38.39	0.742	0.000	64.2-84.2	84.5	61.3
SII	1346.75	0.731	0.000	62.1-84.2	90	54.8
IBI	11.26	0.676	0.001	56.8-78.5	88.2	41.9
CLR	2.08	0.646	0.009	53.6-75.6	86.4	41.9
NLR	2.71	0.698	0.000	58.7-80.9	66.4	71

HALP: Hemoglobin, albumin, lymphocytes and platelets score, NLR: Neutrophil lymphocyte ratio, SII: Systemic inflammatory index, IBI: Inflammatory burden index, CLR: C-reactive protein lymphocyte ratio, AUC: Area under curve, CI: Confidence interval



**Figure 1.** ROC curves for CLR (a). Roc plot for IBI (b). Roc plot for NLR (c). Roc plot for HALP (d). Roc plot for SII (e)

ROC: Receiver operating characteristic, HALP: Hemoglobin, albumin, lymphocytes and platelets score, NLR: Neutrophil lymphocyte ratio, SII: Systemic inflammatory index, IBI: Inflammatory burden index, CLR: CRP lymphocyte ratio. The red line represents the reference line for a non-discriminatory test

disease stages, whereas SRI showed limited discriminatory power. Among these markers, HALP and SII exhibited the highest predictive accuracy, as evidenced by ROC curve analysis. Logistic regression further identified HALP, CLR, and IBI as independent predictors of advanced-stage TGCTs. These findings underscore the relevance of inflammatory and immuno-nutritional indices in stratifying patients and guiding treatment decisions.

Inflammation plays a pivotal role in all stages of tumor development and progression. It also significantly influences the tumor immune microenvironment and treatment response. Elevated neutrophil counts are associated with the release of tumor-promoting factors, including reactive oxygen species, arginase, inflammatory cytokines, tumor or vascular growth factors, and metalloproteinases, which may contribute to cancer progression and metastasis. Conversely, reduced lymphocyte

counts are linked to impaired anti-tumor immune responses, including diminished CD8<sup>+</sup> T-cell cytotoxicity and compromised CD4<sup>+</sup> helper T-cell functions. Platelets play a multifaceted role in cancer progression by releasing cytokines, such as platelet-derived growth factor and platelet-reactive protein, which facilitate hematogenous dissemination and invasion. Monocytes are precursors to tumor-associated macrophages, which are implicated in immune suppression, angiogenesis, and metastasis. Their role in inflammation-mediated cancer progression is well-established (11,24,25). As a marker of systemic inflammation, elevated CRP levels signify a heightened inflammatory response often triggered by cytokines secreted by tumors. High CRP levels have been associated with advanced disease stages (15). Considering the significant influence of nutritional status on tumor immunotherapy, numerous studies

**Table 5. The association between different clinicopathological parameters and immuno-nutritional/ inflammatory scores**

Parameters	HALP, n (%)			SII, n (%)			IBI, n (%)			CLR, n (%)			NLR, n (%)		
	Low	High	p	Low	High	p	Low	High	p	Low	High	p	Low	High	p
<b>Clinical stage</b>															
Stage I	10	66	<0.001	68 (89)	8 (11)	<0.001	72 (95)	4 (5)	<0.001	69 (91)	7 (9)	<0.001	53 (70)	23 (30)	<0.001
Stage II	7	27		31 (91)	3 (9)		25 (74)	9 (26)		25 (74)	9 (26)		20 (59)	14 (41)	
Stage III	19	12		14 (45)	17 (55)		18 (58)	13 (42)		18 (58)	13 (42)		9 (29)	22 (71)	
<b>Tumor size</b>															
<4 cm	10	47	0.049	47 (83)	10 (17)	0.352	47 (83)	10 (17)	0.488	46 (81)	11 (19)	0.451	37 (65)	20 (35)	0.138
≥4 cm	26	57		65 (78)	18 (22)		67 (81)	16 (19)		65 (78)	18 (22)		45 (54)	38 (46)	
<b>LVI</b>															
Yes	19	46	0.204	52 (80)	13 (20)	0.537	54 (83)	11 (17)	0.447	52 (80)	13 (20)	0.554	38 (59)	27 (41)	0.543
No	17	61		63 (81)	15 (19)		63 (81)	15 (19)		62 (80)	16 (20)		46 (59)	32 (41)	
<b>Rete testes invasion</b>															
Yes	23	63	0.371	69 (80)	17 (20)	0.561	70 (81)	16 (19)	0.528	70 (81)	16 (19)	0.342	50 (58)	36 (42)	0.498
No	13	44		46 (81)	11 (19)		47 (83)	10 (17)		44 (77)	13 (23)		34 (60)	23 (40)	

HALP: Hemoglobin, albumin, lymphocytes and platelets score, NLR: Neutrophil lymphocyte ratio, SII: Systemic inflammatory index, IBI: Inflammatory burden index, CLR: C-reactive protein lymphocyte ratio, LVI: Lymphovascular invasion. Cut-off values; HALP 38.39, SII 1346.75, IBI 11.26, CLR 2.08, NLR 2.71;  $\chi^2$  test

**Table 6. The risk of developing clinically advanced disease in relation to the levels of inflammatory and immuno-nutritional scores**

Variables	OR1 (95% CI)	p	OR2 (95% CI)	p
HALP	4.4 (1.919-10.089)	<0.001	5.079 (2.074-12.436)	<0.001
SII	3.778 (1.532-9.313)	0.004	4.339 (1.672-11.266)	0.003
IBI	9.209 (2.974-28.519)	<0.001	11.504 (3.508-37.725)	<0.001
CLR	5.043 (1.986-12.806)	<0.001	6.687 (2.446-18.278)	<0.001
NLR	2.861 (1.432-5.714)	0.003	3.581 (1.675-7.655)	<0.001

HALP: Hemoglobin, albumin, lymphocytes and platelets score, NLR: Neutrophil lymphocyte ratio, SII: Systemic inflammatory index, IBI: Inflammatory burden index, CLR: C-reactive protein lymphocyte ratio, OR1: Crude odds ratio, OR2 is adjusted to tumor size (greater than 4 cm), presence of LVI and presence of rete testis invasion, CI: Confidence interval, LVI: Lymphovascular invasion

have investigated the relationship between nutrition-related factors and prognosis (26,27). Markers of malnutrition, such as low albumin and hemoglobin levels, have been associated with poor clinical outcomes (21).

The NLR is a widely used systemic inflammatory biomarker reflecting the balance between neutrophils, which promote inflammation and tumor progression, and lymphocytes, which mediate anti-tumor immune responses. Elevated NLR values have been consistently associated with poor prognosis in several cancers, including testicular cancer (14,28,29). In our study, NLR significantly increased with advancing clinical stages of testicular GCTs, particularly in seminoma patients, aligning with prior findings linking high NLR to poor overall survival (OS) and progression-free survival (PFS) (15,28). Moreover, NLR has been shown to predict higher metastatic potential and poor chemotherapy responses, reinforcing its value as a predictive marker of disease progression and treatment outcomes (22,29). In this study, SII demonstrated significant differences across clinical stages, with higher values correlating with advanced-stage disease. This observation is consistent with prior research

identifying SII as a strong predictor of adverse outcomes, including OS and PFS, in multiple cancers (30). Compared to NLR, SII's inclusion of platelet counts may provide a more comprehensive representation of the inflammatory milieu, potentially enhancing its prognostic utility. In contrast, the SIRI did not exhibit significant stage-dependent variations in our cohort, suggesting limited discriminatory power in testicular cancer. While SIRI has shown promise in other malignancies, its role in GCTs appears supplementary, possibly enhancing predictive accuracy when used in conjunction with other indices like NLR or SII (15). Collectively, our findings reinforce the utility of NLR and SII as robust, accessible, and cost-effective markers for predicting disease progression in testicular cancer, with SII emerging as the more comprehensive index in this context.

The HALP score, integrating HALP levels, reflects both the nutritional and inflammatory status of cancer patients. In this study, lower HALP scores were strongly associated with advanced clinical stages of testicular GCTs. These findings align with previous research demonstrating HALP's utility in stratifying cancer patients based on disease severity. For

instance, Bumbasirevic et al. (21) reported that HALP scores below 42.56 were predictive of advanced disease, with a four-fold increased risk for stages II and III compared to stage I. Comparatively, HALP has been shown to outperform NLR and PLR in malignancies, such as renal cell carcinoma and bladder cancer, where it predicts survival and enhances prognostic accuracy when integrated into multivariate models (31,32). In testicular cancer, HALP's ability to reflect both systemic inflammation and nutritional deficiencies provides valuable prognostic insights, particularly for guiding treatment decisions and follow-up strategies in advanced-stage patients (21).

The CLR and IBI are less studied in testicular cancer but have demonstrated prognostic significance in other malignancies. In cancers such as colorectal and bladder cancer, elevated CLR values correlate with advanced stages and poorer survival outcomes (17,33). While CLR showed moderate predictive value in this study, its utility may be enhanced when combined with indices like NLR or HALP. Studies in non-small cell lung and gastrointestinal cancers have identified IBI as a strong predictor of survival and adverse outcomes, such as prolonged hospitalization and cachexia (16,34). Although IBI's performance in our testicular cancer cohort was less pronounced, its integration with other markers could provide additional prognostic value.

Among the indices evaluated, SII and HALP emerged as the most comprehensive predictors of testicular cancer progression, followed closely by NLR. SII's broader inflammatory context and HALP's integration of nutritional parameters make them particularly valuable for risk stratification, and treatment planning. In clinical practice, NLR serves as a quick and accessible marker for inflammation. SII provides a broader measure of systemic inflammation, offering enhanced prognostic utility. HALP adds critical insights into the patient's nutritional and immune status, complementing the inflammatory data from NLR and SII. While CLR and IBI demonstrated limited standalone utility in this study, their incorporation into multivariate models could refine prognostic accuracy, particularly in advanced-stage GCTs. These markers, collectively, hold promise for guiding individualized treatment approaches, optimizing follow-up strategies, and improving outcomes in testicular cancer patients.

This study provides valuable insights into the prognostic utility of systemic inflammatory and immuno-nutritional indices in risk stratification for TGCTs. A key strength of this research lies in its comprehensive analysis of multiple biomarkers, including HALP, SII, CLR, IBI, and NLR, using a well-defined cohort and robust statistical methods. The identification of HALP and SII as the most potent predictors of advanced disease underscores their potential role in enhancing clinical decision-making.

## Study Limitations

However, several limitations must be acknowledged. The retrospective design introduces inherent biases, and the absence of a healthy control group limits broader generalizability. Another limitation is that a considerable proportion of the study cohort presented with adverse pathological features such as large tumor size, rete testis invasion, and lymphovascular invasion, which may have influenced the stage distribution and biomarker associations.

## Conclusion

Additionally, while the study establishes strong associations, the underlying biological mechanisms linking these markers to tumor progression warrant further investigation. Despite these limitations, this study contributes to the growing body of evidence supporting the integration of inflammatory and nutritional markers into routine oncological practice. Future prospective studies are essential to validate these findings and explore their applicability in personalized treatment strategies for testicular cancer patients.

## Ethics

**Ethics Committee Approval:** This study protocol was reviewed and approved by Haydarpaşa Numune Training and Research Hospital, Scientific Research Ethics Committee on September 17 2024, approval number HNEAH-BAEK/KK/2024/119.

**Informed Consent:** All participating patients, who agreed to the anonymous use of their data, signed the informed consent in writing.

## Footnotes

### Authorship Contributions

Surgical and Medical Practices: K.K., R.K., E.K., Ç.T., Concept: K.K., R.K., E.K., Design: K.K., R.K., E.K., Data Collection or Processing: B.B.G., Analysis or Interpretation: K.K., R.K., Literature Search: K.K., Ç.T., Writing: K.K., E.K., Ç.T., Ö.E.Y.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study received no financial support.

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# Robot-assisted Partial Nephrectomy for Complex (PADUA score >10) Renal Masses

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## What's known on the subject? and What does the study add?

The preoperative aspects and dimensions used for an anatomical (PADUA) score predicts anatomical complexity and complication risk in partial nephrectomy, but large-scale data on robot-assisted surgery for highly complex tumors are limited. This study demonstrates that robot-assisted partial nephrectomy is feasible and safe even for tumors with PADUA  $\geq 10$ , providing valuable outcome data from a large single-surgeon cohort.

## Abstract

**Objective:** To evaluate the perioperative outcomes of robot-assisted partial nephrectomy (RAPN) in patients with complex renal masses, stratified by preoperative aspects and dimensions used for an anatomical (PADUA) score, and to assess the utility of the PADUA classification in surgical planning and risk prediction.

**Materials and Methods:** We retrospectively analyzed 354 patients who underwent RAPN between April 2008 and February 2023 using Da Vinci Si and Xi systems. Tumors were classified as complex (PADUA  $\geq 10$ ) or non-complex (PADUA  $< 10$ ) based on preoperative imaging. Demographic data, perioperative outcomes, and renal function parameters were compared between groups. Complications were graded using the Clavien-Dindo system.

**Results:** Of the 354 patients, 124 (35%) had PADUA scores  $\geq 10$  (group A), and 230 (65%) had scores  $< 10$  (group B). Group A patients were significantly younger ( $p=0.003$ ) and had had larger tumors, had longer operative and warm ischemia times, had higher blood loss, and had longer hospital stays (all  $p<0.01$ ). Despite increased complexity, positive surgical margin rates were similar between groups. Postoperative declines in hemoglobin, hematocrit, and estimated glomerular filtration rate, along with increased creatinine levels, were significant ( $p<0.001$ ). High PADUA scores correlated with increased surgical difficulty and complication risk, supporting its role as a preoperative risk stratification tool. Despite technical challenges, RAPN provided effective oncologic control, with complication and margin rates consistent with those reported in prior studies.

**Conclusion:** RAPN is a safe and effective treatment for complex renal tumors when guided by detailed preoperative assessment using the PADUA score. A multidisciplinary approach and experienced surgical technique are critical for optimizing outcomes in high-complexity cases.

**Keywords:** Endourology, radiology, urooncology

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**Received:** 08.05.2025 **Accepted:** 11.07.2025 **Epub:** 24.07.2025 **Publication Date:** 02.03.2026

**Cite this article as:** Doğanca T, Tuna MB, Pirdal BZ, Argun ÖB, Tüfek İ, Öbek C, Kural AR. Robot-assisted partial nephrectomy for complex (PADUA score >10) renal masses. J Urol Surg. 2026;13(1):19-25.

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## Introduction

Renal cell carcinoma (RCC) is an entity that accounts for almost 90% of all kidney cancers and has significant clinical importance in current uro-oncology practice (1). Although surgery has a paramount role in the treatment of RCC, a multidisciplinary approach is needed to achieve satisfactory curative results. A primary step of this approach is to recognize the tumor through preoperative radiological evaluation, choose the correct surgical approach, and predict possible complications and outcomes.

We have long been aware of the survival benefit that partial nephrectomy provides the patient compared to radical nephrectomy, without sacrificing oncological survival outcomes (2-6). For this reason, fewer radical nephrectomies and more partial nephrectomies are performed today; however, determining the appropriate technique and approach in partial nephrectomy becomes important.

The preoperative aspects and dimensions used for an anatomical (PADUA) classification system has long been considered a guide to ensure accurate evaluation at this step (7).

Because the T-stage of the classical tumor, node, metastasis classification system evaluates the tumor only in terms of its relationship with major anatomical structures and its size, it may not predict aspects important for surgery. A risk classification based only on size as suggested by the classical T classification would be insufficient for the planning of this delicate surgery. The location of the mass in the vertical and horizontal planes of the kidney, its percentage within the parenchyma, and its proximity to the renal hilus and collecting system are undoubtedly important. In addition to standard scoring systems, the PADUA system also takes into account other anatomical and pathological features of the tumor (7). It does not seem wise to make a risk assessment based solely on tumor size when comparing a small but risky mass (in terms of its relationship with these critical structures) and a large mass that partial excision would not be challenging.

Revealing the tumor characteristics objectively may make more personalized approaches for the treatment of patients possible. Partial nephrectomy, which was initially performed with an open surgical approach due to its difficulties in terms of surgical technique, could also be performed laparoscopically and subsequently robot-assisted over time (7-9), the disadvantages of these closed methods versus open surgery are that they require operation almost exclusively under warm ischemia when ischemia is mandatory (7,9,10). Therefore, it is important to accurately evaluate the complexity of the masses preoperatively in robot-assisted surgery. In this study, we aim to present perioperative data according to the PADUA scores of the tumors in patients who underwent robot-assisted partial nephrectomy (RAPN) due to renal mass.

## Materials and Methods

Between April 2008 and February 2023, a total of 354 patients had undergone RAPN. Demographic (Table 1), clinical (Table 2), preoperative, and peroperative outcomes (Table 3) of the patients were collected retrospectively. All of the procedures were performed with Da Vinci Si and Xi surgical systems (Intuitive Surgical, Sunnyvale, CA, USA).

Age, body mass index (BMI), American Society of Anesthesiologists (ASA) scores, and biochemical evaluations of the patients as well as PADUA scores of the masses were recorded. Main intraoperative data: operation time, warm ischemia time, estimated amount of blood loss. Postoperative data: hospital stay, duration of drain and Foley catheter insertion, surgical margin positivity, data on tumor pathology, serum creatinine levels, hematocrit, and estimated glomerular filtration rate (eGFR). As a biochemical evaluation, these were kept as values. The eGFR calculation method was recorded 1 month after surgery using the appropriate calculation formula.

Patients were evaluated with computed tomography or magnetic resonance imaging in the preoperative period and their PADUA scores were recorded. Two groups were created based on PADUA scores above and below 10, and masses above 10 were considered complex masses. Postoperative complications were recorded according to the Clavien-Dindo grading system (11). Ethics committee approval was obtained for the study from Acibadem University Ethics Committee (approval no: ATADEK 2023-19-643, date: 30.11.2023).

## Operation Technique

All patients were operated on by a single surgeon. During the specified period, Da Vinci S-HD was used for the first year, Da Vinci Si for the next 5 years, and Da Vinci Xi was used for the next 9 years. The patients were positioned in the modified flank position, with the affected kidney on top, and flexion was applied to the table. Partial nephrectomy was performed using a 5-port approach. Excision of the masses was performed by enucleation a combination of these techniques, depending on the condition of the mass. V-Loc and polyglactin sutures were used for suturing the resection bed, repairing the collecting system if it was opened, and parenchymal suturing. A hemostatic agent (human gelatin-thrombin matrix sealant) was used in almost all patients.

## Statistical Analysis

Statistical analysis was performed using SPSS version 21 (IBM Corp., Armonk, NY, USA). In descriptive analyses, the numbers and percentages were classified as categorical variables, and normality of the continuous variables was demonstrated via the Kolmogorov-Smirnov test. The comparisons between the groups

were evaluated using the Mann-Whitney U test for continuous variables and the chi-squared test for categorical variables. Differences between the two paired groups were tested using the Wilcoxon test. A p-value below 0.05 was considered significant.

## Results

Of our study cohort, 124 patients (35%) had a PADUA score  $\geq 10$  (group 1), and 230 patients (65%) had a PADUA score  $< 10$  (group 2). Group 1 (PADUA score  $\geq 10$ ) had a significantly lower mean age when compared to group 2 (PADUA score  $< 10$ ) ( $p=0.003$ ). No significant difference was found in terms of sex, BMI and surgical margin positivity between group 1 (PADUA score  $\geq 10$ ) and group 2 (PADUA score  $< 10$ ). Tumor size, operation time, blood loss, need for collecting system repair, the ischemia time, and hospitalization time were significantly higher in group 1 (PADUA score  $\geq 10$ ) when compared to group 2 (PADUA score  $< 10$ ) ( $p<0.001$ ,  $p=0.002$ ,  $p=0.001$ ,  $p<0.001$ ,  $p<0.001$ ,  $p=0.005$ , respectively).

Three hundred and fifty-four patients who underwent partial nephrectomy were included in the study. 69.1% ( $n=244$ ) of the patients were male; the mean age of the patients was  $53.4 \pm 13.1$ .

The mean BMI was  $27.9 \pm 4.6$ . Descriptive of demographic categories of patients shown in Table 1.

32.5% of the patients were ASA 1, 63% ( $n=223$ ) were ASA 2, and 4.5% were ASA 3. The operated kidney of 51.7% ( $n=183$ ) of the study group was on the left side. The mean PADUA score of the study group was  $8.6 \pm 1.7$ , and the median was 9 (7-10). The most common pathology result was RCC in 83% ( $n=293$ ). When RCC subtypes were examined, it was observed that 69% ( $n=202$ ) clear cell was the most common. When their pathological stages were examined, it's shown that 73.1% ( $n=259$ ) were T1a, 26.3% ( $n=93$ ) T1b, 0.6% ( $n=2$ ) T2a. The Fuhrman nuclear grading distribution in the study cohort was as follows: Grade 1 was identified in 45 cases (15.4%), grade 2 in 207 cases (70.6%), grade 3 in 40 cases (13.7%), and grade 4 in 1 case (0.3%). This distribution reflects a predominance of intermediate-grade tumors (grade 2) within the sample population. Clinical and pathological characteristics of the study population are shown in Table 2.

It was found that the preoperative hemoglobin, hematocrit, and eGFR values of the patients decreased after the surgery, whereas the creatinine values increased ( $p<0.001$ , four instances) (Table 4).

