

Is spinal anesthesia an alternative and feasible method for proximal ureteral stone treatment?

Ramazan Topaktaş¹, Selçuk Altın², Cemil Aydın³, Ali Akkoç⁴, Ahmet Ürkmez¹, Zeynep Banu Aydın⁵

¹Department of Urology, Haydarpaşa Numune Training and Research Hospital, Istanbul, Turkey

²Department of Urology, Necip Fazil Training and Research Hospital, Kahramanmaraş, Turkey

³Department of Urology, Hitit University Çorum Erol Olçok Training and Research Hospital, Çorum, Turkey

⁴Department of Urology, Faculty of Medicine, Alanya Alaaddin Keykubat University, Alanya, Turkey

⁵Department of Radiology, Hitit University Çorum Erol Olçok Training and Research Hospital, Çorum, Turkey

Citation: Topaktaş R, Altın S, Aydın C, Akkoç A, Ürkmez A, Aydın ZB. Is spinal anesthesia an alternative and feasible method for proximal ureteral stone treatment? Cent European J Urol. 2020; 73: 336-341.

Article history

Submitted: May 15, 2020

Accepted: June 14, 2020

Published online: June 15, 2020

Corresponding author

Ramazan Topaktaş
Haydarpaşa Numune
Training and Research
Hospital
Department of Urology
23 Tibbiye Street
34668 Uskudar / Istanbul,
Turkey
phone: +90 216 542 32 32
ramazantopaktas@yahoo.
com

Introduction We investigated the clinical, operational, and pain parameters of patients who underwent semirigid ureterorenoscopy (sURS) under spinal anesthesia (SA) and general anesthesia (GA) for proximal ureter stones.

Material and methods Patients treated with sURS after diagnosis of proximal ureter stones between January 2014 and May 2017 were reviewed retrospectively. The patients were divided into two groups (the SA group and the GA group) based on the type of anesthesia used. Perioperative variables and operation results were evaluated and compared. Success was defined as the patient being stone-free as observed on low-dose non-contrast computed tomography performed in the first month postoperatively.

Results The SA and GA groups had 40 and 32 patients, respectively. There were no statistically significant differences between the groups in terms of age ($p = 0.593$), gender ($p = 0.910$), average stone size ($p = 0.056$), side ($p = 0.958$), or density ($p = 0.337$). Based on the Clavien classification system, complication rates between the two groups were similar. The postoperative visual pain scale in the SA group was statistically significantly lower ($p < 0.05$) than in the GA group. Success rates in the SA and GA groups were found to be 90% (36/40) and 93.7% (30/32), respectively, with no significant difference between the groups ($p = 0.819$).

Conclusions Ureterorenoscopy, which is performed for proximal ureter stone treatment in adult patients, is a reliable surgical method that can be performed under both SA and GA. SA offers the advantage of reduced postoperative pain as compared to GA.

Key Words: feasibility ◊ general anesthesia ◊ proximal ureter stone
◊ spinal anesthesia ◊ ureterorenoscopy

INTRODUCTION

Stone disease in the urinary system has a high prevalence that varies depending on climate, geography, ethnic background, diet, and genetic factors. Ureteral stones are observed in 20% of urinary system stones [1, 2]. Patients with urinary system stones have a 50% chance of relapsing within ten years of their first diagnosis [2].

Important factors that determine the spontaneous passage of ureteral stones are stone size and location. The probability of spontaneous passage is higher in patients with a stone size of ≤ 5 mm, whereas this probability is substantially lower in patients with a stone size of ≥ 10 mm. The probability of spontaneous passage of proximal ureteral stones is low compared with stones in other regions of the ureter, being 48% for proximally located

ureteral stones and 79% for distally located ureteral stones [3].

