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Comparison of Regional and General Anesthesia in Ureterorenoscopic Management of Distal Ureteral Stones: A Prospective Randomized Study

Distal Üreter Taşlarının Üreterorenoskopik Tedavisinde Bölgesel ve Genel Anestezinin Karşılaştırılması: Prospektif Randomize Bir Çalışma

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Abstract

Objective: To compare the effects of regional (spinal) and general anesthesia (GA) on surgical outcomes, perioperative complications, postoperative pain, and surgeon comfort in patients undergoing ureterorenoscopy (URS) for distal ureteral stones.

Method: This prospective, randomized clinical study included patients undergoing URS for distal ureteral calculi at a tertiary academic center between January 2024 and March 2025. Patients were allocated to either the GA or regional anesthesia (RA) group. Baseline demographics, operative parameters, postoperative pain scores [visual analogue scale (VAS)], analgesic requirements, and surgeon comfort were recorded and statistically compared.

Results: A total of 180 patients were included (90 in each group). Demographic and stone characteristics were similar between the two groups. The mean operative time was significantly shorter in the GA group (22.9±8.3 vs. 27.9±9.5 min, p=0.001). VAS were significantly lower in the GA group at the 6th and 12th hours: median VAS scores were 5.0 [interquartile range (IQR) 4.0-6.0] vs. 6.0 (IQR 5.0-6.3) at 6 hours (p=0.001), and 4.0 (IQR 3.0-5.0) vs. 6.0 (IQR 4.0-6.8) at 12 hours (p=0.001), respectively. Surgeon comfort scores were also significantly higher in the GA group (p=0.001). Success and complication rates did not differ significantly between groups.

Öz

Amaç: Distal üreter taşları için üreterorenoskopi (URS) uygulanan hastalarda bölgesel (spinal) ve genel anestezinin (GA) cerrahi sonuçlar, perioperatif komplikasyonlar, postoperatif ağrı ve cerrah konforu üzerindeki etkilerini karşılaştırmaktır.

Yöntem: Bu prospektif, randomize klinik çalışmaya Ocak 2024 ile Mart 2025 arasında üçüncü basamak bir akademik merkezde distal üreter taşları için URS uygulanan hastalar dahil edildi. Hastalar GA veya bölgesel anestezi (RA) grubuna ayrıldı. Başlangıç demografik özellikleri, operatif parametreler, postoperatif ağrı skorları [görsel analog skala (VAS)], analjezik gereksinimleri ve cerrah konforu kaydedildi ve istatistiksel olarak karşılaştırıldı.

Bulgular: Toplam 180 hasta çalışmaya dahil edildi (her grupta 90 hasta). Demografik özellikler ve taş özellikleri iki grup arasında benzerdi. Ortalama ameliyat süresi GA grubunda anlamlı olarak daha kısaydı (22,9±8,3 dakika vs. 27,9±9,5 dakika, p=0,001). Ameliyat sonrası ağrı skorları, 6. ve 12. saatlerde GA grubunda anlamlı olarak daha düşüktü: medyan VAS skorları 6. saatte 5,0 [çeyrekler arası aralık (ÇAA) 4,0-6,0] ve 6,0 (ÇAA 5,0-6,3) (p=0,001) ve 12. saatte sırasıyla 4,0 (ÇAA 3,0-5,0) ve 6,0 (ÇAA 4,0-6,8) (p=0,001) idi. Cerrah konfor skorları da GA grubunda anlamlı olarak daha yüksekti (p=0,001). Başarı ve komplikasyon oranları gruplar arasında anlamlı bir fark göstermedi.

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Abstract

Conclusion: Both general and RA are safe and effective for URS in distal ureteral stone management. However, GA is associated with shorter operative times, reduced postoperative pain in the early period, and improved surgeon comfort. These findings suggest that anesthetic modality may influence both clinical and surgical aspects of endourological procedures.