**Table 1. Descriptive of demographic categories of patients**

Categories (n=354)	n (%)	Mean $\pm$ standard deviation	Median (25-75. interquartile range)
<b>Gender</b>			
Male	244 (69.1)		
Female	110 (30.9)		
Age		$53.4 \pm 13.1$	53 (43.3-64)
Height, cm		$172.3 \pm 8.7$	173 (166-178)
Weight, kg		$82.9 \pm 15.6$	83 (73-92)
Body mass index, kg/cm <sup>2</sup>		$27.9 \pm 4.6$	27 (25-30)

**Table 2. Clinical and pathologic characteristics of the study population**

Categories (n=354)	n (%)	Mean $\pm$ standard deviation	Median (25-75. interquartile range)
<b>ASA</b>			
1	115 (32.5)	$1.72 \pm 0.54$	2 (1-2)
2	223 (63)		
3	16 (4.5)		
<b>Laterality</b>			
Right	171 (48.3)		
Left	183 (51.7)		
Follow-up time, month		$64.9 \pm 39.3$	64 (34-92.8)
PADUA score		$8.6 \pm 1.7$	9 (7-10)

Categories (n=354)	n (%)	Mean ± standard deviation	Median (25-75. interquartile range)
<b>Pathology</b>			
RCC	293(83)		
Oncocytoma	23 (6.5)		
AML	22 (6.2)		
Others (kist, nephrocalcinosis, adenoma, infarct, epithelial and stroma tm, liposarcoma)	16 (4.5)		
<b>RCC sub-type</b>			
Clear cell	202 (69)		
Papillary	57 (19.4)		
Chromofob	23 (7.8)		
Others	11 (3.7)		
<b>Pathologic state</b>			
T1a	259 (73.1)		
T1b	93 (26.3)		
T2a	2 (0.6)		
<b>Fuhrman grade</b>			
1	45 (15.4)		
2	207 (70.6)		
3	40 (13.7)		
4	1 (0.3)		

ASA: American Society of Anesthesiologists, RCC: Renal cell carcinoma, AML: Angiomyolipoma, PADUA: Preoperative aspects and dimensions used for an anatomical

Categories (n=354)	PADUA score		p
	≥10 (124)	<10 (230)	
Age (mean ± standard deviation)	50.6±12.7	54.9±12.9	<b>0.0031</b>
<b>Gender</b>			
Male [n (%)]	81 (65.3)	163 (70.9)	0.2822
Female [n (%)]	43 (34.7)	67 (19.1)	
BMI, kg/cm <sup>2</sup> [n (%)]	28 (25-32)	27 (25-30)	0.0971
Follow-up time, month [median (25-75. interquartile range)]	58.5 (28.8-88.5)	67 (36.5-94)	0.1501
Tumor size [median (25-75. interquartile range)]	40 (30-49.5)	27 (22-37.5)	<b>&lt;0.001</b>
Time of operation [median (25-75. interquartile range)]	109 (82-134.8)	91 (70-121.5)	<b>0.002<sup>1</sup></b>
Amount of bleeding, cc [median (25-75. interquartile range)]	200 (77.5-400)	100 (50-200)	<b>0.001<sup>1</sup></b>
<b>Collecting system entry</b>			
Yes [n (%)]	81 (65.3)	56 (24.3)	<b>&lt;0.001<sup>2</sup></b>
No [n (%)]	43 (34.7)	174 (75.7)	
<b>Ischemia</b>			
Yes [n (%)]	115 (92.7)	180 (78.3)	
No [n (%)]	9 (7.3)	50 (21.7)	<b>&lt;0.001<sup>2</sup></b>
Ischemia time (n=295) [median (25-75. interquartile range)]	21 (19-24)	19 (15-20)	<b>&lt;0.001</b>
<b>Surgical margin</b>			
Positive [n (%)]	2 (1.7)	3 (1.4)	0.818 <sup>2</sup>
Negative [n (%)]	116 (98.3)	215 (98.6)	
Hospitalization time [median (25-75. interquartile range)]	109 (82-134)	91 (70-121)	<b>0.005<sup>1</sup></b>

<sup>1</sup>: Mann-Whitney U test, <sup>2</sup>: Chi square test, BMI: Body mass index, PADUA: Preoperative aspects and dimensions used for an anatomical

**Table 4. Comparison of laboratory values before and after operation**

Categories (n)	Pre-operation	Post-operation	p <sup>1</sup>
	Median (25-75. interquartile range)	Median (25-75. interquartile range)	
Hb (344)	14.3 (13.3-15.4)	12.4 (11-13.5)	<0.001
HCT (344)	42.6 (39.9-45)	37.2 (33.3-39.6)	<0.001
eGFR (248)	93 (79.6-104)	91.7 (76.2-104)	<0.001
Creatinine 1 (350)	0.86 (0.73-1.00)	0.88 (0.76-1.05)	<0.001
eGFR 2 (338)	94 (79.7-105)	91.8 (77-104)	<0.001

<sup>1</sup>: Wilcoxon test, eGFR: Estimated glomerular filtration rate, Hb: Hemoglobin, HCT: Hematocrit

## Discussion

PADUA classification, is a system designed to quantify the anatomical characteristics of renal tumors in patients who are candidates for nephron-sparing surgery (7,12,13). It is an anatomy-based nephrometry scoring system used from preoperative imaging to delineate renal mass characteristics and their relationship to adjacent structures (7,12). The primary purpose of the PADUA score is to predict the risk of surgical and medical perioperative complications in patients undergoing open partial nephrectomy (7,12). It is also intended to help clinicians stratify patients suitable for nephron-sparing surgery into subgroups with different complication risks. It can be used as a standardized tool to test the comparability between groups of patients undergoing partial nephrectomy with different surgical approaches. The PADUA classification evaluates five anatomical aspects of the tumor plus its maximal diameter, including: Longitudinal (polar) location, exophytic rate, renal rim, renal sinus, urinary collecting system. The anterior or posterior face of the kidney can also be indicated with a letter ('a' or 'p') (7,12).

The PADUA score can predict the risk of overall complications. In the study where the score was initially developed, multivariate analysis showed that a PADUA score between 8 and 9 identified patients with a 14-fold higher risk of complications compared to those with scores of 6 or 7 (7). Patients with a score  $\geq 10$  had a 30-fold higher risk of complications compared to those with scores of 6 or 7 (7). Renal tumors with a PADUA score  $\geq 10$  are usually defined as having high surgical complexity (8,13). The median PADUA score in a large multicenter study of patients undergoing PN for complex tumors was 10 (13). In this study, 73.4% of these complex tumors were adjacent to the renal sinus, 81.5% were compressing or infiltrating the urinary collecting system, and 30% were completely endophytic (13).

Comparisons with the RENAL nephrometry score indicate that the two systems are highly correlated (12). They assign almost the same points for maximal tumor size, with a slight difference for tumors, Key differences lie in the definition of sinus lines and the evaluation of the relationship with the urinary collecting system or renal sinus; in PADUA, these are scored separately

(1-2 scale), unlike RENAL's single three-tiered variable. Studies suggest, both systems are similarly effective in predicting the risk of overall complications (7,12).

Studies evaluating partial nephrectomy for highly complex renal tumors defined by PADUA score  $\geq 10$  have provided important insights.

A single-center study comparing laparoscopic partial nephrectomy (LPN) and open partial nephrectomy (OPN) for tumors with PADUA score  $\geq 10$  found that while operation time, conversion to radical nephrectomy, and positive surgical margins were similar between the two groups, LPN was associated with significantly lower estimated blood loss, intra-operative and post-operative transfusion rates, drainage time, and pain score at post-operative day. There was a statistically significant difference in overall complication rate, in favor of the laparoscopic approach, although no significant difference in grade  $\geq 3$  post-operative complications was detected (8).

A large multicenter prospective observational study (RECORD2 project) evaluated patients treated with OPN, LPN, and RAPN for complex tumors (PADUA score  $\geq 10$ ) (8,13). They found that the robotic approach was associated with significantly lower estimated blood loss and a higher trifecta rate compared to both LPN and OPN. RAPN also had a significantly lower postoperative complication rate and transfusion rate than OPN. Multivariable analysis identified lower preoperative hemoglobin and the open versus robotic surgical approach as significant predictive factors of overall postoperative surgical complications. The PADUA score was found to be a predictor of major (Clavien  $\geq 3$ ) postoperative surgical complications. The surgical approach was an independent predictor of postoperative complications, with OPN carrying a 3.91-fold increased risk compared to RAPN (13).

Our study underscores the critical role of the PADUA classification system in characterizing tumor complexity. Tumors classified as group A are associated with higher PADUA scores, signifying their increased complexity due to factors such as larger size, proximity to vital renal structures, and multifocality. As anticipated, we observed that surgical procedures for group A were inherently more challenging, necessitating advanced surgical skills and meticulous planning to achieve optimal results.

Despite the greater complexity of tumor A, it is noteworthy that the surgical approach employed in our study yielded favorable outcomes. Surgical success, as defined by complete tumor resection with negative margins and preservation of renal function, was achieved in a substantial proportion of cases. This highlights the expertise of the surgical team and the adaptability of the chosen technique to manage even the most challenging tumors. Our findings revealed that group A tumors, which were characterized by larger sizes and higher PADUA scores, were associated with a higher incidence of complications. Notably, increased blood loss and prolonged hospital stays were more common in this group. These results are consistent with the established notion that larger tumors often necessitate more extensive surgical resections, potentially leading to increased blood loss. Moreover, the extended hospital stays for group A tumors may reflect the need for closer postoperative monitoring and management of complications. Our findings are consistent with those of Ficarra et al. (7), who reported that higher PADUA scores were associated with increased intraoperative blood loss and prolonged hospital stay. In contrast to previous studies suggesting increased positive surgical margins in complex renal masses, our series demonstrated comparable margin-negative rates regardless of PADUA score.

The disparities in complications between group A and group B tumors underscore the importance of individualized surgical planning. While the surgical technique employed in our study demonstrated its effectiveness, it is crucial for clinicians to recognize that the approach to complex tumors may require additional precautions and resources to mitigate potential complications. This includes meticulous hemostasis techniques, access to blood products, and postoperative care protocols tailored to the specific needs of patients with more complex tumors.

### Study Limitations

While the PADUA score was initially validated in patients undergoing OPN, further external validation is noted as needed. Studies have since evaluated its use in minimally invasive techniques. Some studies using the PADUA score for complex tumors also mention limitations, such as the retrospective nature of the study, small cohort size, procedures being performed by highly experienced surgical teams, and non-randomized surgical approach selection. Despite limitations, these studies indicate that the PADUA score is a valuable tool for assessing tumor complexity and predicting outcomes in partial nephrectomy, particularly for complex lesions.

It is essential to acknowledge certain limitations of our study, including its retrospective nature and the potential for selection bias in patient cohort assignment. Furthermore, our analysis primarily focused on short-term surgical outcomes, and long-

term follow-up is warranted to assess factors such as recurrence rates and overall survival.

### Conclusion

Our study sheds light on the intricate relationship between tumor complexity, surgical technique, and patient outcomes. While group A tumors, classified as more complex by the PADUA scoring system, posed greater challenges during surgery and were associated with increased complications, the chosen surgical approach proved effective in achieving favorable outcomes. This emphasizes the need for a tailored, multidisciplinary approach in the management of renal tumors, especially when dealing with more complex cases. As we continue to refine surgical techniques and incorporate evolving technologies, the ultimate goal remains to optimize outcomes and enhance the quality of life for patients with renal tumors, irrespective of their complexity.

### Ethics

**Ethics Committee Approval:** Ethics committee approval was obtained for the study from Acibadem University Ethics Committee (approval no: ATADEK 2023-19-643, date: 30.11.2023).

**Informed Consent:** Retrospective study.

### Footnotes

#### Authorship Contributions

Surgical and Medical Practices: T.D., M.B.T., Ö.B.A., İ.T., A.R.K., Concept: T.D., M.B.T., Design: T.D., M.B.T., Data Collection or Processing: T.D., M.B.T., B.Z.P., Analysis or Interpretation: T.D., M.B.T., B.Z.P., Ö.B.A., İ.T., C.Ö., A.R.K., Literature Search: T.D., M.B.T., Writing: T.D., M.B.T.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study received no financial support.

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# Evaluation of Nutritional and Inflammatory Status Using Naples Prognostic Score Measurements in Patients with Erectile Dysfunction

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## What's known on the subject? and What does the study add?

Previous studies have demonstrated that nutritional and inflammatory markers, particularly neutrophil-to-lymphocyte ratio, correlate with erectile dysfunction (ED). However, comprehensive prognostic scores like the Naples prognostic score (NPS), combining nutritional and inflammatory parameters, have not been extensively explored in ED patients. This study provides novel evidence that the NPS is significantly associated with both the presence and severity of ED. It highlights that higher NPS scores indicate worse nutritional and inflammatory status, correlating strongly with increased ED severity.

## Abstract

**Objective:** To investigate the relationship between the presence and severity of erectile dysfunction (ED) and the Naples prognostic score (NPS).

**Materials and Methods:** Data from patients who presented to two urology outpatient clinics with complaints of ED between July 2024 and January 2025 were retrospectively analyzed. Patients older than 18 years of age engaged in regular sexual activities were included. A total of 163 patients with ED meeting the inclusion criteria and 160 healthy controls without ED were evaluated. Patients' age, weight, height, comorbidities, laboratory findings, and International Index of Erectile Function-5 scores were recorded at baseline.

**Results:** The mean ages of the patients with ED and controls were  $58.7 \pm 12.4$  and  $56.9 \pm 12.8$  years, respectively ( $p=0.197$ ). In the multivariate analysis between the ED and control groups, the neutrophil-to-lymphocyte ratio ( $p=0.009$ ) and the presence of NPS 3-4 ( $p<0.001$ ) were identified as independent variables. Multivariate analysis comparing mild and mild-to-moderate ED groups with moderate and severe ED groups showed that the presence of NPS 3-4 was the only independent predictor of increased ED severity (NPS group 3-4 vs. NPS group 1-2,  $p=0.021$ ; NPS group 3-4 vs. NPS group 0,  $p=0.007$ ).

**Conclusion:** NPS was higher in patients with ED compared to healthy controls. In addition, NPS was significantly higher in patients with moderate and severe ED than in those with mild or mild-to-moderate ED.

**Keywords:** Naples prognostic score, erectile dysfunction, mild, moderate

## Introduction

Erectile dysfunction (ED) is a common condition that significantly affects men's quality of life (1). It may be psychogenic (20%) or organic (80%) in origin, with organic causes often being vasculogenic or iatrogenic. ED is seen in 1-10% of men under 40 years of age and in 30-50% of those between 40 and 70

years. Metabolic syndrome, cardiovascular disease, and obesity are among the major risk factors (2).

According to the European Association of Urology guidelines, both inflammatory and nutritional disorders such as rheumatic diseases, Crohn's disease, ulcerative colitis, vitamin D deficiency, and folic acid deficiency are associated with an increased risk of ED (3). Furthermore, there is evidence linking inflammatory

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**Received:** 11.06.2025 **Accepted:** 31.07.2025 **Epub:** 04.08.2025 **Publication Date:** 02.03.2026

**Cite this article as:** İlki FY, Bülbül E, Aydın E, Topçu YK, Ünal B, Bedir S. Evaluation of nutritional and inflammatory status using Naples prognostic score measurements in patients with erectile dysfunction. J Urol Surg. 2026;13(1):26-31.

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parameters with ED (4,5). The Naples prognostic score (NPS), which integrates markers of nutritional and inflammatory status, namely total cholesterol, serum albumin, lymphocyte-to-monocyte ratio (LMR), and neutrophil-to-lymphocyte ratio (NLR), has been established as a valuable prognostic tool, particularly in patients undergoing surgery for neoplastic diseases (6-8). The NPS is a composite index that reflects both inflammatory and nutritional status. It is calculated based on four parameters: NLR, LMR, serum albumin level, and total cholesterol level. Specifically, NPS is assigned as follows: NLR  $>2.96$  (1 point), LMR  $\leq 4.44$  (1 point), serum albumin  $<4.0$  g/dL (1 point), and total cholesterol  $\leq 180$  mg/dL (1 point), with a higher total score indicating a poorer nutritional and inflammatory profile (9). Recent studies have also reported associations between NPS and the prognosis of both acute and chronic diseases (10-12). However, there is a paucity of data in the literature on the nutritional status of patients with ED. We hypothesize that both nutritional and inflammatory statuses may be impaired in this patient population. This study aimed to investigate the relationship between the presence and severity of ED and NPS.

## Materials and Methods

### Patient Selection

The ethical approval for the study was obtained from the University of Health Sciences Türkiye, Gülhane Scientific Research Ethics Committee in June 2024 (approval number: 2024-354, date: 28.06.2024). Data from patients who presented to two urology outpatient clinics with complaints of ED between July 2024 and January 2025 were retrospectively analyzed. Patients over 18 years of age with a regular sexual life were included. Patients with malignancy, autoimmune disease, or immunodeficiency; those under follow-up for diabetes mellitus, heart failure, or chronic kidney disease (glomerular filtration rate  $<60$  mL/min); individuals with benign prostatic hyperplasia or psychogenic ED, those with a history of prostate surgery; and patients who had used selective phosphodiesterase type 5 inhibitors within the last three months were excluded from the study. After applying these criteria, a total of 163 patients with ED and 160 healthy controls without ED were evaluated.

### Data Collection

At baseline, patients' age, weight, height, comorbidities, and physical examination findings were recorded. Laboratory tests, including absolute neutrophil, lymphocyte, and monocyte counts, as well as serum albumin and total cholesterol levels, were recorded within seven days of the initial examination.

All participants completed the validated Turkish version of the five-item International Index of Erectile Function (IIEF-5) questionnaire (13). The healthy control group consisted of

volunteers with an IIEF-5 score of greater than or equal to 22. The patients with ED were also categorized into subgroups based on disease severity.

### Statistical Analysis

SPSS version 24.0 was used for statistical analysis (version 24.0, IBM Corp., Armonk, NY, USA). The Kolmogorov-Smirnov test was used to assess the normality of the numerical data distribution. Numerical parameters were compared using Student's t-test. The Cochran-Armitage and chi-square tests were used to compare categorical parameters. Independent parameters were determined using logistic regression analysis. A p-value of  $<0.05$  was considered statistically significant.

The Cochran-Armitage trend test was used to compare variables with more than two ordered categories. This test was applied to assess whether there was a significant linear trend across ordered groups (14).

Ordinal logistic regression analysis was performed for the Naples score groups (more than two groups and ordinal scales) (15).

## Results

The mean ages of the patients with ED and the control group were  $58.7 \pm 12.4$  and  $56.9 \pm 12.8$  years, respectively ( $p=0.197$ ). The mean IIEF-5 scores of the ED and control groups were  $13 \pm 4.7$  and  $23.6 \pm 1.3$ , respectively ( $p<0.001$ ). There were no statistically significant differences between the groups in terms of body mass index, blood lymphocyte count, or monocyte count ( $p=0.148$ ,  $p=0.059$ , and  $p=0.066$ ). However, significant differences were observed in NPS group distribution ( $p=0.001$ ), mean NPS score ( $1.5 \pm 1.1$  vs.  $1.0 \pm 0.9$ ;  $p<0.001$ ), smoking status ( $p=0.036$ ), serum albumin level ( $p=0.019$ ), total cholesterol level ( $p=0.043$ ), and neutrophil count ( $p<0.001$ ). The mean NLR values were  $2.26 \pm 1.10$  in the ED group and  $1.74 \pm 0.58$  in the control group ( $p<0.001$ ), while the mean LMR values were  $4.46 \pm 1.54$  and  $5.18 \pm 1.56$ , respectively ( $p<0.001$ ). In a multivariate logistic regression analysis that compared patients with ED to healthy controls, NLR ( $p=0.020$ ), mean NPS score ( $p=0.003$ ), and the presence of NPS group 3-4 ( $p<0.001$ ) were identified as independent predictors of ED. Table 1 provides a detailed comparison of the parameters between the two groups.

When patients with mild and mild-to-moderate ED (group 1) were compared to those with moderate and severe ED (group 2), their mean IIEF-5 scores were  $16.2 \pm 2.4$  and  $7.6 \pm 1.9$ , respectively ( $p<0.001$ ). No significant differences were found between the groups in terms of body mass index, total cholesterol level, albumin level, or monocyte count ( $p=0.212$ ,  $p=0.067$ ,  $p=0.498$ , and  $p=0.324$ ). However, significant differences were observed in age ( $p=0.007$ ), smoking status ( $p=0.001$ ), neutrophil count ( $p=0.007$ ), lymphocyte count ( $p<0.001$ ), NLR ( $p<0.001$ ), LMR ( $p<0.001$ ), and mean NPS score ( $2.4 \pm 1.1$  vs.  $1.1 \pm 0.7$ ;  $p<0.001$ ).

NPS group distribution also differed significantly between these ED severity groups ( $p < 0.001$ ). Table 2 presents a detailed comparison of the parameters by ED severity. In the multivariate analysis, mean NPS score ( $p < 0.001$ ) and the presence of NPS group 3-4 ( $p = 0.014$  and  $p = 0.042$ , respectively) remained independent predictors of increased ED severity.

In addition to group-wise comparisons, the mean NPS score was significantly higher in patients with ED than in healthy controls ( $1.5 \pm 1.1$  vs.  $1.0 \pm 0.9$ ,  $p < 0.001$ ). Furthermore, in subgroup analysis according to ED severity, patients with moderate and severe ED had significantly higher mean NPS scores compared to those with mild or mild-to-moderate ED ( $2.4 \pm 1.1$  vs.  $1.1 \pm 0.7$ ,  $p < 0.001$ ). These findings further support the association between elevated NPS and increased ED severity.

Additionally, a significant negative correlation was observed between NPS and IIEF-5 scores in patients with ED ( $r = -0.695$ ,  $p < 0.001$ ). Mean IIEF-5 scores progressively decreased with increasing NPS values (NPS 0:  $16.8 \pm 3.9$ ; NPS 1:  $15 \pm 3.2$ ; NPS 2:  $11.3 \pm 3.1$ ; NPS 3:  $8.7 \pm 4.6$ ; NPS 4:  $5.8 \pm 2.7$ ;  $p < 0.001$ , Welch's test). When grouped as NPS 0, NPS 1-2, and NPS 3-4, the corresponding mean IIEF-5 scores were  $16.8 \pm 3.9$ ,  $13.8 \pm 3.6$ , and  $7.6 \pm 4.2$ , respectively ( $p < 0.001$ ). Post-hoc analysis using the Games-Howell test revealed significant differences between NPS 0 and NPS 2, 3, and 4 ( $p < 0.001$ ); between NPS 1 and NPS 2, 3, and 4 ( $p < 0.001$ ); between NPS 2 and NPS 4 ( $p < 0.001$ ); and between NPS 3 and NPS 4 ( $p = 0.008$ ). In grouped comparisons, patients in the NPS 3-4 category had significantly lower IIEF-5 scores than those in NPS 0 and NPS 1-2 categories ( $p < 0.001$ ) (Table 3).