Several methods are currently used for treating proximal ureteral stones, including monitoring, medical expulsive therapy, shockwave lithotripsy (SWL), ureterorenoscopy (URS), laparoscopic surgeries, and, rarely, open surgery. The current European Association of Urology (EAU) urolithiasis guidelines recommend URS as the first-line treatment if the proximal ureteral stone size is >10 mm and SWL and URS for stones with a size of <10 mm [4].

In the literature, several factors affecting the success of the URS operation performed for proximal ureteral stones have been researched, including ureteroscope type and diameter, preoperative stent placement, and stone size and location. However, the effect of the type of anesthesia on URS success remains a subject for discussion. In the EAU urolithiasis guidelines, it is stated that most URS operations are performed under general anesthesia (GA); however, the treatment of mid-distal ureteral stones can be performed under spinal anesthesia (SA) or sedoanalgesia [4]. Although GA is the more commonly preferred approach, the advantages of SA, which include no loss of reflexes, fewer complications regarding patient position, and low treatment cost, should be considered [5]. However, in addition to these advantages, SA also has disadvantages, such as the challenges involved in accommodating the patient's desired position, the patient's concern regarding experiencing pain during the operation, and the occurrence of post-spinal headache. There are numerous studies on SA application in the treatment of distal ureteral stones, but, to the best of our knowledge, studies comparing anesthesia types in proximal ureteral stone treatment are lacking in the literature.

The purpose of this study was to retrospectively compare the results and efficiency of different anesthesia techniques (SA and GA) within patients who underwent semirigid ureterorenoscopy (sURS) with the Holmium:YAG laser for proximal ureteral stones.

MATERIAL AND METHODS

Medical records and files of 102 patients who underwent sURS owing to proximal ureteral stones in a tertiary care training and research hospital between January 2014 and May 2017 were obtained from the database following the approval of the hospital management and were retrospectively examined. All patients signed a written consent form prior to the operation. The present study conforms to the principles of the Declaration of Helsinki.

Patients with a proximal ureteral stone with a size of >5 mm resulting in ectasia in the upper urinary

system, who experienced symptoms and/or had failed SWL three times were included in the study. Patients aged <18 years, those who had to be converted to GA after failed SA, those with a bilateral ureteral stone, those for whom complete data was unavailable, and those without follow-up were excluded from the study.

After applying the exclusion criteria, a total of 72 patients were included in the study. The patients were divided into two groups based on the type of anesthesia they received: the SA group (n = 40) and the GA group (n = 32). The anesthesia type was determined jointly by the anesthesiologist, urologist, and the patient. SA was chosen for patients who did not prefer GA and whose lung pathologies made them ineligible for GA. GA was chosen for patients with severe cardiac issues, such as bradycardia, those who would have been unable to cooperate with the surgical team during the operation, and those who preferred not to receive SA.

Routine physical examination, full blood examination, coagulation parameters, blood biochemistry, full urine analysis, and urine culture were performed on all patients prior to the operation. Patients who had bacteria in the urine culture were treated with an appropriate antibiotic according to the culture before undergoing the operation. All URS procedures were performed in patients with a sterile urine culture. Stones located in the region between the ureteropelvic junction and pelvic brim in the ureter were considered proximal ureteral stones. Urinary system radiography (KUB), urinary ultrasonography (USG), and/or low-dose non-contrast computed tomography (NCCT) by the stone protocol were conducted for the determination of stone size and location. The stone size was recorded in mm by measuring the longest diameter in the axial plane. Characteristic data, the location, density, and size of stones, intraoperative parameters, surgical duration, hospitalization length, postoperative pain, complications and clearing rates of the stone were retrospectively examined and compared over the files. The patients were administered with intravenous 3rd generation cephalosporin prophylactically 30 minutes before the operation. The complications were classified based on the Clavien grading system [6]. The relationship between the induced anesthesia type and the above mentioned variables were evaluated. Pain (renal colic and headache) severity on the first morning following the surgery (24 hours after the operation) was evaluated using the Visual Analog Scale (VAS) (VAS 0 = no pain, VAS 10 = the most severe pain that could be seen). Nonsteroidal anti-inflammatory drugs (diclofenac sodium, 100–150 mg/day) and/or tramadol (50–100 mg) were intravenously administered for pain treatment.