Keywords: Distal ureteral stones, general anesthesia, postoperative pain, regional anesthesia, ureterorenoscopy

Öz

Sonuç: Hem genel hem de RA, distal üreter taşı yönetiminde URS için güvenli ve etkilidir. Ancak, GA daha kısa ameliyat süreleri, erken dönemde postoperatif ağrının azalması ve cerrah konforunun artması ile ilişkilidir. Bu bulgular, anestezi yönteminin hem endoürolojik prosedürlerin klinik hem de cerrahi yönlerini etkileyebileceğini düşündürmektedir.

Anahtar kelimeler: Bölgesel anestezi, distal üreter taşı, genel anestezi, postoperatif ağrı, üreterorenoskopi

Introduction

Ureterorenoscopy (URS) is a well-established and widely used minimally invasive endoscopic procedure in urological practice worldwide (1). Numerous parameters related to this treatment, such as success rates and complications, have been extensively investigated; however, the relationship between the type of anesthesia administered and these outcomes has not been adequately assessed (2).

Although general anesthesia is more commonly used in URS procedures for the treatment of ureteral and renal stones, these procedures can also be performed under regional anesthesia (3). General anesthesia offers advantages over spinal anesthesia (SA) with respect to better control of procedure duration, reduced respiratory motion, and improved intraoperative patient cooperation (4). On the other hand, SA may be more advantageous because it is associated with a lower incidence of complications, such as venous thromboembolism and bleeding (5). We hypothesize that the advantages and disadvantages of each type of anesthesia may vary according to the localization of the ureteral stone. Therefore, we believe that investigating the potential benefits and drawbacks of different anesthesia modalities in relation to stone localization would provide valuable insights.

Although URS procedures for the treatment of urinary system stones have been widely studied with respect to factors such as success rates and complications, our aim in this study is to compare regional and general anesthesia specifically for distal ureteral stones. We focus on evaluating their effects on surgical success, perioperative complications, and surgical comfort.

Materials and Methods

This prospective, comparative study was conducted at a tertiary academic hospital between January 2024 and March 2025. Patients over 18 years of age who underwent URS for distal ureteral calculi were included in the study. Patients were divided by computer-assisted randomization into two groups: General anesthesia and regional anesthesia. The study was initiated after obtaining local ethical approval of University of Health Sciences Turkey, İstanbul Haseki Training and Research Hospital (approval no: 242-2023, dated: 20 December 2023) and was designed in accordance with the principles of the Declaration of Helsinki.

The sample size was calculated based on the study by Sahan et al. (6), which reported that 78 patients (39 per group) would be sufficient to detect significant differences between anesthesia types with 80% power and a 5% alpha error. Accordingly, we included 180 patients (90 per group) to enhance statistical reliability and allow subgroup analyses.

Patients with American Society of Anesthesiologists (ASA) physical status ≥III, those with multiple or bilateral stones, those with prior urinary diversion, those with active urinary tract infection or anatomical anomalies preventing retrograde access, and those who were not eligible for regional or general anesthesia were excluded.

Patient demographic data [age, gender, body mass index (BMI), ASA score, comorbidities, and stone characteristics] were recorded. Intraoperative data were recorded during the procedure. Operative time was recorded as the duration of the endourologic surgical procedure. Anesthesia administration times were not included in the operation time. Success was defined as being completely stone-free without requiring additional intervention. Perioperative complications were noted. All data were compared between the groups.

Primary Outcome

The primary outcome of this study was to compare the surgical success rates between patients undergoing URS with general anesthesia and those receiving regional anesthesia for the treatment of distal ureteral stones.

Secondary Outcomes

The secondary outcomes included operation; time; postoperative pain evaluated via visual analogue scale (VAS) at 1, 6, 12, and 24 hours; requirement for additional non-steroidal anti-inflammatory drugs (NSAIDs); hospitalization time; perioperative complications; and surgeon comfort scores rated on a standardized scale immediately after the procedure.

Anesthesia Techniques

All anesthetic procedures were performed by certified anesthesiologists with at least five years' experience. Preoperative prophylaxis included administration of 1 g of intravenous ceftriaxone 30 minutes before the procedure.