**Table 1. Features of patients with ED and healthy controls**

(n)	Univariate analysis			Multivariate analysis
	ED group (n=163)	Control group (n=160)	p	p
Age (year) mean $\pm$ SD	58.7 $\pm$ 12.4	56.9 $\pm$ 12.8	0.197 <sup>a</sup>	
<b>Smoking status</b>				
Never	56 (34.4)	79 (49.4)	0.036 <sup>b</sup>	0.217
Former	50 (30.7)	39 (24.4)		
Current	57 (34.9)	42 (26.2)		
BMI, mean $\pm$ SD	28.2 $\pm$ 4.1	27.6 $\pm$ 4.2	0.148 <sup>a</sup>	
Albumin (g/dL), mean $\pm$ SD	4.2 $\pm$ 0.44	4.5 $\pm$ 0.2	0.019 <sup>a</sup>	0.362
Total cholesterol (mg/dL), mean $\pm$ SD	201.7 $\pm$ 41.5	193.6 $\pm$ 26.9	0.043 <sup>a</sup>	0.541
Neutrophil count (cell/mL), mean $\pm$ SD	4.510 $\pm$ 1.770	3.760 $\pm$ 0.980	<0.001 <sup>a</sup>	0.275
Lymphocyte count (cell/mL), mean $\pm$ SD	2.130 $\pm$ 0.630	2.310 $\pm$ 0.790	0.059 <sup>a</sup>	
Monocyte count (cell/mL), mean $\pm$ SD	510 $\pm$ 150	470 $\pm$ 190	0.066 <sup>a</sup>	
NLR, mean $\pm$ SD	2.26 $\pm$ 1.10	1.74 $\pm$ 0.58	<0.001 <sup>a</sup>	0.020
LMR, mean $\pm$ SD	4.46 $\pm$ 1.54	5.18 $\pm$ 1.56	<0.001 <sup>a</sup>	0.060
NPS group			0.001 <sup>c</sup>	
0	23 (14.1)	41 (25.6)		<0.001 <0.001 Reference
1-2	108 (66.3)	104 (65)		
3-4	32 (19.6)	15 (9.4)		
NPS, mean $\pm$ SD	1.5 $\pm$ 1.1	1 $\pm$ 0.9	<0.001 <sup>a</sup>	0.003

Univariate analysis: <sup>a</sup>: Independent samples t-test, <sup>b</sup>: Chi-square test, <sup>c</sup>: Cochran-Armitage test multivariate analysis: ordinal logistic regression analysis, SD: Standard deviation, BMI: Body mass index, NLR: Neutrophil-to-lymphocyte ratio, LMR: Lymphocyte-to-monocyte ratio, NPS: Naples prognostic score, ED: Erectile dysfunction

**Table 2. Features of patients with ED according to disease severity**

	Univariate analysis			Multivariate analysis
	Mild and mild-to-moderate ED (n=102)	Moderate and severe ED (n=61)	p	p
Age (year), mean $\pm$ SD	57.8 $\pm$ 11.6	63.1 $\pm$ 12.8	0.007 <sup>a</sup>	0.526
<b>Smoking status</b>				
Never	40 (39.2)	16 (26.2)	0.001 <sup>b</sup>	0.463
Former	34 (33.3)	16 (21.3)		
Current	28 (27.5)	29 (52.5)		

**Table 2. Continued**

	Univariate analysis			Multivariate analysis
	Mild and mild-to-moderate ED (n=102)	Moderate and severe ED (n=61)	p	p
BMI, mean ± SD	28.9±3.8	29.9±4.3	0.212 <sup>a</sup>	
Albumin, (g/dL), mean ± SD	4.3±0.3	4.2±0.5	0.498 <sup>a</sup>	
Total cholesterol, (mg/dL), mean ± SD	204.8±46.8	196.1±48.9	0.067 <sup>a</sup>	
Neutrophil count, (cell/mL), mean ± SD	4.15±1.34	5.10±2.20	0.007 <sup>a</sup>	0.907
Lymphocyte count, (cell/mL), mean ± SD	2.31±0.63	1.82±0.52	<0.001 <sup>a</sup>	0.587
Monocyte count, (cell/mL), mean ± SD	0.49±0.14	0.52±0.17	0.324 <sup>a</sup>	
NLR, mean ± SD	1.86±0.70	2.91±1.1	<0.001 <sup>a</sup>	0.759
LMR, mean ± SD	4.97±1.56	3.59±1.01	<0.001 <sup>a</sup>	0.426
NPS group				
0	20 (19.6)	3 (4.9)	<0.001 <sup>c</sup>	0.014
1-2	78 (76.5)	30 (49.2)		0.042
3-4	4 (3.9)	28 (45.9)		Reference
NPS, mean ± SD	1.1±0.7	2.4±1.1	<0.001 <sup>a</sup>	<0.001

Univariate analysis: <sup>a</sup>: Independent samples t-test, <sup>b</sup>: Chi-square test, <sup>c</sup>: Cochran-Armitage test multivariate analysis: ordinal logistic regression analysis, SD: Standard deviation, BMI: Body mass index, NLR: Neutrophil-to-lymphocyte ratio, LMR: Lymphocyte-to-monocyte ratio NPS: Naples prognostic score, ED: Erectile dysfunction

**Table 3. IIEF-5 score of patients with ED according to NPS**

NPS	0	1	2	3	4	p
IIEF-5 score, mean ± SD	16.8±3.9	15±3.2	11.3±3.1	8.7±4.6	5.8±2.7	<0.001 <sup>a</sup>
NPS group	0	1-2	3-4			
IIEF-5 score, mean ± SD	16.8±3.9	13.8±3.6	7.6±4.2			<0.001 <sup>a</sup>

<sup>a</sup>: Welch's test, NPS: Naples prognostic score, ED: Erectile dysfunction, IIEF-5: Five-item version of the International Index of Erectile Function, Multivariate post-hoc analysis (Games-Howell test): NPS 0 vs. NPS 2, 3 and 4 (p<0.001), NPS 1 vs. NPS 2, 3 and 4 (p<0.001), NPS 2 vs. NPS 4 (p<0.001), NPS 3 vs. NPS 4 (p=0.008), NPS 0 vs. NPS 1-2 (p=0.005), NPS 3-4 vs. NPS 0 and NPS 1-2 (p<0.001)

## Discussion

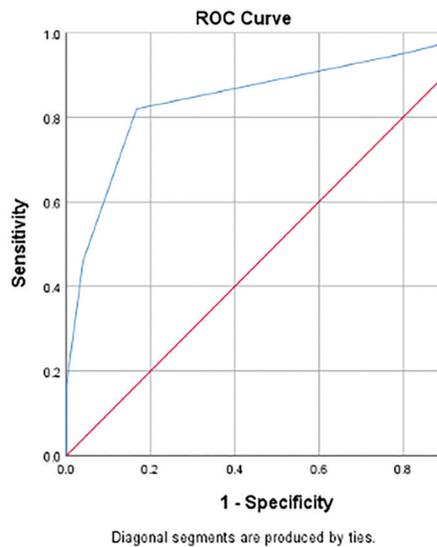
In this study, we evaluated the relationship between inflammatory and nutritional factors and the presence and severity of ED. NPS was significantly higher in patients with ED than in healthy controls. NPS was also higher in patients with moderate or severe ED than in those with mild or mild-to-moderate ED. Our results clearly indicate that nutritional and inflammatory parameters are impaired in patients with ED and that this impairment significantly correlates with disease severity. To the best of our knowledge, this is the first study to assess the association between NPS and ED (Figure 1).

Nutritional status is considered to play a critical role in disease progression and severity (16). Parameters such as serum albumin and cholesterol provide important prognostic information in various diseases (17). Given that NPS incorporates both nutritional and inflammatory components, it offers a comprehensive assessment tool. For example, Zhu et al. (18) reported that NPS was higher in patients with asthma and was associated with mortality. Similarly, Liu et al. (19) demonstrated that a high NPS was predictive of worse short-term (six-month)

outcomes in patients with intracranial hemorrhage. Supporting this, a high NPS in our study was associated with more severe ED symptoms.

It has been suggested that dietary habits may also affect sexual function. Deng et al. (20) found that higher dietary intake of calcium, phosphorus, and potassium was associated with a lower risk of developing ED. Farag et al. (21) reported that ED was more prevalent among individuals with vitamin D deficiency, while Karabakan et al. (22) showed that folic acid levels were lower in patients with ED compared to healthy controls. These findings underscore the significant role of nutritional status, which is influenced by multiple factors, on sexual function.

Previous studies have also established a link between ED and systemic inflammation (23). It has been reported that NLR, a marker of systemic inflammation, is elevated in patients with ED. Sambel et al. (24) found that the median NLR was 1.93 in patients with ED, compared to 1.63 in controls, and Feng et al. (25) reported median NLR values of 2.36 in the ED group and 2.13 in the control group. Consistent with the literature, in our study, the mean NLR was 2.26 in patients with ED and 1.74 in controls.



**Figure 1.** Receiver operating characteristic of NPS for predicting ED severity  
In the ROC curve analysis, the optimal threshold value for NPS was determined as 2. The sensitivity of this threshold (NPS  $\geq 2$ ) for ED severity (moderate and severe ED versus mild and mild-to-moderate ED) was 82%, specificity was 83.3%, (area under the curve=0.849 and  $p < 0.001$ )

ROC: Receiver operating characteristic, NPS: Naples prognostic score, ED: Erectile dysfunction

Sexual dysfunction is a well-documented clinical manifestation of chronic inflammatory diseases. Gaber et al. (26) found that ED was more prevalent among patients with rheumatoid arthritis compared to healthy volunteers and that it correlated with disease activity. Yildiz et al. (27) reported lower IIEF-5 scores in individuals with Behçet's disease compared to healthy controls and attributed this difference to impaired psychometric parameters and quality of life. Similarly, Zhang et al. (28) observed a higher prevalence of ED in patients with Crohn's disease and ulcerative colitis compared to the control group. The authors reported that impaired psychometric parameters and active perianal disease increased the presence of ED.

NPS has been widely used to predict prognosis in many types of cancer among oncological surgery patients (29,30). In the field of urology, Wang et al. (31) evaluated NPS in patients with renal cell carcinoma and found it to be a reliable preoperative prognostic marker. Additionally, Liang et al. (32) conducted a population-based study in China and reported that patients with cancer had higher NPS, and that those with high NPS had a worse prognosis.

### Study Limitations

This study has several limitations. First, the retrospective design may constitute a limitation. Second, the relatively small number of patients could limit the generalizability of the results. However, we employed comprehensive exclusion criteria to create a highly selective cohort to minimize potential confounders.

Nevertheless, considering the limited data published to date on this issue, our findings provide valuable insight, particularly as this study explores the relationship between NPS and ED while contributing to the existing body of literature.

### Conclusion

In this study, NPS was found to be higher in patients with ED than in healthy volunteers. NPS was also higher in moderate or severe ED cases compared to mild or mild-to-moderate cases. To the best of our knowledge, this is the first study to evaluate the association between NPS and ED.

### Ethics

**Ethics Committee Approval:** The ethical approval for the study was obtained from the University of Health Sciences Türkiye, Gülhane Scientific Research Ethics Committee in June 2024 (approval number: 2024-354, date: 28.06.2024).

**Informed Consent:** Retrospective study.

### Footnotes

#### Authorship Contributions

Surgical and Medical Practices: E.B., E.A., Concept: E.B., E.A., Design: F.Y.İ., Y.K.T., S.B., Data Collection or Processing: Y.K.T., B.Ü., Analysis or Interpretation: F.Y.İ., S.B., Literature Search: F.Y.İ., Writing: F.Y.İ.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study received no financial support.

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# Effectiveness of Digital Health Resources: Analysis of the European Society of Urology's Patient Information Videos

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## What's known on the subject? and What does the study add?

Digital video content is increasingly used in patient education, yet few studies have qualitatively assessed the content of such materials in urology. This study conducted a qualitative content analysis of the most-viewed patient education videos on the YouTube channel of the European Association of Urology. It identifies key themes, evaluates educational quality, and provides insights to improve digital health communication.

## Abstract

**Objective:** With advances in communication technologies, digital health resources have become essential in-patient education. Platforms like YouTube allow scientific information to reach large audiences. This study analyzed patient education videos on the European Society of Urology's (EAU) YouTube channel.

**Materials and Methods:** A total of 163 videos from the EAU YouTube channel were reviewed. The 10 most viewed videos were selected for detailed analysis. Data including views, likes, comments, and video duration were recorded. Videos were transcribed and analyzed using MAXQDA 2024 software via qualitative content analysis to identify main themes and subthemes.

**Results:** The top 10 videos averaged 876,700 views, 4,278 likes, 179 comments, and a duration of 2.23 minutes, with an average upload time of nearly 6 years. Content analysis revealed that the videos primarily addressed urological interventions and treatment methods. The most viewed topic was kidney stone removal by ureteroscopy. Other frequent topics include kidney stone treatments, bladder cancer therapies, and overactive bladder management. Less common themes involved urodynamic testing and urostomy care. The videos were categorized into four main subthemes: surgical procedures, medical treatments, diagnostic and evaluation methods, and postoperative care.

**Conclusion:** The EAU's YouTube videos offer comprehensive, accessible, and informative content for patients with urological conditions. These videos support patient education and engagement, potentially improving treatment adherence and health outcomes. Expanding such high-quality digital content in various languages and formats could further enhance patient access and empower informed decision-making in urology care.

**Keywords:** Patient education, urology, nursing, video

## Introduction

The digitalization of healthcare services has profoundly affected the delivery of contemporary healthcare services and facilitated individuals' access to health information (1-3). Digital solutions that increase health literacy have become an important tool in patient education, especially given the abundance of internet-based content (4,5). In line with these developments,

the effectiveness of digital health resources is becoming increasingly important in terms of patient-centered approaches and informed decision-making processes (6).

Effective patient education plays a critical role in shaping individuals' health-related knowledge, attitudes, and behaviors (7-15). Traditional training methods, such as brochures and training booklets, are being replaced by digital platforms (16). Video-based content, in particular, has the potential to make

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**Received:** 22.05.2025 **Accepted:** 03.08.2025 **Epub:** 07.08.2025 **Publication Date:** 02.03.2026

**Cite this article as:** Vural F, Özer Özlü NG. Effectiveness of digital health resources: analysis of the European Society of Urology's patient information videos. J Urol Surg. 2026;13(1):32-38.

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complex medical information more comprehensible due to its audiovisual nature. In this context, professional organizations operating in the field of health must produce user-friendly, accessible content that is scientifically accurate.

The European Association of Urology (EAU) produces digital video content to inform patients (17) which they can easily access on platforms like YouTube. These educational materials provide comprehensive, up-to-date, evidence-based information about urological diseases. They aim to increase patients' knowledge of diagnoses, treatments, and surgical procedures (18). However, the effectiveness of such content depends not only on the quality of the technical production but also on its appropriateness for the target audience, its comprehensibility, and its ability to convey information successfully.

Studies examining the impact of digital resources are increasing in the health communication literature. Studies have shown that video-based patient education materials can positively impact health-related knowledge, reduce anxiety, and support treatment compliance (19-22). However, the effectiveness of digital content depends on the patient profile. Demographic variables, such as age, education level, and health literacy, can influence how content is perceived. This study systematically analyzed patient education videos on the European Society of Urology's YouTube platform, in terms of scientific content quality, audiovisual presentation adequacy, relevance to the target audience, and knowledge transfer efficiency. Additionally, user feedback and viewership data were used to evaluate the videos' effectiveness in practice. The study's primary objective was to qualitatively evaluate the content of patient information videos on the EAU's YouTube platform. The study addressed the following questions:

- What is the content of the patient information videos provided by the EAU on YouTube?
- What extent do these videos meet the information needs of the target audience?
- According to participants' comments, what impact does digital video content have on patient education?

The findings aim to contribute to the development of digital patient education materials in both academic and practical ways. Additionally, the study aims to increase health literacy by providing evidence-based recommendations for developing patient-centered digital communication strategies.

## Materials and Methods

This qualitative study aims to systematically evaluate the content of the EAU's patient information videos. The study employs qualitative content analysis to assess the informativeness and

suitability of digital health resources for the target audience. The data source consists of patient information videos published on the European Urological Association's official YouTube channel (<https://www.youtube.com/@urochannel>). In March 2024, the researchers systematically scanned all videos on the platform and recorded a total of 163 videos. The videos were sorted by number of views, and the ten most-viewed videos were selected as the research sample. The rationale behind this selection is that the number of views reflects the videos' potential to reach the target audience and their impact. The following quantitative data were collected for each selected video:

- Total number of views
- Number of likes
- Number of comments
- Video duration (in minutes: seconds).

This data were manually recorded directly on the YouTube platform. The visual documents were systematically analyzed under meaningful themes and categories. The MAXQDA 2024 software program was used for analysis. First, each video was transcribed, and then a systematic coding process was performed. During open coding, the types of information, conceptual frameworks, narrative styles, and content density in the videos were determined. Then, these codes were categorized according to their similarities, and main themes and sub-themes were created. At the same time, coding trends were created for the comments made on the videos. To increase the reliability of the analysis process, Inter-researcher comparisons were made during creating and categorizing of the codes, and consensus was reached.

## Ethical Assessment

This study did not require ethics committee approval because it was conducted using publicly available digital content that did not contain any personal data. The principles of academic ethics were followed throughout the research process, and the obtained data were used only for scientific purposes.

## Results

The average number of views of the ten most-viewed patient information videos on the European Society of Urology's YouTube channel, which were included in the study, was  $876,700 \pm 1,372,000$ . Significant differences were observed in the number of views of the videos. With an average duration of  $2.23 \pm 0.26$  minutes, the videos provided brief, targeted information. On average, videos have been on the platform for  $5.9 \pm 0.31$  years. On average, videos received  $4,277.5 \pm 7,930$  likes and  $179.4 \pm 373.1$  comments (Table 1).

A qualitative content analysis was conducted using MAXQDA 2024 software, which revealed that most videos focused on urological interventions and treatment methods. The most-viewed video was one about kidney stone removal by ureteroscopy. According to the overall content distribution, the videos covered the following topics:

- Removal of kidney stones (n=4)
- Bladder cancer treatment (n=2)
- Treatment of overactive bladder (n=2)
- Urodynamic tests (n=1)
- Urostomy care (n=1)

The content identified in these videos was categorized under four main themes: surgical procedures, medical treatments, diagnosis and evaluation methods, and postoperative care (Figure 1).

**Theme 1: Surgical Procedures:** This theme focuses on surgical interventions, which comprise a significant portion of the videos. Common procedures such as cystectomy (bladder removal), ureteral stent placement, and lithotripsy (kidney stone crushing or removal) are covered in detail. The videos generally use a three-stage narrative: the purpose of the procedure, the process, and the expected results. Surgical procedures are supported by animations and simulations. Additionally, the risks and possible complications of the procedures are explained in simple, easy-to-understand terms to improve patient understanding.

**Theme 2: Medical Treatments:** This theme is dominated by videos on drug therapy. In particular, the videos comprehensively explain pharmacological treatments for common urological conditions, such as an overactive bladder, benign prostate enlargement, and urinary incontinence. The videos detail drug groups, mechanisms of action, routes of administration, dosage information, and possible side effects. To increase patient compliance with treatment, the videos present the importance

of regularly taking medications and provide guidance on follow-up processes during treatment. These videos are informative and motivational, especially for patients on long-term medication.

**Theme 3: Diagnosis and Assessment Methods:** Diagnostic videos typically focus on functional tests and imaging methods. They explain how procedures such as urodynamics, ultrasonography, cystoscopy, and specialized laboratory tests are performed when they are preferred and what the patient can expect. The visual narratives show the patient's step-by-step experience during the test and are structured into sections such as pre-procedural preparation, the procedure itself, and post-procedural evaluation. These videos aim to increase knowledge about diagnostic methods and reduce patient anxiety by preparing them for the procedures.

**Theme 4: Postoperative Care:** This theme focuses on care processes after surgery. Topics such as post-urostomy care, bladder replacement, skin care, infection prevention, hydration, and hygiene practices are presented in detail in the videos. The points to be considered during the postoperative period are presented in a way that is easy to understand for both patients and caregivers. Additionally, information is provided about the symptoms of potential complications and the measures to address them. The importance of controlling visits and continuity of care is emphasized. These videos provide a valuable educational resource for patients and aim to improve the quality of home care.

Features	Mean ± SD
Number of views	876.700±1.372,000
Video duration (minutes)	2.23±0.26
Time since publication (years)	5.9±0.31
Number of likes	4.277,5±7.930
Number of comments	179.4±373.1
SD: Standard deviation	

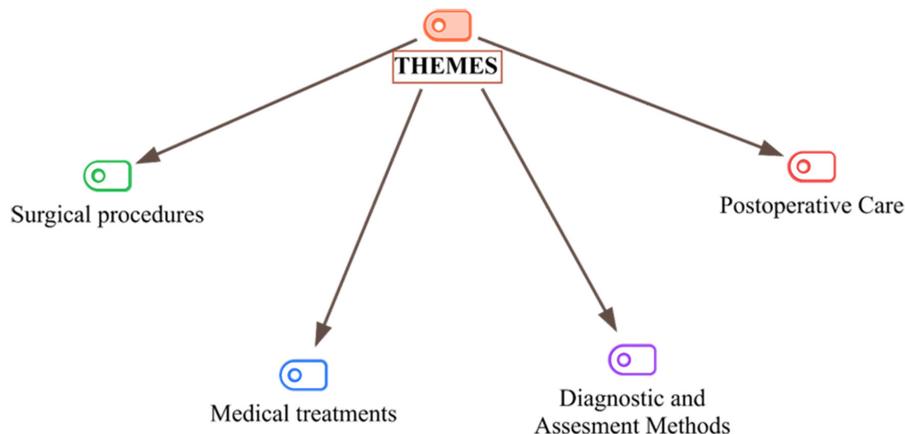


Figure 1. Hierarchical code-sub code model (themes)

Figure 2 shows the code trends generated from comments on videos. According to these trends, the most striking topic is "Cystoscopy (Overactive Bladder)"; this code has the highest comment rate at about 43%. This indicates that users discussed this topic the most. The topic "Changing stoma bag (after bladder cancer treatment)" received the fewest mentions, at about 6%. "Bladder Cancer Treatment Cystectomy" and "Urodynamics for Overactive Bladder" received moderate interest (9-18%). Procedural topics, such as "Removal of Kidney Stones URS", "Removal of Kidney Stones PCNL", "JJ Stent (Removal of Kidney Stones)", and "Removal of Kidney Stones ESWL", attracted 35-40% interest.