Whether the stone was cleared following the surgery was examined using USG or KUB on postoperative day 1 and using low-dose NCCT at the end of the postoperative first month. Stone-free was defined as no stone on NCCT or patients with a stone size of ≤ 3 mm in the first month follow-up.

Spinal anesthesia technique

After 10 ml/kg physiological saline solution was administered via intravenous infusion in the operating theater waiting room, the L3-L4 or L4-L5 vertebral space was determined with the patient in a sitting position on the operating table. Cutaneous and subcutaneous tissues were passed from this space using a 25-gauge needle that was introduced into the subarachnoid region. After the cerebrospinal fluid flow was observed, a total of 10–15 mg of heavy bupivacaine was injected into this space. A pinprick test was performed using a sterile needle to evaluate the level of anesthesia. Anesthesia was provided in the dermatome up to the T6 level. These patients were administered 1–2 mg midazolam intravenously for sedation.

General anesthesia technique

At the beginning stage of anesthesia, 2–3 mg/kg propofol and 1–2 mcg/kg fentanyl were administered; 0.6 mg/kg rocuronium bromide was administered prior to tracheal intubation. Anesthesia was maintained with sevoflurane 1–2% and N₂O/O₂ 50%/50% in oxygen in addition to supplemental doses of rocuronium bromide 0.1 mg/kg every 30 min.

Operation technique

In the lithotomy position under GA or SA, a 0.035-inch sensor type guidewire was inserted for safety from the ipsilateral ureteral orifice toward the kidney with a 8/9.8 Fr or 4.5/6.5 Fr Wolf sURS. After the endoscope reached the stone, a stone cone ureteral catheter was inserted to the proximal end of the stone as is standard. Holmium YAG: laser device (Quanta System Litho laser) with 0.8–1.5 J energy level, 8–15 Hz frequency, and 272–365 μ m size laser probe was preferred in all patients for stone fragmentation. A basket catheter or grasping forceps were not used. All other fragmented stones were left for spontaneous passage. At the end of the operation, a double-J catheter was placed depending on the discretion of the surgeon and edema in the ureter. A 16- or 18-Fr Foley catheter was placed in all patients at the end of the operation. Urethral Foley catheters were extracted on postoperative day 1, whereas the urethral double-J stents were extracted within 3–4 weeks.

Data analysis

For the statistical analysis, the IBM Statistical Package for Social Sciences (IBM SPSS Statistics; Armonk, NY, USA) statistics software 25 program was used. The normal distribution fitness of the parameters was assessed using the Shapiro-Wilk test. One-way ANOVA was used for the comparison of groups with normal distribution in the comparison of the descriptive statistical methods (mean, median, standard deviation, and frequency), and a Mann-Whitney U test was used to determine the group causing the difference. Independent Sample t-test was used for inter-group comparison of quantitative data showing normal distribution. A p value of <0.05 was considered statistically significant.

RESULTS

Of the 72 patients included in the study, 49 (68%) were male and 23 (31.9%) were female. The mean age and female/male ratio of both groups (SA vs. GA) were similar, and there was no significant difference between the two groups in terms of age and sex ($p = 0.593$ and $p = 0.910$). Patient demographics are presented in Table 1. The mean stone size and density of both groups were similar, and no significant differences were observed between the two groups