General anesthesia: Intravenous access was established using an 18-20 G cannula. Patients were preoxygenated with 100% O_2 for 4-5 minutes. Induction was achieved with fentanyl (2 µg/kg), propofol (2-3 mg/kg), and rocuronium (0.5 mg/kg). Anesthesia was maintained with 1% sevoflurane in 50% oxygen. Controlled mechanical ventilation was provided at a tidal volume of 8-10 mL/kg and a respiratory rate of 10-12 breaths/min.

Regional anesthesia: SA was performed at the L3-4 or L4-5 interspaces using a 25-26 G spinal needle. Upon confirmation of cerebrospinal fluid, 2 mL of 0.5% hyperbaric bupivacaine was injected. Sensory block was verified via pinprick test, with surgery commencing upon attainment of a T6-T8 dermatome level.

Surgical Procedure

All procedures were conducted in the lithotomy position using standardized endourological instruments. After the insertion of a hydrophilic guidewire, a 9.5-Fr semi-rigid ureteroscope was advanced to access the stone. Fragmentation was achieved using a holmium:YAG laser with energy settings tailored to stone size and location. Stone clearance was confirmed endoscopically, and a 4.8-Fr double-J stent was inserted post-procedure in all patients. Operative time was defined as the duration of the endoscopic procedure, excluding anesthesia preparation and induction times.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) version 27 (IBM Corp., Armonk, NY, USA) was used. The normality of the distribution of the variables was assessed using the Shapiro-Wilk test and Q-Q plots. Data showing a normal distribution were compared using the independent-samples t-test, and data not showing a normal distribution were compared using the Mann-Whitney U test. Quantitative data are shown as mean ± standard deviation or median [interquartile range (IQR)]. Discrete data were compared using the chi-square test. The data were analyzed at a 95% confidence level.

Results

Patient demographic data are summarized in Table 1. The mean age was similar between the general anesthesia group (41.8±13.5 years) and the regional anesthesia group (38.7±12.2 years, p=0.107). Gender distribution, BMI, ASA score, and the presence of comorbidities, including hypertension, diabetes mellitus, and coronary artery disease, were comparable between the groups (p>0.05 for all). Similarly, no significant differences were observed in Hounsfield units, presence of hydronephrosis, history of previous stone surgery, laterality of the affected side, or preoperative creatinine levels. The mean stone size was also similar between the two groups (12.2 mm vs. 11.5 mm, p=0.191).

Operative data revealed a significantly shorter mean operation time in the general anesthesia group than in the regional anesthesia group (22.9±8.3 vs. 27.9±9.5 minutes; p=0.001). However, no significant differences were observed between the two groups regarding hospitalization duration (median 24 hours in both groups; p=0.768), procedural success rates (95.6% vs. 91.1%, p=0.232), or overall complication rates (3.3% vs. 2.2%, p=0.650) (Table 2).

Postoperative pain assessments showed that the general anesthesia group had significantly lower VAS scores at 6 and 12 hours postoperatively compared with the regional anesthesia group. The median VAS score at 6 hours was 5.0 (IQR 4.0-6.0) in the general group and 6.0 (IQR 5.0-6.3) in the regional group (p=0.001). At 12 hours, the values were 4.0 (IQR 3.0-5.0) versus 6.0 (IQR 4.0-6.8) (p=0.001). No significant differences were noted at 1 and 24 hours. The need for additional NSAID administration was higher in the regional anesthesia group (28.9% vs. 15.5%, p=0.031). Furthermore, surgeon comfort scores were significantly higher in the general anesthesia group (8.8±2.3 vs. 6.3±1.7, p=0.001) (Table 3).

Discussion

When intervention is required for ureteral stones, the most commonly selected procedure is URS, involving lithotripsy and/or stone extraction with a basket (7). Performing URS in the distal ureter offers several technical advantages.