## Discussion

This study analyzed, using content analysis, informative videos prepared by the EAU for patients. The findings were then evaluated under thematic categories. Four main themes were identified as a result of the analysis: surgical procedures, medical treatments, diagnostic and evaluation methods, and postoperative care. These themes highlight the importance of digital resources for patient education and information in all urological treatment and care processes. While viewers mostly commented on practical and procedural topics, such as endoscopic procedures and stent removal, they commented less on diagnostic content, such as symptoms and tests. Topics such as ostomy bag replacement received significantly less user interest.

In terms of surgical procedures, videos generally contain detailed explanations of topics such as the preoperative process,

how the surgery is performed, possible risks, and expected outcomes. Visual animations and explanatory voiceovers are thought to support the stages of interventions such as bladder removal, stone crushing, and stent placement, allowing patients to develop realistic expectations about the surgical process. However, although YouTube has become a popular source of medical information for patients, studies evaluating urology-related content have reported significant quality problems. Studies analyzing videos on ureteroscopy (22), transrectal ultrasound-guided prostate biopsies (14), prostate cancer treatments (23), and ureteral stent placement (24) consistently revealed that most of the content provided low- to moderate-quality information. These studies emphasize that, in its current form, YouTube is inadequate as a source of urological information for patients, and a need exists for higher-quality, patient-oriented content. However, the videos in this study were produced by the European Urological Association, which increases their reliability as a source of information. These videos may play an important role in reducing patients' surgical anxiety and increasing their satisfaction.

Videos focusing especially on medical treatments highlight information about medication use. They convey the mechanisms of action, dosages, and possible side effects of drugs used to treat overactive bladder in simple, understandable language. This information can boost patients' confidence in their treatment and positively impact their medication compliance. However, studies have found that videos on YouTube and TikTok about OAB are generally of low quality and limited comprehensibility (11,25). Only 12.5% of urinary incontinence videos on YouTube were both understandable and actionable (26). Although videos

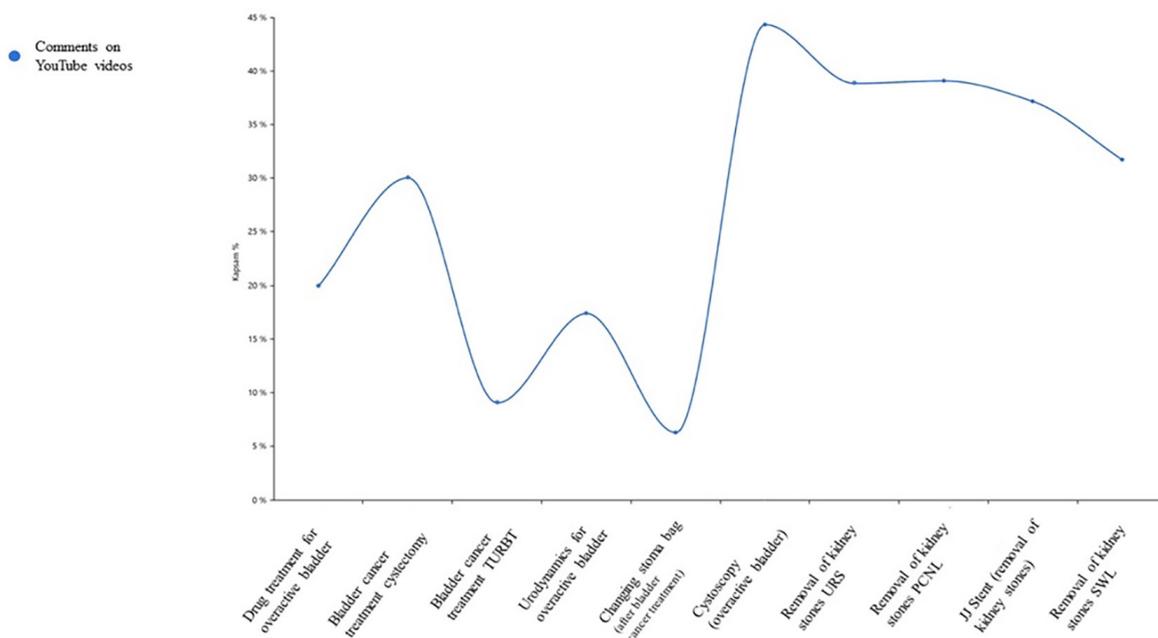


Figure 2. Code trends

featuring physicians are of higher quality, they often do not appear in the top search results (11). Similarly, quality issues have been identified in bladder pain syndrome videos on YouTube. In contrast, the videos in this study, produced by the European Society of Urology, stand out for their content quality, scientific accuracy, and reliability. Such quality content may help patients obtain information about the treatment process, increase their confidence in treatment, and contribute positively to medication adherence and overall patient satisfaction. These findings suggest that more qualified and reliable content should be disseminated for patient education on social media platforms. Additionally, having prior knowledge of potential problems that may arise during treatment may lead to more effective and efficient communication between patients and physicians.

The videos on diagnostic and evaluation methods thoroughly explain the purpose, performance, and considerations of functional examination methods, such as urodynamic tests. This type of content clarifies complex or anxiety-provoking diagnostic procedures, encouraging patient participation and increasing the utilization of health services. A study evaluating the educational value of YouTube videos about neurogenic bladder and intermittent catheterization found that videos with instructions from a healthcare professional were significantly more effective than videos narrated by patients (27). A lack of information about functional diagnostic tests can cause unnecessary anxiety in patients. For this reason, explanatory video content is valuable in closing this information gap. However, diagnostic videos on social media platforms generally have some limitations in terms of content quality, comprehensibility, and scientific accuracy. Conversely, the videos analyzed in this study, which were produced by the European Society of Urology, were found to be of high quality in terms of information reliability, clarity, and patient education. Such content may encourage patients to actively participate in the process and utilize health services more effectively by alleviating their concerns about the diagnostic process.

Videos on postoperative care focus on hygiene practices for conditions that require special care, such as urostomy. They also cover ways to prevent complications and to integrate care into daily life. These videos are an important source of information for both patients and caregivers. However, studies have shown mixed results regarding the quality and reliability of these videos. While some videos provide useful information (28,29), many may be misleading. Videos uploaded by health professionals, universities, and professional organizations tend to be more reliable and higher quality (28). Despite the potential of YouTube videos as complementary educational tools, the open-access nature of YouTube requires guidance from healthcare professionals to select appropriate videos

(29). The smooth progression of postoperative home care is especially important in reducing hospital readmission rates and improving quality of life. In this context, the videos prepared by the European Urological Association and evaluated in our study were found to consistently provide reliable information on postoperative care. Such quality content is thought to reduce the risk of complications, increase patient satisfaction, and contribute to a healthier postoperative process by meeting the informational needs of patients and caregivers.

The analysis reveals that the patient information videos provided by the EAU on YouTube are well-structured and scientifically sound. Addressing basic health topics such as diagnosis, treatment, and postoperative care, these videos largely meet the information needs of the target audience, providing an effective resource for patient education. Literature frequently emphasizes the positive effects of digital health materials on patient education, and this study shows that EAU videos can significantly contribute to the patient education process due to their reliable, understandable, and systematic structure. Participant comments support the informative nature of these videos and reveal that they increase patients' awareness and participation in the treatment process. Overall, the study concluded that EAU content can be used as an effective, high-quality digital health communication tool. However, it is important to note that all videos analyzed in this study were presented solely in English. This monolingual presentation limits the accessibility and usefulness of the content for patients from diverse linguistic and cultural backgrounds. In multicultural societies, language barriers can significantly hinder patients' ability to understand, engage with, and act on health information. To ensure equitable access to reliable patient education materials, professional organizations like the EAU should consider offering multilingual versions of their content, including translated subtitles or dubbed narration. Such efforts would expand the reach of digital health communication tools and promote health equity on a broader scale.

### **Study Limitations**

This study has some methodological and contextual limitations. First, it was unable to assess how the target audience perceived the video content in relation to their knowledge, expectations, and experiences. Furthermore, the videos were only presented in English, which significantly limits accessibility for individuals who are not proficient in the language. This monolingual approach may hinder the comprehension of essential health information and reduce the utility of the videos for diverse populations, particularly those from non-English-speaking backgrounds. The lack of multilingual content not only poses a barrier to equitable access but also restricts the potential for cross-cultural applicability and relevance. Future studies should prioritize the inclusion of subtitles or dubbed versions

in multiple languages and evaluate how language diversity influences understanding, engagement, and satisfaction across different patient groups. Incorporating multilingual content on various platforms can enhance inclusivity and provide more meaningful, comparative insights into the effectiveness of such educational tools.

## Conclusion

In conclusion, the EAU's patient information videos are comprehensive and informative. They present a wide range of information, including surgical procedures, drug treatments, diagnostic tests, and post-operative care. Thus, they support patients in participating in health processes in a more informed and prepared manner. This study once again demonstrates that audiovisual content is an effective tool in patient education and health communication. Future studies comparing content in different languages and directly evaluating patients' benefit from video content could contribute to the development of digital health materials.

## Ethics

**Ethics Committee Approval:** This study did not require ethics committee approval because it was conducted using publicly available digital content that did not contain any personal data.

**Informed Consent:** Not necessary.

## Footnotes

### Authorship Contributions

Surgical and Medical Practices: F.V., N.G.Ö.Ö., Concept: F.V., N.G.Ö.Ö., Design: F.V., N.G.Ö.Ö., Data Collection or Processing: F.V., N.G.Ö.Ö., Analysis or Interpretation: F.V., N.G.Ö.Ö., Literature Search: F.V., N.G.Ö.Ö., Writing: F.V., N.G.Ö.Ö.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study received no financial support.

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# Expert-AI Concordance in Varicocele Management: How Reliable Is ChatGPT-4.0?

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## What's known on the subject? and What does the study add?

Large language models like ChatGPT are increasingly used by both clinicians and patients to obtain medical information. However, their accuracy and alignment with expert recommendations in specific urological conditions such as varicocele remain unclear. Previous studies evaluating ChatGPT have focused mainly on general medical knowledge or patient education. This study is the first to systematically assess the clinical reliability of ChatGPT-4.0 in varicocele-related infertility scenarios using structured expert evaluation. It demonstrates that ChatGPT-4.0 provides recommendations largely consistent with expert opinion, especially in guideline-based standard cases, while highlighting its limitations in gray-zone decisions that require individualized clinical judgment.

## Abstract

**Objective:** Artificial intelligence (AI)-based large language models (LLMs), such as ChatGPT-4.0, are increasingly being considered for clinical decision-making support. However, their reliability in providing clinical recommendations for varicocele-related infertility remains to be thoroughly evaluated. This study aimed to evaluate the reliability of ChatGPT-4.0 in providing clinical recommendations for patients with varicocele-related infertility.

**Materials and Methods:** A standardized clinical scenario was created involving a 32-year-old male with varicocele and oligoasthenoteratozoospermia, including details from physical examination, hormonal profile, and semen analysis based on the World Health Organization 6<sup>th</sup> edition criteria. Sixteen diagnostic and therapeutic questions were developed and submitted to ChatGPT-4.0. The AI-generated responses were reviewed by 24 experienced urologists specializing in varicocele management, who rated the recommendations using a 5-point Likert scale.

**Results:** The urologists demonstrated an 80.2% agreement, 10.7% disagreement, and 9.1% neutrality with ChatGPT-4.0 recommendations. For 14 of the 16 questions, the majority of urologists either agreed or strongly agreed with ChatGPT-4.0. Recommendations regarding varicocelectomy indication, antioxidant usage, the female partner age greater than 35, follow-up after varicocelectomy, testosterone deficiency, and normospermic varicocele showed the highest consensus. However, lower agreement rates were noted for microsurgical varicocelectomy (54.1%) and preoperative sperm cryopreservation (16.7%).

**Conclusion:** ChatGPT-4.0 demonstrates reliability in providing clinical recommendations in most scenarios related to varicocele treatment, showing strong agreement with expert clinicians. However, specific "gray zone" scenarios requiring individualized decision-making highlight limitations; emphasizing the importance of experienced clinical judgment. ChatGPT-4.0 can serve as a reliable informational tool regarding varicocele treatment but should be used with caution in complex clinical decisions requiring personalized evaluation.

**Keywords:** Varicocele, male infertility, artificial intelligence, ChatGPT-4.0

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**Received:** 30.07.2025 **Accepted:** 19.08.2025 **Epub:** 21.08.2025 **Publication Date:** 02.03.2026

**Cite this article as:** İlki FY, Bülbül E, Topçu YK, Bedir S. Expert-AI concordance in varicocele management: how reliable is ChatGPT-4.0? J Urol Surg. 2026;13(1):39-45.

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## Introduction

Male infertility is a significant reproductive health issue affecting approximately 15% of couples, with male factors being the primary cause in 40-50% of these cases (1). One of the most common causes of male infertility is varicocele, which is observed in 35-40% of subfertile men and up to 15% of the general population (2,3). The effects of clinical varicocele on infertility have been studied for many years, and surgical treatment—particularly microscopic subinguinal varicolectomy—has been reported to improve sperm parameters and increase spontaneous pregnancy rates (4,5).

The management of varicocele cases remains controversial in "gray zone" situations such as mild sperm abnormalities, grade I varicocele, or azoospermia (6,7). Treatment decisions are typically based on a holistic evaluation of multiple factors, including the patient's clinical findings, semen analysis results, female partner's age, and the couple's reproductive expectations (8,9).

In recent years, the integration of artificial intelligence (AI) systems into clinical decision-making processes has accelerated. Artificial intelligence-based large language models (LLMs), especially advanced versions such as ChatGPT-4.0, have begun to be used experimentally in medical education and clinical decision support (10). Nowadays, patients frequently consult internet sources and LLMs for health-related issues. However, the extent to which LLMs are beneficial to patients and the accuracy of their recommendations in specific clinical scenarios remain unclear (11). The consistency of LLMs with expert opinions and the reliability of the information they provide have been assessed in only a limited number of studies (12).

In this study, diagnostic and therapeutic suggestions provided by ChatGPT-4.0 were obtained for an infertile male patient diagnosed with varicocele, as well as, for different clinical scenarios of varicocele. The clinical responses generated by ChatGPT for each scenario were evaluated by urology specialists. The aim was to evaluate the reliability of artificial intelligence-based language model recommendations by clinicians for varicocele disease.

## Materials and Methods

### Study Design

No patient identifiers were used in this study. LLMs are based on publicly available information. Since there were no human subjects involved, ethical approval was not required for studies related to LLMs (13,14). In this study, an AI-based language model, ChatGPT-4.0, was utilized. This observational study was conducted in April and May 2025. The Institutional

Ethics Committee of University of Health Sciences Türkiye, Gülhane Training and Research Hospital reviewed the study design and concluded that ethical approval was not necessary. This decision was based on the absence of patient data, the exclusive collection of anonymous professional opinions, and the non-interventional nature of the survey. Real patient data was not included in this study. No identifiable personal or health information was obtained, and all responses remained anonymous. The study was conducted in accordance with the principles outlined in the Declaration of Helsinki (2004 revision).

### Creating Case Scenarios

The survey questions were created by the authors (F.Y.I., E.B., Y.K.T. and S.B.). A case scenario was designed based on a 32-year-old infertile male patient diagnosed with varicocele. The case included physical examination findings, hormone profile, scrotal Doppler ultrasonography results, and semen analysis (according to the 6<sup>th</sup> edition of the World Health Organization classification) (15). Subsequently, multiple clinical scenarios were generated by modifying various parameters such as sperm count, female partner's age, and hormone levels. A total of 16 questions were developed.

The initial scenario used in this study was based on a representative index case constructed to reflect a typical clinical presentation of varicocele-related infertility. To evaluate a broader range of decision-making contexts, this base scenario was systematically modified to include varying clinical parameters, thereby creating more complex clinical situations. Although no real patient data were used, the final set of scenarios was designed to closely resemble real-life cases.

To assess the clinical realism of the case scenarios, participants were asked to rate the similarity of the scenarios to actual clinical practice using a 5-point Likert scale. Remarkably, 100% of the respondents selected "strongly agree", indicating that the scenarios were perceived as highly reflective of real-world cases.

### AI-based Clinical Decision Generation and Expert Opinion Survey

Diagnostic and therapeutic recommendations for infertile male case scenarios with varicocele were generated by ChatGPT-4.0. These responses were evaluated by 24 specialists in a survey of urologists. The evaluation was conducted and recorded through Google Forms. Urologists with experience in the diagnosis, follow-up, and treatment of varicocele were included in the study. Participants assessed the responses of ChatGPT-4.0 anonymously. Participation was voluntary, and no incentives were provided. No random sampling was performed. The online survey utilized a 5-point Likert scale to evaluate ChatGPT-4.0. The specialists were asked to rate their level of agreement with each recommendation using the Likert scale (1 = strongly disagree, 5 = strongly agree).

## Statistical Analysis

The collected data were analyzed statistically using SPSS version 26.0 (IBM, Armonk, NY, USA). The data distribution was tested using the Kolmogorov–Smirnov test. For the comparison based on the experience level of urologists, an independent-samples t-test was used to assess the mean Likert scale scores. A p-value of <0.05 was considered statistically significant. Inter-rater agreement among the 24 participating urologists was assessed using Fleiss' kappa for multiple raters. The original 5-point Likert scale responses were dichotomized into "Agree" (scores 4–5) and "Not Agree" (scores 1–3) to facilitate interpretation. Kappa values were interpreted according to Landis and Koch's criteria, where <0.20 indicates slight agreement, 0.21–0.40 fair agreement, 0.41–0.60 moderate agreement, 0.61–0.80 substantial agreement, and >0.80 almost perfect agreement.

## Results

### Clinical Features

A 32-year-old male patient presented with a two-year history of infertility. His 29-year-old female partner had no abnormalities on gynecological evaluation. The patient's testicular volumes were 18 mL on the right and 16 mL on the left. Physical examination revealed a grade II varicocele on the left side. Scrotal Doppler ultrasonography showed a left pampiniform plexus vein diameter of 3.4 mm during the Valsalva maneuver, with a reflux duration of 2.1 seconds. Hormonal analysis revealed follicle-stimulating hormone levels were 4.1 IU/L, luteinizing hormone levels were 3.5 IU/L, and total testosterone levels were 4.8 ng/mL. The semen analysis results of the representative case created for the study are presented in Table 1, which were consistent with varicocele-associated oligoasthenoteratozoospermia.

## ChatGPT-4.0 Responses and Survey Evaluation

Among the 24 participating urology specialists, 12 had <5 years (group A) and 12 had >5 years (group B) of clinical experience. Additionally, twelve were employed at tertiary care centers, eight at state hospitals, and four in private institutions. The clinical questions posed to ChatGPT-4.0 and its corresponding responses are presented in Table 2. There were no statistically significant differences between groups A and B in terms of the mean scores assigned to any of the questions ( $p < 0.05$ ).

The distribution of responses from 24 urologists to the 16 clinical questions is illustrated in Figure 1. Each stacked bar depicts the proportion of participants selecting each category on the 5-point Likert scale, ranging from "Strongly disagree" to "Strongly agree." Visual inspection of the figure shows clear patterns of consensus in certain scenarios, particularly those with guideline-based management recommendations, while other scenarios, especially those in "gray zones," reveal more heterogeneous response distributions. This graphical representation complements the tabulated data and highlights the variation in expert agreement across all questions. Urologists who evaluated ChatGPT-4.0's response to 16 questions had 80.2% agreement, 10.7% disagreement, and 9.1% neutral responses. The distribution of expert ratings for each question is shown in Figure 1. For 14 out of 16 questions, the vast majority of urologists selected either "Agree" or "Strongly Agree" with ChatGPT-4.0.

The ChatGPT-4.0 responses regarding varicocelectomy indication (Question 1, 100%), antioxidant recommendation (Question 3, 91.7%), female partner age >35 (Question 6, 91.7%), follow-up after varicocelectomy (Question 7, 91.7%), testosterone deficiency (Question 10, 91.7%), and normospermic varicocele (Question 12, 95.8%) had the highest consensus among clinicians.