Table 1. Assessment of demographic and clinical characteristics of patients

	Spinal Anesthesia Group (n = 40)	General Anesthesia Group (n = 32)	P value
Sex			
Male	28 (70%)	22 (68.7%)	0.910
Female	12 (30%)	10 (31.2%)	
Mean age, years (range)	41.9 \pm 12.3 (19–72)	40.3 \pm 13.3 (20–76)	0.593
History of SWL treatment n (%)	12 (30%)	9 (28.1%)	0.863
Mean stone size, mm (range)	10.1 \pm 2.2 (6–15)	11.1 \pm 2.1 (8–17)	0.056
Ureteral stone side n (%)			
Right	21 (52.5%)	17 (53.1%)	0.958
Left	19 (47.5%)	15 (46.8%)	
Mean stone density Hounsfield units (range)	991.7 \pm 404 (350–2500)	1093.4 \pm 489 (400–3000)	0.337
Impacted ureteral stone n (%)			
Yes	24 (60%)	18 (56.2%)	0.750
No	16 (40%)	14 (43.7%)	
Stone opacity n (%)			
Radiopaque or poor radiopacity	37 (92.5%)	29 (90.6%)	0.776
Non-opaque	3 (7.5%)	3 (9.3%)	

SWL – shockwave lithotripsy

($p = 0.056$ and $p = 0.337$). According to the surgical notes, the stones were impacted in more than half of the patients 58.3% ($n = 42/72$) in total. When the groups were evaluated separately, it was detected that in both groups, most of the stones were embedded in the ureteral mucosa and were impacted, and there was no significant difference ($p = 0.750$). Almost all of the stones in both groups were radiopaque or semi-opaque (SA vs. GA, 92.5% vs. 90.6%, respectively).

There was no statistically significant difference in terms of duration of surgery in both groups ($p = 0.875$). In the SA group, in total, 2 (5%) patients reported that they experienced slight pain during the operation and were treated with intravenous sedation (fentanyl and ketamine). In the SA group, one patient developed nausea, and this patient was successfully treated with intravenously administered metoclopramide HCl. At the end of the operation, a double-J stent was used in 65% of the patients in the SA group and 62.5% of the patients in the GA group. Median visual pain scale was much lower in the SA group than in the GA group, and this difference was highly significant (1 vs. 2.5, $p = 0.000$) (Table 2).

The general complication rate in the SA group was slightly higher, but this difference was not significant (10% vs. 9.3%, $p = 0.776$). During the postoperative period, headache and dizziness developed in 2 patients (5%) in the SA group, who were treated within 5 days using nonsteroidal anti-inflammatory drugs, caffeinated drinks, and bed rest. A postoperative fever and urinary system infection (Clavien grade I) developed in one patient in the SA group and in two patients in the GA group; these were treated with the appropriate antibiotic and antipyretic treatment. Renal colic (Clavien grade IIIa) requiring ureteral stent placement developed in one patient in each group. The stone was not pushed back to the kidney in any of the patients, and there were no major Clavien grade IV and above complications observed. Table 2 summarizes the relationship between variables during and after the operation and the anesthesia types.

The success (stone-free) rate at the first month follow-up after the surgery was 90% (36/40) in the SA group, whereas it was 93.7% (30/32) in the GA group. Although the success rate was slightly higher in the GA group, no statistically significant difference was observed between the two groups ($p = 0.819$).

DISCUSSION

The aim of the treatment of the ureteral stone is to ensure that the patient is completely stone-free with minimal morbidity. sURS is frequently used for ure-

Table 2. Comparison of postoperative outcomes

	Spinal Anesthesia Group (n: 40)	General Anesthesia Group (n: 32)	P value
Mean operative time, min (range)	56.6 ±21.1 (30–110)	55.7 ±24.1 (30–120)	0.875
Mean hospital stay, day (range)	1.2 ±0.7 (1–5)	1.3 ±0.8 (1–5)	0.603
Double J stent placed (n, %)			0.827
Yes	26 (65%)	20 (62.5%)	
No	14 (35%)	12 (37.5%)	
Visual analog scores, median	1	2.5	0.000*
Complications, n (%)	4 (10%)	3 (9.3%)	
Urinary tract infection (Clavien I)	1	2	0.776
Postoperative headache (Clavien I)	2	–	
Renal colic requiring stent (Clavien III)	1	1	
Ureteroscopy success rate, n (%)	38 (95%)	28 (93.7%)	0.819