Table 1. Comparison of preoperative data between groups

	General anesthesia (n=90)	Regional anesthesia (n=90)	p-value
Age (years)*	41.8±13.5	38.7±12.2	0.107
Sex, n (%)			0.654
Male	47 (52.2%)	50 (55.6%)	
Female	43 (47.8%)	40 (44.4%)	
BMI (kg/m²)*	26.5±4.4	26.6±4.2	0.934
ASA score*	1.4±0.6	1.4±0.6	0.626
Comorbidities, n (%)			
Hypertension	13 (14.4%)	11 (12.2%)	0.661
Diabetes mellitus	11 (12.2%)	12 (13.3%)	0.823
Coronary artery disease	8 (8.9%)	6 (6.7%)	0.578
Stone size (mm)*	12.2±3.4	11.5±3.6	0.191
Presence of hydronephrosis, n (%)	65 (72.2%)	71 (78.9%)	0.298
Previous stone surgery, n (%)	23 (25.6%)	24 (26.7%)	0.865
Side, n (%)			0.233
Right	48 (53.3%)	40 (44.4%)	
Left	42 (46.7%)	50 (55.6%)	
Hounsfield unit**	873.0 (614.3-1100.0)	857.5 (559.5-1107.0)	0.450
Preoperative creatinine (mg/dL)**	1.0 (0.8-1.2)	0.9 (0.8-1.3)	0.938

*: Mean ± standard deviation, **: Median (IQR), BMI: Body mass index, ASA: American Society of Anesthesiologists, IQR: Interquartile range

Table 2. Comparison of operation data, success and complication rates between groups

	General anesthesia (n=90)	Regional anesthesia (n=90)	p-value
Hospitalization time (hours)**	24 (16-28)	24 (17-27)	0.768
Operation time (endoscopy) (min)*	22.9±8.3	27.9±9.5	**0.001**
Success, n (%)	86 (95.6%)	82 (91.1%)	0.232
Complications, n (%)	3 (3.3%)	2 (2.2%)	0.650

*: Mean ± standard deviation, **: Median (IQR), IQR: Interquartile range

Table 3. Comparison of postoperative VAS scores and surgeon comfort between groups

	General anesthesia (n=90)	Regional anesthesia (n=90)	p-value
Additional NSAID requirement, n (%)	14 (15.5%)	26 (28.9%)	**0.031**
VAS score**			
Postoperative 1st hour	3.0 (2.0-5.0)	4.0 (2.0-5.0)	0.384
Postoperative 6th hour	5.0 (4.0-6.0)	6.0 (5.0-6.3)	**0.001**
Postoperative 12th hour	4.0 (3.0-5.0)	6.0 (4.0-6.8)	**0.001**
Postoperative 24th hour	3.0 (2.0-4.0)	4.0 (2.0-5.0)	0.329
Surgeon comfort*	8.8±2.3	6.3±1.7	**0.001**

*: Mean ± standard deviation, **: Median (IQR), VAS: Visual analogue scale, NSAID: Non-steroidal anti-inflammatory drug, IQR: Interquartile range

These include easier and faster access compared with proximal stones and a reduced impact of respiratory movements (inspiration and expiration) on the procedure (8). Based on these factors, we hypothesize that the disadvantages associated with SA—such as reduced patient compliance, increased postoperative pain, and decreased surgeon comfort—may pose a lower risk in URS procedures targeting distal ureteral stones.

Postoperative pain is one of the factors that can prolong the length of hospital stay and negatively affect patients' quality of life (9). The type of anesthesia administered can influence the intensity of postoperative pain and the need for NSAIDs for pain relief. Çakici et al. (10) found no significant difference in postoperative pain levels between two anesthesia modalities in patients undergoing URS. In contrast, our study revealed that VAS scores at 2 hours postoperatively were significantly higher in the regional

anesthesia (RA) group, although no significant difference was observed at 24 hours. Similarly, the need for additional postoperative NSAID administration was significantly higher in the RA group than in those who received general anesthesia via a laryngeal mask airway (LMA). We attribute this to the higher incidence of colicky pain due to obstruction caused by ureteral stones, increased nociceptive signaling in obstructed ureters, and a relatively lower likelihood of obstruction in URS procedures targeting renal stones. Nonetheless, the absence of significant differences in pain levels at 24 hours postoperatively suggests that SA may be a viable alternative to LMA for URS targeting distal ureteral stones.