**Table 1. Semen analysis results of the sample case presented to ChatGPT-4.0 and urology specialists**

Parameter	1 <sup>st</sup> semen analysis	2 <sup>nd</sup> semen analysis
Ejaculate volume	2.6 mL	2.8 mL
Sperm concentration	9 million/mL	13 million/mL
Total sperm count	23.4 million	36.4 million
Progressive motility (PR)	18%	22%
Total motility (PR + NP)	32%	38%
Immotile sperm	68%	62%
Normal morphology (kruger)	3%	2%
Vitality (eosin test)	68%	70%
Presence of leukocytes	<1 million/mL (normal)	<1 million/mL (normal)
Agglutination	Not observed	Not observed
pH	7.8	7.7
Viscosity	Normal	Normal
Liquefaction time	20 minutes	20 minutes
NP: Non-progressive motility		

**Table 2. A compilation of 16 clinical questions related to the diagnosis and management of varicocele, along with the corresponding answers generated by ChatGPT-4.0 in the context of a standardized male infertility case**

Questions	Answers
<b>Q1:</b> Is varicocelectomy surgery indicated in this patient?	<b>A1:</b> This patient has symptomatic grade II varicocele, impaired semen parameters, and meets the criteria for surgical indication in the context of an infertile couple. Microsurgical subinguinal varicocelectomy is recommended.
<b>Q2:</b> In addition to varicocele surgery, would you consider a supportive approach in terms of medical treatment?	<b>A2:</b> In this patient, I would recommend antioxidant supplementation during both the preoperative and postoperative periods of varicocelectomy. Although the current hormonal profile does not require intervention, fertility-friendly agents such as clomiphene may be considered if a decline is observed during follow-up. Lifestyle modifications should also be strongly encouraged.
<b>Q3:</b> What types of preparations would you recommend as antioxidant therapy?	<b>A3:</b> In male patients with OAT for whom varicocelectomy is planned, a combination of antioxidants (e.g., CoQ10, L-carnitine, zinc, and vitamin E) may be recommended for a duration of 3 to 6 months. This supportive therapy has the potential to enhance sperm quality when used in conjunction with surgery.
<b>Q4:</b> If we go back to the beginning of the case, you mentioned that you would recommend varicocelectomy. If microsurgical equipment is not available, would you refer the patient to another center, or would you proceed with the surgery yourself?	<b>A4:</b> If I do not have the appropriate equipment or experience for microsurgical varicocelectomy, I would prefer to refer the patient to a center where this technique can be performed.
<b>Q5:</b> Would you recommend sperm cryopreservation for this patient prior to varicocelectomy?	<b>A5:</b> Although sperm cryopreservation is not an absolute indication in this case, the patient should be informed about the potential risk of deterioration in semen parameters following surgery, and the option of 'preventive sperm banking' should be offered.
<b>Q6:</b> If the female partner were 36 years old in this case, would it change your approach?	<b>A16:</b> When the female partner is 36 years old, the indication for varicocelectomy does not change, but the management strategy does: sperm cryopreservation is strongly recommended to avoid loss of time, a parallel plan with IVF is considered, and the observation period is shortened.
<b>Q7:</b> Assuming varicocelectomy has been performed in this patient, how long should we wait for spontaneous pregnancy postoperatively?	<b>A7:</b> If there is no urgent reproductive pressure for the couple after varicocelectomy, I would wait at least 3 months, preferably 6 months, for spontaneous conception. If pregnancy does not occur within this period, I would reassess both the sperm parameters and the condition of the female partner to revise the treatment plan accordingly.
<b>Q8:</b> If the patient has already cryopreserved sperm prior to varicocelectomy, would you still wait for 6 months or consider extending the waiting period?	<b>A8:</b> If sperm has been cryopreserved, the waiting period for natural conception can be extended. However, depending on the couple's specific circumstances, this period should not exceed 12 months.
<b>Q9:</b> If the first semen analysis showed OAT, but the second one was within normal limits, what would you recommend?	<b>A9:</b> The female partner's age of 29 places this case at the lower threshold for surgical indication. Due to the variability in semen analysis, a third test should be requested; if stable normozoospermia is observed, there would no longer be an indication for surgery. Since the chance of natural conception remains high, active surveillance is the most appropriate strategy.
<b>Q10:</b> If this patient had mild testosterone deficiency, how would it affect your treatment plan?	<b>A9:</b> In infertile men with varicocele and mild testosterone deficiency, varicocelectomy should be prioritized, and the hormonal response should be monitored postoperatively. If the testosterone deficiency is symptomatic, fertility-preserving treatments such as clomiphene or hCG may be considered. Direct testosterone replacement is contraindicated in the context of fertility.
<b>Q11:</b> If this patient had a left-sided grade 1 varicocele, what would your treatment plan be?	<b>A10:</b> In an infertile male with grade I varicocele and mild semen abnormalities, active surveillance is preferred prior to surgery, especially if the female partner is young and there is no time pressure. Surgery is considered only if semen parameters worsen or if the couple opts against assisted reproductive techniques such as IVF.
<b>Q12:</b> If both semen analyses had shown normal sperm parameters in this case, would you still recommend varicocelectomy?	<b>A11:</b> No, if both semen analyses are normal and the patient is asymptomatic, I would not recommend varicocelectomy. Instead of surgery, monitoring the chances of natural conception and adopting a couple-based approach to infertility would be preferred.

Table 2. Continued	
Questions	Answers
<b>Q13:</b> If the semen analysis results in this case had shown severe OAT, what would your initial recommendation be?	<b>A12:</b> If the semen analysis findings are severely impaired in this case, sperm cryopreservation should be performed prior to surgery. Microsurgical varicocelectomy should then be planned. Although an appropriate female partner age may allow for a period of observation, the couple should be counseled in advance about the possibility of treatment failure.
<b>Q14:</b> If azoospermia had been detected in the semen analysis of this patient, what would your initial management plan be?	<b>A13:</b> Initially, genetic testing and hormonal evaluation should be performed. Depending on the patient's condition, micro-TESE, varicocelectomy, or a combination of both may be planned. However, the decision for surgery should be based on the potential for sperm production.
<b>Q15:</b> Which should be performed first: micro-TESE or varicocelectomy?	<b>A14:</b> If the patient has non-obstructive azoospermia and is a suitable surgical candidate (e.g., AZFc deletion, FSH <15, and moderate testicular volume), varicocelectomy may be recommended as the initial approach. This is because some patients may exhibit spontaneous sperm in the ejaculate postoperatively, or the success rate of subsequent micro-TESE may improve.
<b>Q16:</b> Would you consider performing micro-TESE and varicocelectomy simultaneously?	<b>A15:</b> In azoospermic patients with limited testicular reserve, time constraints, and a planned IVF cycle, performing micro-TESE and varicocelectomy in the same session may be considered. However, this approach requires careful surgical planning and informed patient consent. In most cases, performing varicocelectomy first and observing the outcome is a safer and more physiological strategy.
OAT: Oligoasthenoteratozoospermia, TESE: Testicular sperm extraction, FSH: Follicle stimulating hormone, CoQ: Coenzyme Q, IVF: In vitro fertilization, hCG: Human chorionic gonadotropin, AZFc: Azoospermia factor c	

The discussion between ChatGPT-4.0 and urologists regarding microsurgical varicocelectomy (Question 4) showed an agreement rate of 54.1% (13/24), a neutral rate of 20.9% (5/24), and a disagreement rate of 25% (6/24). Regarding preoperative sperm cryopreservation (Question 5), the agreement rate among ChatGPT-4.0 and urologists was 16.7% (4/24), the neutral rate was 33.3% (8/24), and the disagreement rate was 50% (12/24).

Inter-rater agreement was re-evaluated by considering only the "Agree" (scores 4-5) and "Disagree" (scores 1-2) categories, excluding "Neutral" (score 3) responses. Using this approach, the overall Fleiss kappa value was 0.267, indicating fair to moderate agreement according to the Landis and Koch classification. This method eliminates the influence of indecisive responses and allows a clearer assessment of the consistency between positive and negative judgments.

## Discussion

This study assessed the concordance between the clinical recommendations of ChatGPT-4.0 for varicocele-related infertility and the evaluations of practicing urologists. The high overall agreement suggests that ChatGPT-4.0 is capable of generating recommendations aligned with expert perspectives, particularly when guideline-based indications are clear.

Disagreement was most evident in scenarios involving microsurgical varicocelectomy and preoperative sperm

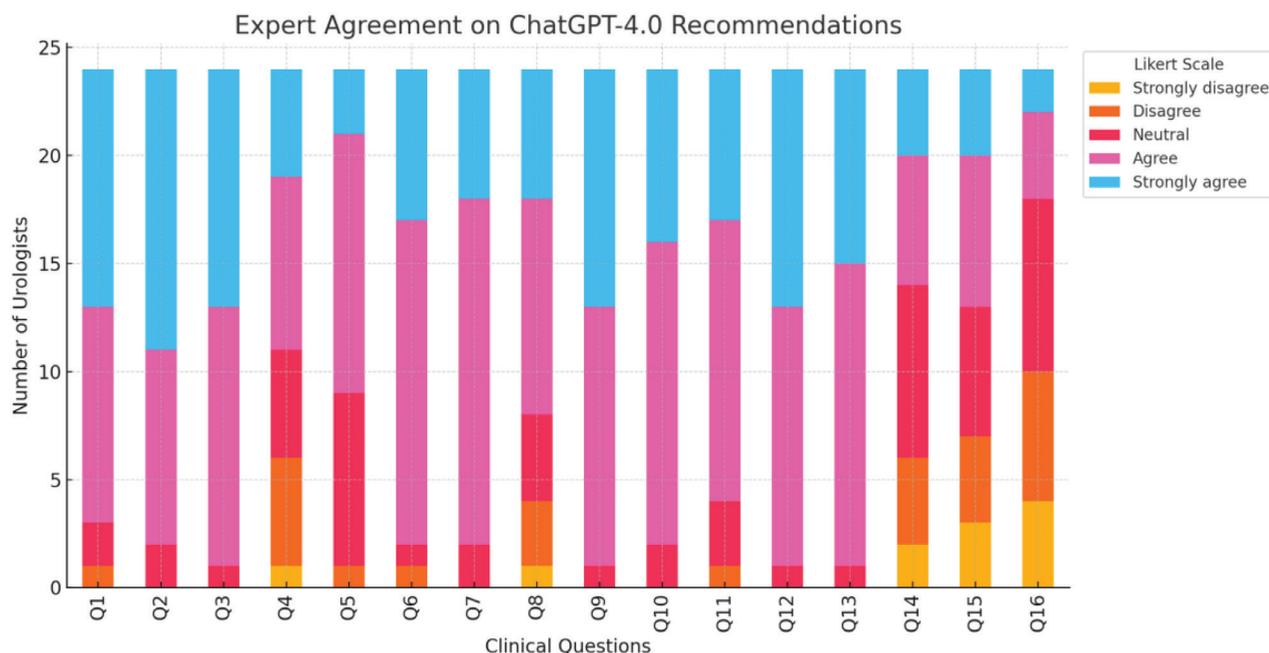
cryopreservation. These differences likely reflect variations in institutional resources, surgical expertise, and the absence of definitive guidance in current clinical recommendations. For example, while microsurgical varicocelectomy is widely regarded as the standard of care, practical limitations may influence decision-making in certain settings. Similarly, the lack of strong evidence regarding preoperative sperm cryopreservation leads to heterogeneity in clinical practice.

The model's suggestion to incorporate antioxidant therapy and to adjust treatment strategies when the female partner is older than 35 years was broadly endorsed by experts, reflecting alignment with both current literature (4,5) and international guidelines (8,9). The consistency of agreement across urologists with different levels of experience further suggests that LLMs may offer uniform, guideline-consistent information to patients, regardless of the clinician's background.

Despite these strengths, limitations remain in "gray zone" scenarios, where nuanced clinical judgment is essential and standardized recommendations are lacking. This reinforces the view expressed in prior literature (16,17) that AI tools should serve as complementary aids rather than replacements for clinician expertise.

## Study Limitations

This study has several limitations. First, the performance of ChatGPT-4.0 was evaluated based on fixed clinical scenarios,



**Figure 1.** Distribution of responses from 24 urologists evaluating the appropriateness of ChatGPT-4.0's answers to 16 clinical questions using a 5-point Likert scale. Each stacked bar represents the number of experts selecting each level of agreement (from "Strongly disagree" to "Strongly agree") for a given question. The graphic illustrates the degree of expert consensus or divergence across all responses

which may not fully reflect the dynamic nature of real-life patient interactions. Second, the number of participating urologists was limited, which may restrict the generalizability of expert opinions. Previous studies have shown that LLMs may occasionally produce inaccurate responses that appear correct and may demonstrate inconsistencies when dealing with complex clinical scenarios (18–20). Therefore, although ChatGPT-4.0 showed high agreement with expert opinions in many scenarios, it should be used cautiously in complex cases.

## Conclusion

While AI-based language models such as ChatGPT-4.0 demonstrate a high level of consistency with clinical guidelines and expert consensus in standard index cases, their utility remains limited in complex or low-evidence scenarios where nuanced clinical judgment is essential. In such contexts, expert opinion remains irreplaceable, and current AI systems cannot substitute for the depth and flexibility of experienced clinical reasoning.

## Ethics

**Ethics Committee Approval:** Not necessary.

**Informed Consent:** Not necessary.

## Authorship Contributions

### Footnotes

Surgical and Medical Practices: Y.K.T., S.B., Concept: F.Y.İ., Design: F.Y.İ., Data Collection or Processing: Y.K.T., Analysis or Interpretation: E.B., Literature Search: E.B., Writing: F.Y.İ.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study received no financial support.

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# The Impact of Anaesthetic Technique on Perioperative Bleeding in Endourological Stone Surgery: A Retrospective Analysis

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## What's known on the subject? and What does the study add?

Perioperative bleeding during ureterorenoscopy (URS) and retrograde intrarenal surgery (RIRS) is mainly affected by stone size, stone location, and procedure-related factors. Previous comparative studies have generally reported similar operative and postoperative outcomes between spinal and general anaesthesia. Evidence specifically focusing on anaesthetic technique and haemoglobin change remains limited. This study shows that the choice of anaesthetic technique (general vs. spinal) does not significantly influence perioperative haemoglobin reduction in URS/RIRS. Operative time is identified as an independent predictor of haemoglobin decline. Use of a ureteral access sheath is significantly associated with greater haemoglobin reduction. The findings suggest that procedure-related factors, rather than the anaesthetic method, predominantly determine bleeding risk in endourological stone surgery.

## Abstract

**Objective:** This study investigated whether the type of anaesthesia—general anaesthesia (GA) or spinal anaesthesia (SA)—affects perioperative haemoglobin (Hb) changes and postoperative complications in patients undergoing ureterorenoscopy (URS) or retrograde intrarenal surgery (RIRS). A secondary aim was to identify perioperative factors associated with Hb decline.

**Materials and Methods:** Patients aged  $\geq 18$  years who underwent rigid URS or RIRS between April 2020 and April 2025 were evaluated retrospectively. Demographic characteristics, stone features, operative details, anaesthetic technique, and perioperative Hb values were recorded. Patients with combined or epidural anaesthesia, active anticoagulation, coagulopathy, or incomplete data were excluded. Factors related to Hb reduction were assessed using univariate analyses and multivariate logistic regression.

**Results:** A total of 247 patients met the criteria. The mean Hb decrease was 0.37 g/dL in the GA group and 0.28 g/dL in the SA group; the difference was not significant ( $p > 0.05$ ). No transfusions were required. Larger stones, location in the renal pelvis, longer operative time, and use of a ureteral access sheath were significantly associated with Hb decline (all  $p = 0.001$ ). In multivariate analysis, stone size, operative duration, and access sheath use remained independent predictors, while anaesthetic technique and comorbidities were not significant predictors. The overall complication rate was low (0.8%), with no events above Clavien-Dindo grade IIIa.

**Conclusion:** Anaesthetic technique does not significantly influence perioperative Hb reduction or complication rates during URS or RIRS. Operative duration and the use of an access sheath are the main determinants of bleeding risk.

**Keywords:** Basic science, endourology, general urology

## Introduction

Urolithiasis is an important health problem that is increasingly common both worldwide and in our country. The prevalence in Türkiye has been reported to reach 14.8% (1). Urinary stone disease

may present with recurrent episodes of pain, infection, and, if not treated promptly, may ultimately cause irreversible impairment of renal function. Recently, endourological interventions have become a preferred treatment option for urolithiasis because they are minimally invasive and offer high success rates (2).

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**Received:** 18.11.2025 **Accepted:** 16.12.2025 **Epub:** 19.02.2026 **Publication Date:** 02.03.2026

**Cite this article as:** Yaşar E, Eren AE, Baz O, Tarhan H. The impact of anaesthetic technique on perioperative bleeding in endourological stone surgery: a retrospective analysis. J Urol Surg. 2026;13(1):46-52.

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Among endourological procedures, ureterorenoscopy (URS) and retrograde intrarenal surgery (RIRS) have become increasingly widespread owing to technological advancements, particularly in laser systems. The anaesthetic technique used during these procedures can directly influence surgical comfort, haemodynamic stability, operative duration, and postoperative complications (3,4).

Traditionally, general anaesthesia (GA) is preferred, particularly in cases involving proximal ureteric stones or requiring RIRS. The main reasons for this include longer operative duration, higher intrarenal irrigation pressure, prevention of patient movement, and airway security (3,5). GA also enhances operative comfort by offering the surgeon a better visual field, controlled ventilation, and improved haemodynamic stability (6,7).

In contrast, spinal anaesthesia (SA) has recently become an important alternative, particularly for short- to medium-duration endourological procedures, owing to its safety profile, cost-effectiveness, and rapid recovery time (4,8). A spinal block offers several advantages during the intraoperative period, including a more stable haemodynamic profile, reduced opioid requirements, and earlier mobilisation. Physiological effects, such as preserved renal blood flow and reduced systemic absorption of irrigation fluid—both related to decreased sympathetic tone—may also contribute to these benefits (5-8).

Recent reviews, including several systematic analyses, suggest that there is no meaningful difference between spinal and GA in terms of stone-free rates or overall complications for patients undergoing retrograde intrarenal surgery. Several studies report that patients operated on under SA experience less blood loss and require fewer postoperative analgesics (9-11).

In practice, perioperative bleeding and the risk of complications are often influenced by procedure-related factors - for example, operative duration, stone size and position, and use of a ureteral access sheath (12-15). Some authors also note that the sympathetic blockade produced by neuraxial anaesthesia could help maintain renal blood flow, which, in turn, may attenuate these perioperative changes (16,17).

However, data directly comparing the effects of the two anaesthetic techniques on perioperative decreases in haemoglobin (Hb) and bleeding-related parameters remain limited. Therefore, this study retrospectively examined the influence of anaesthesia type on perioperative Hb changes and the occurrence of complications in patients undergoing URS or RIRS for urolithiasis.

In addition, we sought to identify factors that might contribute to Hb decline, including stone size, stone location, procedure duration, use of a ureteral access sheath, and comorbidities.

## Materials and Methods

This study was designed as a single-centre retrospective cohort analysis covering the period from April 2020 to April 2025. It was conducted using the archived records of the Departments of Urology and Anaesthesiology at Muğla Sıtkı Koçman University in accordance with the principles of the Declaration of Helsinki. Ethical approval was obtained from the Muğla Sıtkı Koçman University Clinical Research Ethics Committee (approval no: 205, date: 03.10.2025). Owing to the retrospective nature of the study, informed consent was waived; all data were anonymised and confidentiality was maintained in line with institutional policy.

Patients aged 18 years or older who underwent rigid URS or RIRS (flexible URS) for urolithiasis were eligible for inclusion. Surgical and anaesthesia charts, perioperative Hb and haematocrit measurements, details of general or spinal anaesthesia, and complete records of bleeding and transfusion were required for inclusion.

Patients who received combined, epidural, or other regional anaesthesia techniques, patients on active anticoagulant therapy, patients with known coagulopathies, and patients with missing or inconsistent clinical data were excluded from the study.

All procedures were performed using standard endourological techniques. Operations were performed under either general or spinal anaesthesia. The choice of anaesthetic method was based on several clinical considerations, including the patient's overall condition, the location of the stone (particularly the proximal ureter or renal pelvis), the anticipated duration of the procedure, the patient's ability to cooperate, and the judgement of the attending anaesthesiologist. The absence of a uniform protocol was regarded as a methodological limitation of the study.

GA was typically preferred for proximal ureteric stones, for patients undergoing RIRS, and for cases in which the patient explicitly requested it. In these patients, ureteral access sheaths were inserted. To maintain a stable irrigation pressure, the irrigation bag was positioned approximately 90 cm above the patient. Owing to the retrospective design, real-time intrarenal pressure measurements were not available; therefore, it cannot be confirmed with certainty that irrigation pressure remained fully standardised across all procedures.

Stone fragmentation was performed with a Ho:YAG laser in dusting mode. Laser energy parameters (joules and frequency) were not consistently documented in the records and could not be included in the analysis. A guidewire was used in all cases, and a postoperative Double J (DJ) stent was routinely inserted. Patients requiring ureteral dilatation had a DJ stent inserted, and their procedures were postponed. All operations were

performed by two surgeons, each with experience of more than 100 URS and RIRS procedures.

Patient age, sex, body mass index (BMI), comorbid conditions, type of anaesthesia, stone laterality and location, maximum stone diameter (mm), perioperative transfusion requirement (transfusion indicated when Hb fell below 8 g/dL), change in Hb from the preoperative value to the 24<sup>th</sup> postoperative hour (g/dL), postoperative events within 30 days, classified according to the Clavien-Dindo classification, and operative time were obtained from the anaesthesia and surgical records. A standardised data collection form was created to record all variables.

### Statistical Analysis

All analyses were performed using IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarised as mean ± standard deviation or median (minimum-maximum), while categorical variables were presented as frequency (n) and percentage (%). Differences between groups were assessed using Student's t-test for normally distributed variables and the Mann-Whitney U test for non-normally distributed variables. Categorical variables were compared using the chi-square ( $\chi^2$ ) test or Fisher's exact test, as appropriate.

To identify factors associated with Hb decline, univariate analyses were initially performed. Variables showing statistical significance in univariate testing ( $p < 0.05$ ) were entered into a multivariate logistic regression model. Results were reported as odds ratios (OR) with 95% confidence intervals. A  $p$ -value of  $< 0.05$  was considered statistically significant.

### Results

Between April 2020 and April 2025, 324 patients who underwent URS or RIRS for urolithiasis were evaluated. 50 patients were excluded because of incomplete records, 20

because a preoperative ureteral stent was placed, and 7 because they received combined anaesthesia.

The demographic characteristics of the study cohort are summarised in Table 1. Although the mean age of patients in the SA group was slightly higher than that in the GA group, this difference was not statistically significant ( $p = 0.237$ ). Males predominated in both groups (59.0% and 67.8%, respectively), with no significant difference between groups ( $p = 0.376$ ). The BMI distribution was also comparable between the two groups ( $p = 0.487$ ), and most patients were classified as normal weight or overweight.

The mean Hb drop was 0.37 g/dL in the GA group and 0.28 g/dL in the SA group. Although the proportion of patients experiencing a decrease in Hb was higher in the GA group (20.5%) than in the SA group (2.9%), this difference was not statistically significant ( $p > 0.05$ ; Table 2).

No significant difference in Hb reduction was observed between patients with comorbidities and those without them ( $p > 0.05$ ). The highest mean Hb drop was observed in patients with a history of arrhythmia (0.33 g/dL), while lower mean drops were recorded in patients with hypertension, diabetes, or coronary artery disease. Despite these minor variations, the presence of comorbidity did not appear to have a meaningful impact on perioperative Hb levels (Table 3).

The relationship between operative variables and decline in Hb is summarised in Table 4. A significant association was found between stone size and Hb reduction ( $p = 0.001$ ); patients with larger stones experienced a more pronounced reduction in Hb. Stone location was also significantly associated with change in Hb ( $p = 0.001$ ); the greatest mean decrease in Hb was observed in cases with renal pelvis stones (50%).

A ureteral access sheath was used in 12 patients with renal pelvic stones, 46 with proximal ureteral stones, and 7 with

	General anaesthesia (n=79)	Spinal anaesthesia (n=245)	Total (n=324)	p-value*
Age (year) <sup>a</sup>	51.0±17.5 (median: 53.5)	51.8±15.8 (median: 51)	51.6±16.2 (median: 53)	0.726
Gender <sup>b</sup> (female/male)	30/49 (38.0%/62.0%)	82/163 (33.5%/66.5%)	112/212 (34.6%/65.4%)	0.628
BMI <sup>b</sup> 20-25 25-30 ≥30	37 (46.8%) 36 (45.6%) 7 (8.9%)	112 (45.7%) 116 (47.3%) 16 (6.5%)	149 (46.0%) 152 (46.9%) 23 (7.1%)	0.797
Stone size (mm, mean ± SD) <sup>c</sup>	13.6±6.0	9.4±3.3		<0.001
Operative time (min, mean ± SD) <sup>c</sup>	60.0±27.7	36.1±7.8		<0.001
URS (n, %) <sup>b</sup>	12 (15.1%)	235 (95.9%)		<0.001
RIRS (n, %) <sup>b</sup>	21 (26.6%)	9 (3.7%)		<0.001
PCNL (n, %) <sup>b</sup>	8 (10.1%)	0		<0.001

BMI: Body mass index (kg/m<sup>2</sup>), <sup>a</sup>: Mann-Whitney U (Wilcoxon rank-sum), <sup>b</sup>: Chi-square test, <sup>c</sup>: Independent samples t-test, SD: Standard deviation, URS: Ureterorenoscopy, RIRS: Retrograde intrarenal surgery, PCNL: Percutaneous nephrolithotomy

**Table 2. Clinical findings and transfusion requirement by type of anesthesia**

Anesthesia type	Number of patients (n)	Number of transfusions (n)	Transfusion rate <sup>a</sup>	Mean Hb decrease (g/dL) <sup>b</sup>
General anaesthesia	79	6	7.6%	0.99
Spinal anaesthesia	245	1	0.4%	0.27

<sup>a</sup>: Chi-square test, <sup>b</sup>: Welch's Mann-Whitney U test, Hb: Haemoglobin

**Table 3. Effect of comorbidities on haemoglobin decrease**

Comorbidity	Mean Hb decrease (with) (g/dL)	Mean Hb decrease (without) (g/dL)	p-value <sup>a</sup>
Hypertension	0.39	0.49	0.364
Diabetes mellitus	0.40	0.46	0.431
Arrhythmia	0.46	0.45	0.562
Coronary artery disease	0.53	0.44	0.942

<sup>a</sup>: Mann-Whitney U test, Hb: Haemoglobin

**Table 4. Relationship between stone size, stone location, access sheath and haemoglobin decrease**

Parameter	Mean Hb decrease (-)	Mean Hb decrease (+)	p-value
Stone size (mm + SD)	14.3±3.2	18.4±3.4	0.001 <sup>a</sup>
Stone location			
Renal pelvis n (%)	12 (5.1%)	7 (50%)	
Proximal ureter n (%)	64 (27.4%)	4 (28.5%)	
Mid ureter n (%)	58 (24.8%)	2 (14.2%)	
Distal ureter n (%)	92 (39.4%)	0 (0%)	
Upper pole kidney n (%)	7 (3%)	1 (71%)	
Total	233	14	0.001 <sup>b</sup>
Ureteral access sheath n (%)	23 (76.7%)	7 (23.3%)	0.001
Operative time, mean ± SD (minute)	45.8±15.2	63.8±21.2	0.001

SD: Standard deviation, <sup>a</sup>: Independent Samples t-test, <sup>b</sup>: Chi-square test, Hb: Haemoglobin

upper-pole renal stones. Hb reduction was significantly more common among patients who had an access sheath inserted (p=0.001); sheath use increased the likelihood of Hb decline by approximately ninefold (OR=9.13). This association likely reflects the greater procedural complexity and intrarenal manipulation in these cases rather than the effect of the anaesthetic technique. Among the sheath-treated patients, 26 underwent the procedure under general anaesthesia, in accordance with the clinical preference for GA in more demanding endourological interventions.

In two patients with mid-ureteric stones who were treated with semirigid URS, postoperative DJ stents were placed within 24 hours because they developed high fever and pain (Table 4).

No patient required a blood transfusion.

Postoperative complications classified according to the Clavien-Dindo system are presented in Table 5. The overall complication rate in the study was low (approximately 0.8%). All events were limited to grade I-IIIa. Two patients (0.8%) developed mild fever and pain; both required placement of a DJ stent under local anaesthesia (grade IIIa). No cases of transfusion, sepsis, or mortality were recorded.

These findings indicate that URS and RIRS are generally safe procedures and that the choice of anaesthetic technique does not appear to influence the frequency or severity of postoperative complications.

The main factors associated with perioperative Hb decline are summarised in Table 6. A more pronounced Hb reduction was significantly associated with larger stone size, stone location in the renal pelvis, longer operative time, and use of a ureteral access sheath (p=0.001 for all). In contrast, neither the anaesthetic technique (general versus spinal) nor comorbidities such as hypertension, diabetes mellitus, coronary artery disease, or arrhythmia showed any meaningful association with change in Hb (p>0.05). Multivariate logistic regression analysis (Table 7) identified stone size, operative time, and use of ureteral access sheath as independent predictors of reduction in Hb levels (p=0.001, p=0.002, and p=0.001, respectively). In contrast, neither the type of anaesthesia nor the presence of comorbidities, including hypertension, diabetes mellitus, and coronary artery disease, showed any significant association with Hb decline (p>0.05).

**Table 5. Classification of postoperative complications according to the Clavien-Dindo system**

Clavien-Dindo grade	Definition	Number of cases (n)	Rate (%)	Description
Grade I	Minor complications (pain, fever, non-medical intervention)	0-2	0-0.8	Patients with mild fever/pain
Grade II	Medical treatment (antibiotics, transfusion, etc.)	0-2	0-0.8	No transfusion; antibiotic use presumed
Grade IIIa	Endoscopic intervention (without general anaesthesia)	2	0.8	Patients who had a Double J stent inserted due to fever/pain
Grade IIIb	Surgical intervention requiring general anaesthesia	0	0	None
Grade IV-V	Life-threatening/fatal complications	0	0	None

**Table 6. Univariate analysis of factors associated with perioperative hemoglobin reduction**

Variable	Association	p-value
Stone size <sup>a</sup>	Greater Hb reduction in larger stones	0.001
Stone location <sup>b</sup>	Marked Hb reduction in renal pelvis stones	0.001
Operative time <sup>a</sup>	Longer procedures associated with greater Hb drop	0.001
Access sheath use <sup>b</sup>	Greater Hb reduction when used (OR: 9.13)	0.001
Anaesthetic technique <sup>b</sup>	GA > SA, difference not significant	>0.05
Comorbidities <sup>a</sup> (HT, DM, CAD, arrhythmia)	No significant association	>0.05

<sup>a</sup>: Independent samples t-test, <sup>b</sup>: Chi-square test, Hb: Haemoglobin, GA: General anaesthesia, SA: Spinal anaesthesia, HT: Hypertension, DM: Diabetes mellitus, CAD: Coronary artery disease, OR: Odds ratio

**Table 7. Multivariate logistic regression analysis of factors associated with haemoglobin reduction**

Factor	OR	95% CI	p-value
Stone size (mm) <sup>a</sup>	2.80	1.5-5.2	0.001
Operative time (min) <sup>a</sup>	2.30	1.3-4.1	0.002
Ureteral access sheath use <sup>b</sup>	4.10	2.1-7.9	0.001
Anaesthetic technique <sup>b</sup> (GA vs. SA)	1.60	0.8-3.0	0.090
Comorbidity <sup>b</sup> (HT/DM/CAD)	1.10	0.6-2.0	0.450

<sup>a</sup>: Continuous variables, <sup>b</sup>: Categorical variables, OR: Odds ratio, CI: Confidence interval, GA: General anaesthesia, SA: Spinal anaesthesia, HT: Hypertension, DM: Diabetes mellitus, CAD: Coronary artery disease, min: Minute

## Discussion

The main purpose of this study was to examine whether the anaesthetic technique chosen for URS and RIRS had any impact on perioperative Hb levels or postoperative complications in patients treated for urolithiasis. In our series, the pattern of Hb change was broadly similar in both the GA and SA groups, and the overall amount of blood loss was small, regardless of the technique used.

Among the variables examined, two factors—longer operative time and use of a ureteral access sheath—showed a stronger association with a decrease in Hb. These findings point to the possibility that the technical demands of the procedure and the degree of intrarenal manipulation are more influential than the anaesthetic approach itself. The relatively few previous studies comparing GA and SA with respect to perioperative bleeding mean that the present findings are a useful addition to the existing evidence base.

When the baseline characteristics of the two anaesthesia groups were compared, no meaningful differences were observed in age, sex, or body mass index. This similarity strengthens the validity of our comparisons, since it limits the influence of confounding factors. Similar observations have been reported by Cai et al. (3) and Topaktaş et al. (4), who also highlighted that balanced baseline profiles allow for a clearer interpretation of outcome differences.

In the current study, the mean fall in Hb was 0.37 g/dL for GA and 0.28 g/dL for SA. The proportion of patients who experienced any measurable decline was higher in the GA group (20.5%) than in the SA group (2.9%). Although the difference did not reach statistical significance, it remains clinically relevant. Comparable patterns have been described in the studies by Kızılay et al. (5) and Olivero et al. (7), both of whom reported slightly greater Hb reductions in patients undergoing RIRS under GA. Higher intrarenal irrigation pressures and, in some cases, longer procedure times under GA may be contributing

factors. Another point to consider when interpreting changes in Hb is the procedural profile of the two anaesthetic groups. Flexible URS (RIRS) was performed significantly more often under general anaesthesia, and both stone size and operative duration were greater in the general-anaesthesia group. These procedural differences—rather than the anaesthetic technique itself—may partly account for the slightly greater reduction in Hb observed in patients undergoing general anaesthesia. When these variables were adjusted for in the multivariate analysis, the type of anaesthesia no longer showed an independent association with change in haemoglobin, suggesting that surgical complexity is a more relevant determinant of bleeding.

Our overall findings align well with the broader literature. Cai et al. (3) found no significant differences in blood loss or stone-free rates when comparing GA, SA, and epidural anaesthesia during flexible URS procedures. Topaktaş et al. (4) also reported that SA is both safe and practical in the management of proximal ureteric stones. Likewise, Kızılay et al. (5) and Shaikh et al. (6) concluded that SA does not compromise operative comfort and achieves stone-free outcomes comparable to GA.

Systematic reviews and meta-analyses published in recent years have drawn similar conclusions. Ho et al. (9), Duan et al. (10), and Patil et al. (11) noted that neuraxial anaesthesia is at least as effective as GA for URS and RIRS, with some evidence suggesting lower postoperative analgesic requirements and reduced bleeding with SA. Our data follow the same pattern: the anaesthetic method did not produce a clinically important difference in perioperative Hb change.

The two operative factors most clearly linked to Hb decline in our analysis were the length of the procedure and the use of an access sheath. This observation is broadly consistent with previous studies showing that prolonged operative time and higher irrigation pressures are associated with an increased risk of bleeding (13,15). Although access sheaths generally help reduce intrarenal pressure, procedures performed without a sheath may be subjected to higher intrarenal pressure, which may produce a transient haemostatic effect, resulting in less mucosal bleeding despite increased irrigation. By contrast, stone size did not appear to influence Hb levels in our cohort, likely because all stones were smaller than 2 cm.

### Study Limitations

From the perspective of anaesthetic physiology, SA has been reported to reduce systemic vascular resistance, maintain renal blood flow and limit the systemic uptake of irrigation fluid (16,17). These mechanisms may confer some protection against bleeding and help explain why SA remains a reasonable option, particularly for short and moderate-duration endourological interventions.

The postoperative complication rate in our study was (0.8%), which is below the range commonly reported in the literature (approximately 2–5%) (12,15). No patient required blood transfusion, and no complications of grade IIIb or higher were observed. This probably reflects a combination of surgical experience and careful case selection.

A key strength of this study is the relatively large number of URS and RIRS cases evaluated under either GA and SA, allowing a direct and clinically meaningful comparison between GA and SA. Although the retrospective nature of the study imposed certain limitations, the multivariate analysis helped control for confounders. Nonetheless, several limitations must be acknowledged: irrigation pressure and stone hardness could not be standardised; blood loss had to be inferred from changes in Hb rather than measured directly.

### Conclusion

In summary, the present data show no significant difference between GA and SA in terms of perioperative Hb reduction or postoperative complications in endourological stone surgery. SA appears to be a safe and practical alternative to GA, particularly for shorter procedures, given its favourable recovery profile and low complication rate. More importantly, operative time and the use of an access sheath seem to be the primary determinants of perioperative bleeding risk, rather than the anaesthetic method itself.

Another methodological point requires clarification. Because this study was retrospective, the use of a ureteral access sheath was not consistently documented in the operative records, and a comparison between sheath-positive and sheath-negative cases could not be performed. In routine practice, however, access sheaths are used exclusively during flexible URS (RIRS). For this reason, any interpretation of sheath use in our study was limited to the RIRS subgroup to avoid confounding by rigid URS procedures, in which a sheath is never employed. This approach provides a more accurate reflection of the procedural factors influencing Hb change.

### Ethics

**Ethics Committee Approval:** Ethical approval was obtained from the Muğla Sıtkı Koçman University Clinical Research Ethics Committee (approval no: 205, date: 03.10.2025).

**Informed Consent:** Not necessary.

### Footnotes

#### Authorship Contributions

Surgical and Medical Practices: E.Y., A.E.E., O.B., H.T., Concept: E.Y., A.E.E., O.B., H.T., Design: E.Y., A.E.E., O.B., H.T., Data Collection

or Processing: E.Y., A.E.E., O.B., H.T., Analysis or Interpretation: E.Y., A.E.E., O.B., H.T., Literature Search: E.Y., A.E.E., O.B., H.T., Writing: E.Y., A.E.E., O.B., H.T.

**Conflict of Interest:** Hüseyin Tarhan MD is section editor in Journal of Urological Surgery. He had no involvement in the peer-review of this article and had no access to information regarding its peer-review.

**Financial Disclosure:** The authors declared that this study received no financial support.

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# Can the Rate of Idiopathic Cases in Chronic Scrotal Pain be Reduced with an Effective Multidisciplinary Approach?

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## What's known on the subject? and What does the study add?

This study aims to evaluate the etiological distribution among patients presenting with chronic scrotal pain, to demonstrate the contribution of a multidisciplinary approach to diagnosis, and to help determine possible causes, especially in cases classified as idiopathic.

## Abstract

**Objective:** This study aims to evaluate the etiological distribution among patients presenting with chronic scrotal pain, to demonstrate the contribution of a multidisciplinary approach to diagnosis, and to help determine possible causes, especially in cases classified as idiopathic.

**Materials and Methods:** In this retrospective study, 127 patients (mean age 35 years, range 18-66 years) who presented to our urology clinic with chronic scrotal pain (CSP) between January 2023 and June 2025 were evaluated. All patients underwent a diagnostic evaluation, including a detailed medical history, a comprehensive physical examination, scrotal Doppler ultrasonography, and laboratory investigations. To identify possible sources of pain beyond urological causes, patients were evaluated in multidisciplinary consultations.

**Results:** Pain was unilateral in 40 patients (31.5%) and bilateral in 87 patients (68.5%). Chronic epididymitis and prostatitis were present in 25 patients (19.68%); varicocele was present in 27 patients (21.26%); and pain after varicocelectomy-inguinal hernia repair was present in 18 patients (14.17%). Of the 57 patients (44.90%) with undetermined urological etiology, 20 (15.75%) were diagnosed with perianal pathologies during consultation in the general surgery clinic, and 7 (5.51%) were diagnosed with lumbar disc herniation during consultation in the neurosurgery clinic. The cause of pain could not be determined in 30 patients (23.62%).

**Conclusion:** CSP is a multifactorial clinical condition. We believe that rates of idiopathic cases, reported in the literature as 35-45%, can be reduced to 23.62%, as observed in our study, through a multidisciplinary approach that includes systematic evaluation and clinical consultations.

**Keywords:** Andrology, chronic scrotal pain, multidisciplinary approach, regional neuroanatomy

## Introduction

Chronic scrotal pain (CSP) is defined as intermittent or constant scrotal pain that lasts for at least three months and negatively affects quality of life (1). It is a condition frequently encountered in urological practice. However, diagnosis and treatment remain challenging due to its heterogeneous etiology and the frequent inability to identify a definitive cause.

According to the literature, approximately 1% of urology clinic visits—particularly those by young men—are related to CSP. In addition, complaints of scrotal pain account for 2-5% of outpatient urology visits (2,3).

The etiology of CSP is multifactorial. Infectious conditions, previous surgical interventions, vascular pathologies, neurogenic and musculoskeletal causes, as well as retroperitoneal and scrotal malignancies, have all been reported as potential etiological

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**Received:** 12.01.2026 **Accepted:** 13.02.2026 **Epub:** 23.02.2026 **Publication Date:** 02.03.2026

**Cite this article as:** Geyik S, Babayiğit M. Can the rate of idiopathic cases in chronic scrotal pain be reduced with an effective multidisciplinary approach? J Urol Surg. 2026;13(1):53-57.

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factors. Despite extensive evaluation, the etiology remains idiopathic in 35–45% of cases reported in the literature (4).

CSP is not only a physical symptom but also has significant negative effects on sexual function, psychosocial well-being, and overall quality of life (5). Therefore, a systematic evaluation and a multidisciplinary approach are essential, particularly for patients in whom an initial urological evaluation fails to identify a clear cause.

This study aims to evaluate the etiological distribution among patients presenting with CSP, to demonstrate the diagnostic contribution of a multidisciplinary approach, and to contribute to determining possible causes, especially in cases classified as idiopathic.

The aim of this study was to evaluate the etiological distribution among patients presenting with CSP, to demonstrate the diagnostic contribution of a multidisciplinary approach, and to identify possible underlying causes, especially in cases initially classified as idiopathic.

## Materials and Methods

### Study Design and Patient Selection

This retrospective study evaluated patients who presented to our urology clinic with complaints of CSP between January 2023 and June 2025. CSP was defined as intermittent or persistent pain localized to the scrotal contents lasting for at least three months.

Patients aged 18 years or older with scrotal pain persisting for at least three months and with complete clinical records and regular follow-up data were included in the study. Patients with acute genitourinary infections (acute epididymitis or prostatitis), patients with known or suspected scrotal or testicular malignancies, patients who developed acute scrotal pain due to trauma, and patients with insufficient clinical data or inadequate follow-up were excluded from the study.

### Clinical Evaluation

All patients underwent a standardized clinical assessment that included a detailed medical history and a comprehensive physical examination. Particular attention was paid to pain characteristics (duration, localization, laterality, and triggering factors), surgical history, infection history, and associated systemic or musculoskeletal symptoms.

Following the initial clinical assessment, a stepwise diagnostic approach was applied. Scrotal Doppler ultrasonography and laboratory investigations, including urinalysis, urine culture, and semen analysis when indicated, were routinely performed at the first visit to evaluate possible urological etiologies.

Patients in whom no urological pathology was identified on initial scrotal ultrasonography and laboratory tests underwent further evaluation at the second visit.

At the second visit, additional imaging studies, including abdominal or urinary tract ultrasonography and other cross-sectional imaging modalities when clinically indicated, were performed to further exclude urological causes of pain.

In patients in whom no urological etiology could be identified despite extended imaging and laboratory evaluation, a multidisciplinary assessment pathway was initiated. Symptoms suggestive of accompanying gastrointestinal or perianal pathology were re-evaluated in detail, and patients reporting such symptoms were referred to the Department of General Surgery for further assessment. Patients with findings indicative of neurogenic or musculoskeletal involvement, such as low back pain, radicular symptoms, or neuropathic pain characteristics, were evaluated by the Neurology and Neurosurgery departments. The results of all multidisciplinary consultations were incorporated into the final etiological classification.

Approval for this retrospective study was obtained from the Aksaray University Health Sciences Scientific Research Ethics Committee (approval number: 2025-144, date: 13.11.2025). The results were analyzed using descriptive statistics.

## Results

In this study, data from 246 patients who presented to our clinic with CSP between January 2023 and June 2025 were evaluated retrospectively. Forty-five patients with insufficient file and/or follow-up data, 43 with acute prostatitis or epididymitis, 20 evaluated for acute scrotal pain due to trauma, and 11 with detected testicular malignancy were excluded from the study. Consequently, a total of 127 patients were included in the study.

The mean age of the patients included in the study was 35 years (range, 18–66 years). The mean duration of pain was 6.6 months (3–18 months). When pain localization was evaluated, pain was unilateral in 40 patients (31.5%) and bilateral in 87 (68.5%).

When the etiological distribution was examined, infectious causes among the most frequent. A diagnosis of chronic epididymitis and chronic prostatitis was made in 25 patients (19.68%). Following medical treatment, including long-term antibiotic therapy combined with anti-inflammatory agents, complete resolution of pain was achieved in 10 patients, and significant reduction in pain was achieved in 15 patients (Table 1).

Among vascular causes, varicocele was detected in 27 patients (21.26%). Varicocelectomy was performed in 20 of these patients (74%); pain was eliminated in 12 (60%) and decreased in 8 (40%). Calcium dobesilate (2×1) was initiated in 7 patients

(26%) who preferred medical treatment; all reported a significant reduction in pain (Table 1).

CSP developing after surgery was observed in 18 patients (14.17%) who had undergone varicocelectomy or inguinal hernia repair. 12 patients (9.45%) had undergone inguinal hernia repair, and 6 (4.72%) had undergone varicocelectomy. None of the patients had a history of vasectomy. Analgesic and anti-inflammatory treatment was administered to all patients, resulting in pain reduction in all; however, complete pain relief was not achieved (Table 1).

In 57 patients (44.90%) in whom no etiology could be determined following urological evaluation, potential neurogenic, musculoskeletal, and perianal causes were investigated. After the second visit, perianal pathologies (18 anal fissures and 2 anal fistulas) were detected in 20 patients (15.75%) during consultation at the general surgery clinic. Two patients were operated on by the general surgery clinic for anal fistulas, and 10 patients were operated on for anal fissures; their pain completely resolved. Eight anal fissures treated medically showed a reduction in pain in all patients; however, complete pain relief was not achieved.

Neurogenic causes, such as lumbosacral radiculopathy or pudendal nerve irritation, were identified in 7 patients (5.51%) following consultation with the neurology clinic. Two patients underwent surgery and reported complete pain relief. five patients given medical treatment and physical therapy reported regression in pain; however, complete pain relief was not achieved (Table 1).

A total of 30 patients (23.62%) had no identifiable cause for their symptoms after urological and other clinical evaluations. Anti-inflammatory analgesics were prescribed for symptomatic relief. All patients reported that their pain remained unchanged. No patients with persistent pain accepted interventional treatment options, such as nerve blocks or spermatic cord denervation.