Postoperative pain is significantly influenced by the type of anesthesia used during URS. In our study, patients in the regional anesthesia group reported significantly higher VAS scores at 6 and 12 hours postoperatively. A possible explanation is that SA primarily provides intraoperative sensory blockade, but its analgesic effect diminishes within a few hours postoperatively. In contrast, general anesthesia—especially when combined with systemic opioids—may offer more prolonged pain control in the early postoperative period.

In endoscopic interventions for ureteral stones, the use of intraluminal energy—especially lasers—carries risks of tissue damage and suboptimal stone fragmentation due to challenges in laser targeting. These factors may prolong the procedure and, consequently, increase energy exposure time. Additionally, respiratory movements that affect the maneuverability of the URS device within the lumen can prolong operative time (11). In their study, Cai et al. (12) reported no significant difference in operative time between anesthesia types used during URS procedures. In our study, the mean operative time was significantly shorter in the general anesthesia group. This finding may be attributed to several factors. First, the use of muscle relaxants during general anesthesia ensures complete immobility, allowing for more efficient endoscopic maneuvering and laser lithotripsy. Second, controlled ventilation minimizes respiratory-induced motion artifacts, facilitating accurate targeting of stones and more rapid fragmentation. Additionally, higher surgeon comfort scores in the GA group suggest that the operative environment was more favorable, potentially leading to shorter procedure times. In contrast, during regional anesthesia, even minor voluntary or involuntary patient movements — such as coughing, muscle tension, or discomfort — may prolong the operative procedure by disrupting scope control or laser precision.

SA carries potential drawbacks that may significantly impact the surgeon's comfort, including increased sensitivity to inspiratory and expiratory movements, patient instability, and involuntary movements such as coughing or sneezing, all of which can impede optimal laser targeting (13). In a study by Sahan et al. (6) evaluating surgeon comfort during URS, general anesthesia provided significantly better conditions than SA. In contrast to their findings, our study found that surgeons' comfort was significantly higher in the SA group. We attribute this difference to the greater susceptibility of renal procedures to respiratory motion, due to the kidney's proximity to the diaphragm, and to the higher likelihood of movement triggered by coughing or sneezing. In the distal ureter, these disadvantages are markedly reduced, which may explain the improved surgical experience.

Our study is unique in that, unlike previous research comparing anesthesia types for ureteral stone surgery, it specifically focuses on the distal ureter.

Study Limitations

However, there are several limitations. First, the sample size was small and the study had a retrospective design. Pain evaluation was limited to the first 24 hours postoperatively, and no long-term assessment was conducted. Additionally, cost analysis was not included in our study.

Conclusion

In conclusion, both SA and LMA are effective and safe anesthetic techniques for URS procedures. However, our study demonstrated that the endoscopy duration was significantly shorter, and surgeon comfort was significantly better, in the SA group than in the LMA group. We recommend that these findings be further validated through large-scale, prospective, randomized controlled trials.

Ethics

Ethics Committee Approval: The study was initiated after obtaining local ethical approval of University of Health Sciences Turkey, İstanbul Haseki Training and Research Hospital (approval no: 242-2023, dated: 20 December 2023) and was designed in accordance with the principles of the Declaration of Helsinki.

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: U.Ç., A.A., Ö.Ş., F.Ö., Concept: M.K., Ö.Ş., F.Ö., Design: M.K., Ö.Ş., Ö.S., Data Collection or Processing: R.Y., Ö.S., Analysis or Interpretation: U.Ç., Ö.S., Literature Search: R.Y., A.A., F.Ö., Writing: M.K., R.Y., A.A.

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