Data regarding the etiology, treatment, and outcomes of the patients included in the study are shown in Table 1.

## Discussion

CSP is a multifactorial clinical condition. Following a thorough anamnesis and examination, Evaluation must continue with imaging and consultations directed at the source of the pain. Recent large-scale reviews support the heterogeneity of this condition, emphasizing that patients often present with co-occurring genitourinary and musculoskeletal symptoms, underscoring the need for a standardized approach (6).

In a prospective study evaluating post-vasectomy pain syndrome in 488 patients, Leslie et al. (7) reported new-onset scrotal pain in 65 patients (14.7%). In our study, no patients presented with post-vasectomy pain. This is because only two vasectomies were performed in our clinic during the study period, and their follow-up records were not available. a recent national practice survey by Bettencourt et al. (8) found that, although vasectomy reversal is the guideline-recommended treatment for post-vasectomy pain, many urologists prefer microsurgical denervation because of financial barriers or practice patterns. Our lack of post-vasectomy cases prevents a direct comparison

**Table 1. Etiology, treatment, and outcomes of patients**

Etiology	Number of patients (n)	(%)	Treatment	Results
Infectious causes (chronic epididymitis, chronic prostatitis)	25	19.69%	Medical treatment (n=25)	No pain: 10 Less pain: 15
Vascular causes (varicocele)	27	21.26%	Varicocelectomy (n=20) Medical treatment (n=7)	Surgical: No pain: 12 Less pain: 8 Medical: No pain: 0 Less pain: 7
Post-surgical pain (inguinal hernia repair varicocelectomy, vasectomy)	18	14.17%	Medical treatment (n=18)	No pain: 0 Less pain: 18
Neurogenic/musculoskeletal (lumbosacral radiculopathy, pudendal nerve irritation)	7	5.51%	Lomber surgery (n=2) Medical treatment/physical therapy (n=5)	Lomber surgery: No pain: 2 Medical treatment/physical therapy Less pain: 5
Perianal pathologies (anal fissures, anal fistules)	20	15.75%	Surgery (n=12) Medical treatment (n=8)	Surgery: No pain: 12 Medical treatment Less pain: 8
Idiopathic	30	23.62%	Medical treatment (n=30)	Medical treatment: No improvement in pain

but highlights the variability in patient populations across centers.

In the literature, CSP has been reported at rates of approximately 10% after inguinal hernia repair and 8-15% after varicocelectomy (9,10). In our study, complaints of CSP secondary to surgery occurred in patients with a prior surgical history of varicocele and inguinal hernia repair. The recent study reported that urologists generally perceive conservative management as having a lower success rate than surgery (8). However, in our study analgesic and anti-inflammatory treatment was administered to both patient groups (12 post-inguinal hernia repairs, 6 post-varicocelectomies) without additional surgery; although their symptoms regressed significantly, complete pain relief was not achieved. This suggests that while conservative measures may not offer a complete cure for post-surgical neuropathic pain, they provide a meaningful reduction in symptoms without exposing the patient to the risks of reoperation.

In patients evaluated for infectious etiologies, CSP in prostate, epididymal, and testicular infections has been reported to be 11.5% in the literature (4). In our clinical study, this rate was determined to be 19.6%. The younger age group and limited awareness of sexually transmitted diseases may be reasons. It is crucial to distinguish between a diagnosed infection and empiric treatment. A recent retrospective analysis by Lam et al. (6) found that, although 42% of CSP patients were treated with antibiotics, only 7.6% achieved complete resolution, indicating a high rate of ineffective empiric antibiotic use. In our study, following medical treatment administered to these patients, complete resolution of pain was achieved in 10 patients (40%), and a significant reduction in pain was achieved in 15 patients. Our study focused on targeted therapy for confirmed chronic prostatitis and epididymitis, which may explain our higher success rates than those reported for empirical approaches in the literature. We also believe that younger, more sexually active patients positively influenced the success of our prostatitis treatment.

Classically, the presence of a varicocele can cause testicular pain, and surgical treatment is highly effective in relieving this pain (11). Varicocele was present in 18.1% (23 patients) of patients in our study. Among the 15 patients recommended for operation, pain was eliminated in 60%, while it regressed in 20%. The literature also reports that pain resolved in up to 70% of surgically treated patients (12).

Among neurogenic and musculoskeletal causes, lumbosacral radiculopathies or pudendal nerve irritations can also contribute to CSP via the neuroanatomical connections of the penoscrotal region (13-15). This regional neuroanatomy is one of the most important justifications for a multidisciplinary approach to patient care. Our findings align with Lam et al.

(6), who reported that approximately 40% of men presenting with CSP experienced co-occurring low-back pain associated with functional disability, and nearly 66% had hip symptoms. In our study, lumbar and perianal pathologies were detected in 27 patients (21.26%). While a recent survey revealed that "reassurance" is the most frequent first-line strategy among urologists, our results demonstrate that active multidisciplinary intervention yields better outcomes (8). Twelve patients were completely relieved of pain by surgical treatment in the general surgery clinic and 2 by surgical treatment in the neurosurgery clinic; medical treatment was administered to the remaining 13 patients in the relevant clinics. All patients experienced a significant reduction in pain.

The results obtained in our own clinical study show that CSP has a multifactorial etiology, consistent with the literature. Although patients primarily present to urology clinics, an effective multidisciplinary approach is essential because of etiological heterogeneity. Contemporary literature and practice pattern surveys continue to cite idiopathic rates as high as 40-50%. Reducing these idiopathic case rates to 23.62%, as observed in our study, is possible with an effective multidisciplinary approach (4). This significant reduction suggests that a subset of "idiopathic" patients in the general population actually suffer from undiagnosed, treatable non-urological pathologies.

### Study Limitations

The present study has several limitations. First, its retrospective and single-center design may limit the generalizability of the findings. Although vasectomy is frequently reported in the literature as an important cause of post-surgical CSP, only two vasectomies were performed at our institution during the study period because of cultural and traditional factors. Therefore, the relationship between vasectomy and CSP could not be adequately evaluated. Another limitation is the absence of a standardized pain scoring system, which restricts the objective quantification of pain severity and treatment response. Consequently, outcome assessment was primarily based on patients' subjective reports.

### Conclusion

CSP is a multifactorial clinical condition that is difficult to diagnose and treat. Primarily, a systematic investigation into the etiology of the pain is required. That idiopathic cases in our study were lower than in the literature indicates that a multidisciplinary approach involving systematic evaluation and multiple consultations that consider regional neuroanatomy is critical for treatment success.

### Ethics

**Ethics Committee Approval:** Approval for this retrospective study was obtained from the Aksaray University Health Sciences

Scientific Research Ethics Committee (approval number: 2025-144, date: 13.11.2025).

**Informed Consent:** Retrospective study.

## Footnotes

### Authorship Contributions

Surgical and Medical Practices: S.G., M.B., Concept: S.G., Design: S.G., Data Collection or Processing: S.G., M.B., Analysis or Interpretation: M.B., Literature Search: S.G., Writing: S.G., M.B.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study received no financial support.

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# Laparoscopic Y-V Pyeloplasty on a Horseshoe Kidney with Perc-Ncircle Mediated Stone Extraction from the Trocar Port

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## Abstract

This study features laparoscopic stone surgery and Y-V plasty procedure performed on a 26-year-old female patient presenting with a horseshoe kidney and multiple renal calculi. Port site extraction of ureteric stone allowed successful removal of stones from the renal pelvis and the upper calyx, thereby maintaining the minimally invasive nature of the surgery and obviating the need for the use of specimen retrieval bags. This case underscores the intricacies of managing stone disease with congenital anomalies and emphasizes the utility of laparoscopic surgery combined with endourological elements for its flexibility and adaptability.

**Keywords:** Horseshoe kidney, laparoscopy, V-Y pyeloplasty

## Introduction

Horseshoe kidney is a congenital malformation with an incidence of 1/500 (1,2). This specific malformation occurs as a result of the kidney's ascent being impeded by the inferior mesenteric artery (3). A significant portion, roughly 30-60%, of individuals with horseshoe kidneys may present with kidney stones. These individuals are at a higher risk for ureteropelvic junction obstruction development and prone to developing stone disease with metabolic origin throughout their lives (4). Depending on the size and location of the stones in affected patients, treatments such as ureteroscopy (URS), extracorporeal shock wave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), or laparoscopic pyelolithotomy can be opted for.

Studies comparing the surgical outcomes of URS and ESWL in patients with horseshoe kidney anomalies and nephrolithiasis signify that URS tends to offer higher stone-free rates (5-9); yet there is still no consensus regarding the superiority of the treatment modalities over the other for horseshoe kidneys with stones larger than 2 cm (9). While percutaneous nephrolithotomy is the preferred treatment in most cases, a meta-analysis conducted by Wang et al. (10) in 2013 revealed that laparoscopic pyelolithotomy outperformed PCNL in terms

of both stone-free rates and postoperative complications for patients with stones larger than 2 cm and a horseshoe kidney. Today, with advancements in laparoscopic techniques (i.e., hand assisted laparoscopy, single port surgery), varieties of URS-nephroscopes, and emerging laser technologies stone treatment can be carried out in various ways during a laparoscopic surgical setting. The ports used in laparoscopy allow the use of various endourological instruments in both transperitoneal and retroperitoneal routes (11-13). In this study, we aimed to share video footage of a patient with a horseshoe kidney and a 2 cm stone at the right ureteropelvic junction, using a combination of laparoscopic and endourological tools (Video 1).

## Case Presentation

A 26-year-old female patient presented to our outpatient clinic with an excruciating left-flank pain and left-sided abdominal pain. Patient underwent a subsequent computed tomography scan which revealed a horseshoe kidney with a bifid fused extrarenal pelvis on left side. A calculus with a diameter of 18 mm was observed inside the left portion of the pelvis alongside 4 mm and 4.5 mm calyceal stones on the left kidney. After a shared decision-making process, the patient agreed to undergo laparoscopic stone removal and Y-V pyeloplasty.

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**Received:** 28.11.2023 **Accepted:** 08.05.2025 **Epub:** 30.06.2025 **Publication Date:** 02.03.2026

**Cite this article as:** Gültekin MH, Dereköylü E, Özden SB, Önal B. Laparoscopic Y-V pyeloplasty on a horseshoe kidney with perc-ncircle mediated stone extraction from the trocar port. J Urol Surg. 2026;13(1):58-60.

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In the operating room, under general anesthesia, the patient was placed in a left semi-lumbotomy position. After surgical prepping and draping, a Veress needle-guided access was undertaken through the left edge of the umbilicus. As the inflation had been completed, a 10 mm trocar was inserted into the Veress puncture site. By using the camera through the initial port, an additional 10 mm port was inserted 8 cm caudal to the camera port midway between iliac spine and umbilicus, and a 5 mm port was inserted below the subcostal arch corresponding to "Palmer Point". Following the transperitoneal access, a window into the mesentery was opened and the bulging pelvis was exposed circumferentially. A sling suture was applied using 3.0 polypropylene suture material to indent renal pelvis. Using laparoscopic scissors, sharp dissection was performed along the renal pelvis. A laparoscopic hook and grasper were used together to extract the large stone. The stone was then grasped using Perc-Neircle and extracted from the 10 mm trocar in proximity to the iliac spine. The trocar port was then replaced and a semirigid 7 Fr URS was introduced through the 10 mm port in adjunct with a laparoscopic aspirator inserted through the 5 mm port. The calyceal stones were also removed using a nitinol stone retrieval basket advanced through the URS. The ureter was spatulated 2-3 cm along its vertical axis, and the defect was closed using 4.0 polyglactin suture in a watertight fashion. A drain was placed through the 5 mm trocar port at the end of the surgery. The drain was removed on the 5<sup>th</sup> day. No complications regarding the surgery were identified during the follow up at the 1<sup>st</sup> and 3<sup>rd</sup> month after the surgery.

## Discussion

Horseshoe kidney occurs around the 8<sup>th</sup> gestational week due to the fusion of the inferior poles of both kidneys below the level of the inferior mesenteric artery (1). Patients are generally prone to stone formation and infections (2,4,5). Laparoscopic pyelolithotomy on anomalous kidneys was first described by Maheshwari et al. (14) in 2004. Since then, several publications have been published featuring the laparoscopic treatment of stone disease in anomalous kidneys. The surgery usually requires flexibility and there is no predefined cut-and-dried methodological approach hence the stone composition, accessibility of the stones, stone burden and the anatomy of the patient may necessitate varying approaches to provide a stone free outcome (1,3,5,7-9). Despite the lack of evidence-based data, there are several case-based studies combining the elements of endourology with laparoscopy reporting excellent outcomes (12,15,16). Even though the anterior PCNL combined with flexible URS is the emerging trend defined in recent years, minimally invasive characteristics and the surgical outcome of the procedure on the anomalous kidney remain controversial (17). The laparoscopic approach combined with endourological

elements, on the other hand, was found to be feasible and safe in case-based studies. The evidence level of these data are also low, due to lack of prospective and retrospective cohort studies (12,15,16).

## Conclusion

Surgical interventions in patients with horseshoe kidneys necessitate flexibility. This case exemplifies the management of a complex stone disease on an anomalous kidney and demonstrates that laparoscopic approach combined with endourological elements is feasible and safe to perform.



Video 1.

## Ethics

**Informed Consent:** Retrospective study.

## Footnotes

### Authorship Contributions

Surgical and Medical Practices: M.H.G., E.D., S.B.Ö., B.Ö., Concept: M.H.G., E.D., S.B.Ö., B.Ö., Design: M.H.G., E.D., S.B.Ö., B.Ö., Data Collection or Processing: M.H.G., E.D., S.B.Ö., B.Ö., Analysis or Interpretation: M.H.G., E.D., S.B.Ö., B.Ö., Literature Search: M.H.G., E.D., S.B.Ö., B.Ö., Writing: M.H.G., E.D., S.B.Ö., B.Ö.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declare that they received no financial support for this study.

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## Letter to the Editor: "Satisfaction and Quality of Life of Elderly Women with Pelvic Organ Prolapse Undergone Colpocleisis"

© Ahmet Burak Yılmaz

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### Dear Editor,

I read with great interest the article by Rajabzadeh et al. (1), "Satisfaction and Quality of Life of Elderly Women with Pelvic Organ Prolapse Who Have Undergone Colpocleisis". The study offers valuable insight into the outcomes of colpocleisis in elderly women with pelvic organ prolapse—an important but often overlooked topic in urogynecologic research. Although the results are promising, several methodological limitations warrant critical evaluation.

The study has several strengths. Using standardized tools like the pelvic organ prolapse (POP)-quantification system and short form-36 (SF-36) provides reliable assessment of anatomical and functional outcomes. Having the same expert team perform surgeries at two centers also reduces variability in the procedures. The postoperative results—complete absence of POP stage >II and significant reduction in urinary incontinence (from 10.37% to 4.71%,  $p < 0.001$ )—highlight both objective success and clinical benefit. The reported high patient satisfaction and absence of regret suggest appropriate patient selection and thorough preoperative counseling, particularly regarding expectations for sexual activity.

Nonetheless, certain limitations merit attention. The retrospective design limits the ability to draw causal conclusions and may introduce selection and information bias (2). Without a comparison group—such as patients undergoing reconstructive surgery or expectant management—it is difficult to attribute the improvements directly to colpocleisis. The small sample size and its restriction to a single region in Iran (106 patients) reduce the generalizability of the findings. In addition, the use of self-reported SF-36 data adds a degree of subjectivity, which may be affected by recall or social desirability bias (3). Of particular

concern is the report of zero postoperative complications, despite a cohort with substantial comorbidity (30.8% with two or more comorbidities). This raises the possibility of underreporting or insufficient systematic complication monitoring. Greater transparency in perioperative assessment protocols would strengthen the study's clinical relevance.

While the authors acknowledge the limitation of lacking a control group, the absence of any discussion on possible selection bias or confounding variables—such as variation in surgical technique or presence of occult incontinence—is a missed opportunity. Also, the claim of no regret may reflect cultural or demographic specificity, as previous studies have reported post-colpocleisis regret and body image concerns (4). A brief discussion addressing these discrepancies would add nuance to the findings.

In conclusion, Rajabzadeh et al. (1) contribute to the growing evidence supporting colpocleisis as a safe and effective option for elderly women with advanced POP. However, the study's retrospective design, absence of a control arm, modest sample size, and lack of complication reporting warrant cautious interpretation. Future prospective, multicenter, randomized trials with standardized outcome reporting and longer follow-up are needed to validate these findings and inform clinical decision-making.

### Ethics

**Informed Consent:** Retrospective study.

### Footnotes

**Conflict of Interest:** No conflict of interest was declared by the author.

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**Received:** 13.06.2025 **Accepted:** 17.06.2025 **Epub:** 26.06.2025 **Publication Date:** 02.03.2026

**Cite this article as:** Yılmaz AB. Letter to the editor: "satisfaction and quality of life of elderly women with pelvic organ prolapse undergone colpocleisis". J Urol Surg. 2026;13(1):61-62.

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**Financial Disclosure:** The author declared that this study received no financial support.

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# A Novel Technique for Stent Placement During Ureteroureterostomy

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## Abstract

Ureteroureterostomy is a surgical procedure involving the end-to-end anastomosis of transected ureters, often supplemented with ureteral stenting to promote healing and prevent strictures. Traditional stent placement methods, such as cystoscopy-guided or fluoroscopic techniques, can be resource-intensive and time-consuming. In this study, we introduce a novel, resource-efficient technique for intraoperative ureteral stent placement that eliminates the need for patient repositioning, cystoscopy, or additional guidance modalities. The method involves a modified Double J stent with a longitudinal incision at the predicted site of anastomosis, facilitating guidewire insertion and stent placement over the wire without repositioning or specialized equipment. We demonstrate the applicability of this technique across various clinical scenarios, including ureteral strictures, traumatic injuries, and oncologic resections, with no observed instances of stent malposition or retention. This approach offers a simplified, cost-effective alternative to existing methods, potentially reducing operative time and resource utilization during ureteroureterostomy procedures.

**Keywords:** Endourology, general urology, reconstructive urology

## Introduction

Ureteroureterostomy is a surgical procedure in which two parts of a transected ureter are anastomosed, in an end-to-end fashion. The procedure can be done by laparotomy or laparoscopy (1).

A ureteral stent is commonly employed in this procedure with the intent to assist with healing of the anastomosis and urinary drainage. Ureteral stenting may prevent recurrent strictures as shown in experimental animal studies (2).

There are several methods for intraoperative stenting, including using visual guidance, cystoscopy guidance, fluoroscopic guidance, and so on (1,3,4). These techniques may be cumbersome and inefficient in terms of resource use.

In the present study, we propose a new method for stent placement during ureteroureterostomy that does not require repositioning or cystoscopy and may decrease surgical time.

## Surgical Technique

Depending on the level of injury (and thus the expected location of ureteroureterostomy), an incision was made to access both ureters, typically via a lower abdominal approach. The ureters were carefully dissected free from surrounding tissues, and any diseased segment of the affected ureter was excised as needed. The ends of both ureters were spatulated longitudinally at 12 and 6 o'clock (approximately 1-2 cm) to create wide openings. The ureters were then approximated and brought close together without tension.

The ureters were sutured end-to-end using interrupted absorbable sutures (4-0 Vicryl), with careful placement through the mucosa and submucosa of both ends to ensure a watertight, tension-free anastomosis (5). A multi-length, 26 cm, 6 Fr Boston Scientific ureteral stent (Boston Scientific, Marlborough, MA, USA) is prepared for insertion. The stent is modified by a 1-2 cm through-and-through or one-sided longitudinal incision using a scalpel. The incision corresponds to the predicted level of

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**Received:** 19.06.2025 **Accepted:** 11.08.2025 **Epub:** 13.08.2025 **Publication Date:** 02.03.2026

**Cite this article as:** Taha T, Malinger A, Tsivian M, Tsivian A. A novel technique for stent placement during ureteroureterostomy. J Urol Surg. 2026;13(1):63-65.



anastomosis (Figure 1). For example, if the level of anastomosis is predicted to be 3 cm from the ureteropelvic junction, the incision in the stent is centered at about 3 cm from the proximal mark on the stent. The stent is then introduced into the abdomen. We locate the distal end of the ureter and pass the stent to reach the bladder. Then, we insert the guidewire through the incision in the stent proximally until it reaches the renal pelvis before the stent is inserted into the ureter over it. The wire is then removed through the incision in the stent. Finally, we perform ureter reconstruction with interrupted sutures without tension over the stent. All steps of the technique are depicted in Figure 2.

We use this technique in several scenarios, such as ureteral stricture repair, iatrogenic transection of the ureter, segmental ureteroureterostomy in patients with transitional cell carcinoma, ureterolithotomy, and trauma surgery, such as in the cases of gunshot wounds during minimally invasive or open surgery. In

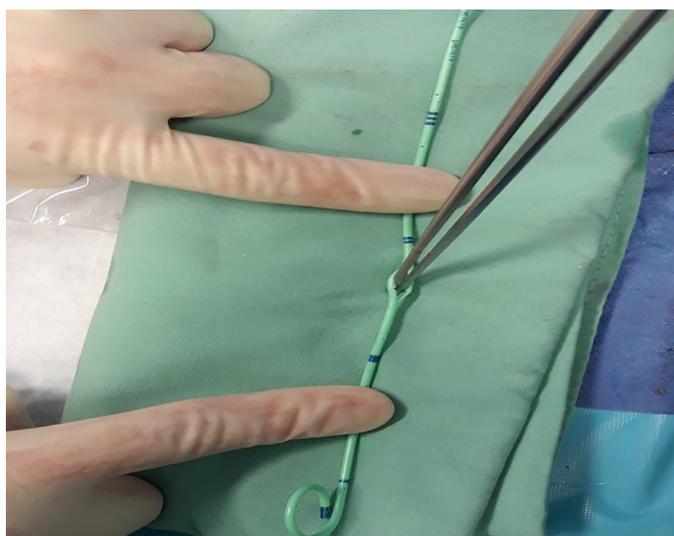


Figure 1. An incision is made in the stent

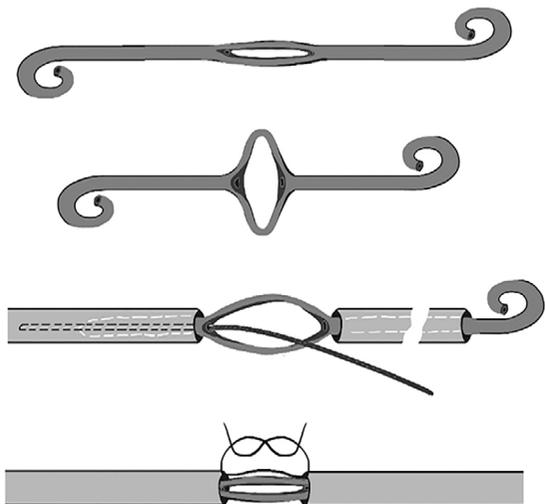


Figure 2. Steps depiction

our experience, we did not note occurrences of retained stent fragments or malpositions of the stents (Table 1).

## Discussion

During laparoscopy and open surgery alike, stent insertion may be technically difficult and time-consuming. The most common method of stent insertion during laparoscopic procedures is through retrograde cystoscopy, but this method requires repositioning the patient in a lithotomy position, the use of additional sterile equipment, and is time-consuming (1); others described an antegrade fashion through a nephrostomy. During open surgery, a stent can be placed at the end of the operation, mostly via retrograde cystoscopy.

In 2023 Limbachiya et al. (6) described positioning the patient in low Trendelenburg before initiating the laparoscopic ureteroureterostomy so that cystoscopy and ureteral stent could be performed without the need to reposition the patient. A guide wire is inserted into the ureter and advanced under vision through the distal ureteral end into the proximal ureteral end, following the stent placement process in the same manner.

Stent placement in both directions through the open ureter has been reported on one occasion. In 2008, Brichart et al. (7) described a way to insert the stent with only laparoscopy. First, they inserted a guidewire into the bladder via the distal ureteral end and passed a stent over it until it reached the bladder. The guidewire was then removed from the stent, and a second guidewire was placed in the stent through one of its lateral side holes. This allowed the stent to be placed in the renal pelvis. The guide wire was then removed, and the ureter was sutured over

Variable	n (%)
No. of patients	12
Mean age, years	56
<b>Gender</b>	
Male	3
Female	9
<b>Side</b>	
Right	6
Left	6
<b>Location of the injury</b>	
Lumbar	8
Pelvic	4
<b>Surgical approach</b>	
Open	8
Lap	4
Surgical success	100%
Malposition rate of the stent	0

the stent with interrupted sutures. The problem this method presents, is that the second guidewire needs to be very small, so as to pass through the side holes.

## Conclusion

In the present report, we propose a new technique for ureteral stent placement during ureteroureterostomy that does not require patient repositioning or use of cystoscopy or other guidance methods, and is resource efficient.

## Ethics

**Informed Consent:** Informed consent was obtained from the patient.

## Footnotes

### Authorship Contributions

Surgical and Medical Practices: A.T., Concept: M.T., A.T., Design: M.T., A.T., Data Collection or Processing: A.M., Analysis or Interpretation: T.T., Literature Search: T.T., Writing: T.T.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study received no financial support.

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# Testicular Mass: Is Orchiectomy Necessary? A Case Report

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## Abstract

Testicular fibrous pseudotumor is a rare benign condition. It is often mistaken for malignant testicular masses, leading to unnecessary orchiectomies in many patients. We present a case of a 23-year-old male with a painless and enlarging mass in his left testis. Tumor markers were within normal limits, and imaging studies, including ultrasound and magnetic resonance imaging, could not definitively differentiate between a benign and malignant mass. During surgery, intraoperative frozen section analysis did not reveal malignancy, so the mass was excised en bloc with its capsule, sparing the testis and spermatic cord, thus avoiding unnecessary orchiectomy.

**Keywords:** Benign, case report, testicular tumor, fibrous pseudotumor

## Introduction

Testicular fibrous pseudotumor is a rare inflammatory fibroproliferative disorder. Its clinical significance lies in its ability to mimic testicular tumors during physical examination. As a result, in cases where tumor markers are normal, unnecessary orchiectomies are often performed under the suspicion of a "burned-out" tumor. Here, we present the case of a 23-year-old patient who visited our clinic with a testicular mass in June 2024.

## Case Presentation

A 23-year-old male presented to our clinic, after noticing a mass approximately 3 cm in size in his left scrotum four months earlier. Physical examination revealed a firm, poorly defined mass approximately 4x3 cm in size at the upper pole of the left testis, which was non-tender and without discharge. The boundaries between the left testis and the mass were unclear, while the inferior part of the left testis appeared normal. The right scrotum and testis were also normal. No palpable lymph node enlargement was detected in the bilateral inguinal regions. The patient had no history of fever, pain, difficulty urinating, hematuria, suspicious sexual contact, or previous urogenital surgery. Tumor markers were within normal limits (beta- human chorionic gonadotropin): <2.39 mIU/mL, (alpha-fetoprotein): 5.42 ng/mL, and lactate dehydrogenase: 146.1 U/L). Scrotal

Doppler ultrasound revealed a solid, partially heterogeneous, 35x20 mm mass in the head of the left epididymis with calcifications causing the posterior acoustic shadowing. Magnetic resonance imaging (MRI) showed a 38x35 mm well-defined solid lesion, T2 hypointense and T1 iso-hypointense, located extratesticularly, and suspected to originate from the epididymis, in the left scrotal region adjacent to the superior part of the testis. Diffusion-weighted imaging demonstrated significant diffusion restriction in the lesion, and post-contrast images showed marked contrast enhancement (Figure 1). Through a left inguinal incision, the spermatic cord and testis were mobilized en bloc without ligating the cord. The mass was found to originate from the tunica vaginalis, independent of the spermatic cord, epididymis, and testis tissue. A total of five masses, the largest being 5x6 mm, were identified along the tunica parietalis. The 38x35 mm mass at the superior pole of the testis was excised en bloc without damaging the spermatic cord, testis, or epididymis using sharp and blunt dissection. The other five masses were also excised. Intraoperative frozen section analysis of the mass did not indicate malignancy, so the testis was returned to the scrotum, and the procedure was completed. The mass was encapsulated, homogeneous, and shiny white in appearance, with no necrosis or calcification (Figure 2). The patient was discharged on the first postoperative day. Pathology confirmed the diagnosis of fibrous pseudotumor (Figure 3). Written informed consent for publication of the case details.

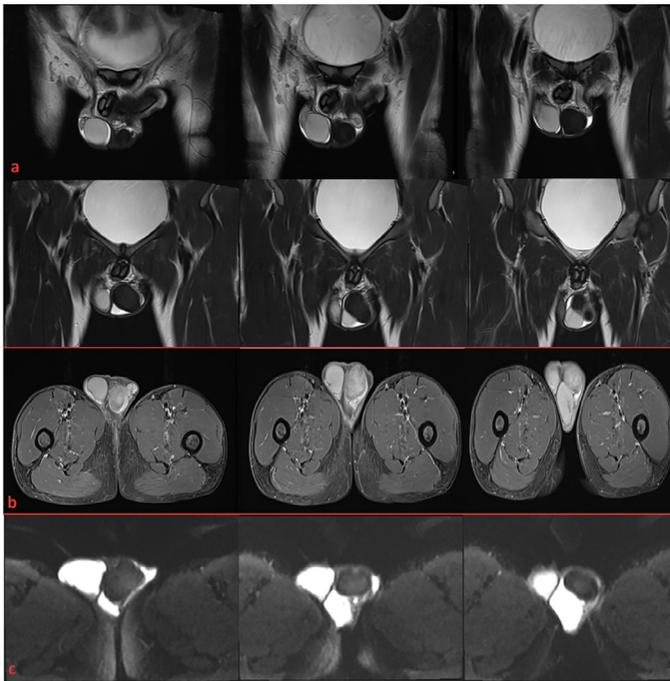
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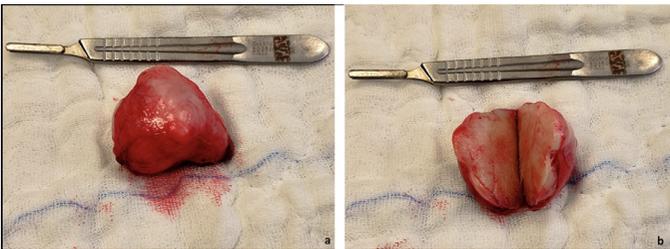
**Received:** 11.09.2024 **Accepted:** 25.11.2024 **Publication Date:** 02.03.2026

**Cite this article as:** Özer MS, Akan G. Testicular mass: is orchiectomy necessary? A case report. J Urol Surg. 2026;13(1):66-68.

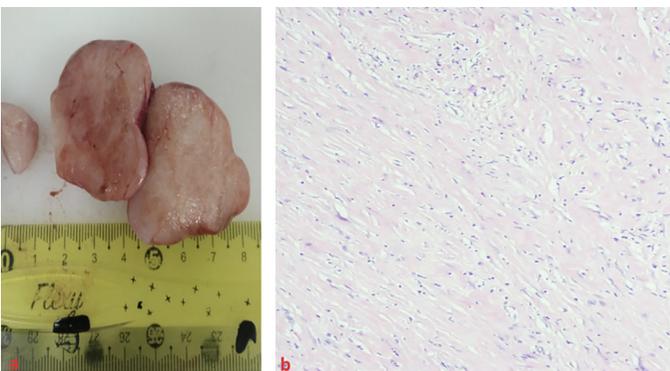




**Figure 1.** Magnetic resonance images of the mass (a. T2 coronal, b. transverse, c. transverse diffusion)



**Figure 2.** Intraoperative view of the mass (a. excised with its capsule, b. midline incision homogeneous grayish interior)



**Figure 3.** Pathological examination of the mass (a. macroscopic view, b. H&E $\times$ 100 showing collagen-rich fibrous stroma without atypia, necrosis or mitosis)

H&E: Hematoxylin and eosin

## Discussion

Testicular fibrous pseudotumor is a rare disease, with limited detailed information on its epidemiology or prevalence. There

are over 20 case reports in the literature (1-6). In a retrospective study by Bařal et al. (1), only 2 out of 838 patients operated on for testicular mass were diagnosed with testicular fibrous pseudotumor. Although most patients are aged 20-30, cases have also been reported in pediatric and elderly patients (1,7). The exact etiology is unclear, but the benign lesion originates from the tunica vaginalis, and an abnormal inflammatory response is thought to play a role in its pathophysiology (8). Some studies suggest that IgG4-related sclerosis may contribute to the tumor's formation (8). Its clinical significance lies in its ability to mimic testicular tumors on physical examination. Benign testicular masses generally do not elevate tumor markers. In some cases, ultrasound may be insufficient for differential diagnosis. In such situations, diffusion MRI or intraoperative frozen section analysis can aid in differentiation, particularly when the boundaries of the lesion are unclear or when imaging does not provide a definitive description. Frozen section analysis can help prevent unnecessary radical orchiectomy. Since it is a benign mass, complete excision of the lesion and its components is sufficient for treatment. The prognosis is excellent, with no reported cases of recurrence or progression in the literature.

## Conclusion

Testicular fibrous pseudotumor is a benign condition often mistaken for malignant masses in young men, leading to unnecessary treatment. Intraoperative frozen section analysis is beneficial to avoid unnecessary orchiectomy. The success of the treatment is determined by the complete excision of the lesions along with their capsules.

## Ethics

**Informed Consent:** Written informed consent for publication of the case details.

## Footnotes

## Authorship Contributions

Surgical and Medical Practices: M.S.Ö., G.A., Concept: M.S.Ö., G.A., Design: M.S.Ö., G.A., Data Collection or Processing: M.S.Ö., Literature Search: M.S.Ö., Writing: M.S.Ö.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study received no financial support.

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# Complex Urological Reconstruction in a Case of Bladder Mesh Erosion Following Inguinal Hernioplasty with Genitourinary Tuberculosis and Small Capacity Bladder

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## Abstract

Mesh migration into the urinary bladder is an uncommon complication after inguinal hernia repair. Studies have shown that mesh erosion commonly affects the urinary bladder. This report presents a 49-year-old patient with mesh erosion into the urinary bladder following an inguinal hernioplasty, alongside genitourinary tuberculosis (GUTB) and a small bladder capacity. The successful outcome of complex reconstruction highlights the importance of a tailored, multidisciplinary approach in managing rare complications like bladder mesh erosion. This case is unique due to the coexistence of GUTB and mesh erosion, which has been unreported in literature.

**Keywords:** Bladder mesh erosion, genitourinary tuberculosis, mesh migration

## Introduction

Mesh erosion into the urinary bladder is a rare but serious complication of hernia repair surgeries, typically occurring several years later. While prosthetic mesh has reduced recurrence rates, its increased use has led to complications like mesh migration and erosion into adjacent organs (1). Symptoms include recurrent urinary tract infections, hematuria, and lower urinary tract issues, sometimes mimicking malignancy (2). In severe cases, it may cause fistula formation and bladder stones. This case report describes a patient with genitourinary tuberculosis (GUTB) and small bladder capacity, who experienced mesh erosion years after inguinal hernioplasty, highlighting delayed presentation and surgical challenges.

## Case Presentation

A 49-year-old patient presented with complaints of lower urinary tract symptoms (LUTS), including increased daytime frequency, nocturia, urgency, straining, poor urinary flow, and a

persistent sense of incomplete voiding. He reported experiencing multiple episodes of gross painful hematuria over the past two years, each episode resolving within 2-3 days.

The patient's medical history includes a laparoscopic right inguinal hernioplasty performed in 2013, though relevant records were not available. There was no history suggestive of pulmonary tuberculosis or contact with infected individuals. He was further evaluated for GUTB, after urine samples tested positive for acid-fast bacilli. He completed a nine-month course of antitubercular therapy in 2021.

Further diagnostic workup included an ultrasound, which showed normal bilateral upper tracts, a partially distended urinary bladder, and an echogenic focus measuring approximately 3 cm. Computed tomography urography confirmed normal bilateral upper tracts and revealed a contracted bladder with fibrotic wall thickening measuring 8.4 mm. A dystrophic bladder calculus measuring 3.7 x 2.2 cm was noted within the bladder lumen (Figure 1A).

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**Received:** 31.10.2024 **Accepted:** 13.01.2025 **Epub:** 18.04.2025 **Publication Date:** 02.03.2026

**Cite this article as:** Saini A, Sharma U, Paighan NM. Complex urological reconstruction in a case of bladder mesh erosion following inguinal hernioplasty with genitourinary tuberculosis and small capacity bladder. J Urol Surg. 2026;13(1):69-71.

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A retrograde urethrogram indicated subtle irregularities in the penile and bulbar urethra, while a micturating urethrogram could not be properly performed due to the patient's inability to hold urine during the filling phase, attributed to a reduced bladder capacity (Figure 1B).

The patient was scheduled for cystoscopy and subsequent intervention. Intraoperative findings revealed a normal external urethral meatus, an unhealthy anterior urethra, and a healthy posterior urethra. The urinary bladder mucosa appeared inflamed; mesh erosion with encrustations was observed on the anterior bladder wall. Bladder capacity was estimated at approximately 80 mL. The procedure concluded with a Johansson stage I urethroplasty.

The patient was further planned for laparoscopic mesh removal with Augmentation Ileocystoplasty and bilateral ureteric reimplantation after 3 months. Intraoperatively, the mesh was found eroding through the anterior bladder wall, into the bladder lumen. Mesh was dissected and removed (Figure 2). The procedure required conversion to open surgery due to dense adhesions surrounding adjacent structures. An infraumbilical incision was made, and the fibrotic bladder wall was excised and augmented using 20 cm of ileum. Bilateral Lich-Gregoir ureteric reimplantation was subsequently performed.

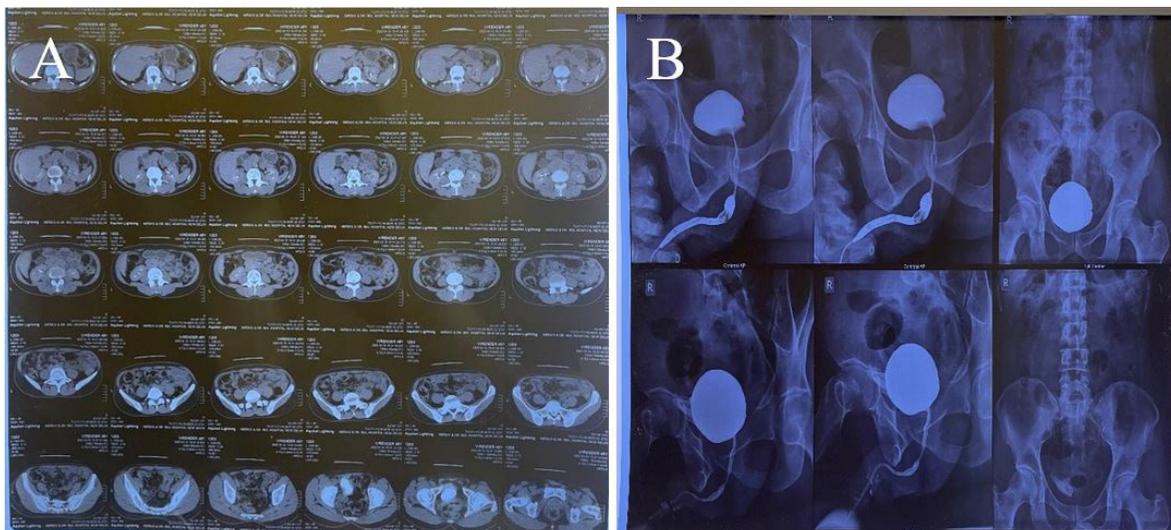
## Discussion

Mesh erosion into the urinary bladder is an infrequent but severe complication following hernia repair, most commonly associated with laparoscopic procedures such as transabdominal

preperitoneal (TAPP) and totally extraperitoneal (TEP), repairs (3). In a review of published reports on mesh erosion into the urinary bladder, 21 cases were identified. Of these, 11 cases occurred after laparoscopic procedures (either TEP or TAPP), while in four cases, the specific laparoscopic method was not specified. Additionally, only one documented case was associated with the Liechtenstein repair technique (4). The mechanisms behind this phenomenon are still debated, but are generally categorized into two pathways: mechanical migration and erosion due to chronic inflammation. Mechanical migration occurs when the mesh is inadequately fixed during surgery or experiences displacement due to external forces. Erosion, on the other hand, is a slower, more insidious process where chronic inflammation from the body's reaction to the foreign material gradually wears away tissue, leading to mesh penetration into the bladder (4).

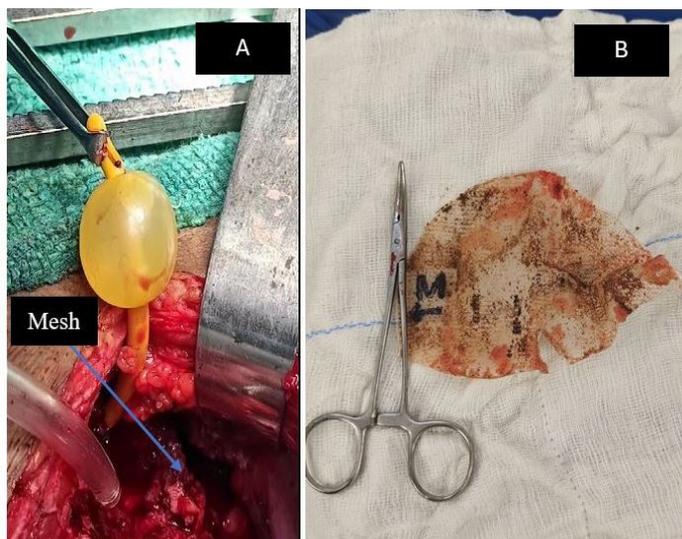
The latency period for the manifestation of mesh erosion can vary significantly, from a few months to over 20 years after the initial surgery (3). The patient in this case presented with symptoms four years after the original hernia repair, aligning with literature that suggests long-term inflammation or low-grade infection could precipitate such complications. In cases where recurrent urinary tract infections are accompanied by symptoms like dysuria or hematuria, mesh erosion should be a differential diagnosis, especially in patients with a history of hernia repair.

Management of mesh erosion into the bladder typically involves surgical intervention. Minimally invasive techniques such as laparoscopy have emerged, offering the advantages of reduced



**Figure 1.** A. CT urography showing a reduced capacity urinary bladder with a dystrophic calcification inside the lumen. B. Retrograde urethrogram indicated subtle irregularities in the penile and bulbar urethra

CT: Computed tomography



**Figure 2.** Intraoperative view. **A.** Depicting an intraoperative mesh following cystostomy. **B.** Display of the mesh post removal

post-operative pain, faster recovery and shorter hospital stays. However, laparoscopic management is often complicated by the extent of adhesions and the precise location of the mesh. In cases where the mesh has deeply eroded into the bladder, complete removal may be challenging (5).

In this case, the patient was diagnosed with GUTB and he underwent stage I urethroplasty first due to urethral stricture. He experienced Storage LUTS and was found to have a small capacity bladder, which could have two possible explanations, either due to GUTB or chronic inflammation due to mesh erosion. Later removal of the eroded mesh, along with augmentation ileocystoplasty and bilateral ureteric reimplantation, was performed successfully. The patient recovered without complications, highlighting the efficacy of this unique reconstructive approach when performed by experienced surgeons.

## Conclusion

Mesh erosion into the urinary bladder is a serious complication that requires careful diagnosis and timely surgical intervention. While minimally invasive techniques such as laparoscopic removal offer significant benefits, the complexity of each case must be assessed individually to determine the most appropriate management strategy. This case was unique and complex as the

patient was diagnosed with GUTB having small bladder capacity and a stricture in the urethra. The patient was systematically investigated and managed. No such case is present in the literature of a patient diagnosed with GUTB and stricture urethra, who concomitantly has mesh erosion into the urinary bladder, further requiring a complex reconstructive procedure. Highlighting the importance of such a case is necessary to have a systematic approach to management.

## Bottom of Form

Written informed consent was obtained from the patient and his parents for the publication of this case report and any accompanying images.

## Ethics

**Informed Consent:** Written informed consent was obtained from the patient and his parents for the publication of this case report and any accompanying images.

## Footnotes

### Authorship Contributions

Surgical and Medical Practices: A.S., N.M.P., Concept: A.S., U.S., Design: A.S., U.S., N.M.P., Analysis or Interpretation: N.M.P., Literature Search: A.S., N.M.P., Writing: A.S., N.M.P.

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The author declared that this study received no financial support.

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