* $p < 0.05$

teral stones in daily urological practice. The selection of the anesthesia type to be used during sURS is determined by the stone location, surgical method employed, emergency of the operation, patient–urologist–anesthesiologist preferences, and the abilities of the anesthesiologist. The tendency to perform sURS under regional anesthesia for the diagnosis and treatment of upper urinary system stones and other pathologies is continuing to increase at the recommendation of the anesthesiologists [7]. This increase is owing to the increasing number of patients being operated daily in the operation theatre, to decrease costs, and to facilitate the safe discharge of patients on the same day or the day after [8]. However, although SA is a considerably better-tolerated anesthesia type than GA, its preference is contradictive when considered from an urologists' point of view. Most urologists believe that ureteral trauma can occur owing to reflexes such as deep breathing and coughing not being controlled during sURS performed under regional anesthesia, and these reflexes can be better controlled with GA. Contrary to popular belief, no significant difference has been reported in the literature between the anesthesia types used in the URS operation in terms of ureteral trauma. Although there are several studies regarding the reliability, applicability, and tolerability of sURS performed owing to distal ureteral stones under SA, local anesthesia, or sedation, studies directly comparing the applied anesthesia types for the endoscopic treatment of the proximal ureteral stones is lacking [7, 8]. We think that there is a deficiency in the literature about this topic so we aimed to investigate the efficacy of SA instead of GA for pain and feasibility of those who underwent sURS for proximal ureteral stones.

During and after the operation, the expectations and objectives of the surgeon and anesthesiologist from the operation are different. The surgeon desires to complete the operation without complications or with minimal complications and to achieve the most successful results, whereas the anesthesiologist aims to awaken the patient with the most reliable and fastest approach at the end of the operation. These different expectations and objectives of the surgical team can cause incompatibilities in technical and specific operations such as URS. Urologists believe that the prevention of involuntary reflexes, such as coughing, sneezing, and hiccups, is more likely when the proximal ureteral stones are reached comfortably under GA and the ureter is more relaxed and there is less resistance. The most important reasons for this belief are that the path to be undertaken in the ureter using the semirigid ureterorenoscope is longer, and the tense and physiologic curves of the ureter disappear via the entire ureter, and the ureter becomes straight. Apart from these, urologists do not prefer regional anesthesia because it is not always successful, it causes anxiety in the patient, and adequate muscle relaxation is not achieved [9, 10].

Although ureteroscopy is a minimally invasive method, when being performed routinely under GA, it is considered a more invasive method. Therefore, it is necessary to change the anesthesia type. There are numerous studies comparing the anesthesia types performed before sURS; however, most studies compare local anesthesia with GA or SA [9–13]. Frequently, carefully selected patients, such as those with distal ureteral stones and female patients were included in these studies, and thinner caliber ureteroscopes are used during the surgeries. In a study, the applicability of ureteroscopic lithotripsy using local anesthesia was researched, and it was emphasized that ureteroscopic lithotripsy is effective and reliable [14]. However, in that study, the stone was in the proximal ureter in only 6 out of these 200 patients, and none of them had a stone size of >10 mm [14]. In another recent study, SA or GA has been induced for sURS, and the results obtained were evaluated. GA was induced for most patients, and it was emphasized that the location and impaction of the stone is a predictive factor for negative surgical results [15]. Similarly, in another study, Hollenbeck et al. have researched the effectiveness of URS operations in proximal and distal ureteral stones. In that study wherein the patients were divided into two groups (GA-SA or sedation) with a similar number of patients, they reported that the treatment of ureteroscopic stone can be safely performed for both proximal and distal ureteral stones and those patients with proximal ureteral stone are not at an additional risk [16]. In the

above-mentioned studies, although the effects of SA and GA on sURS results were not directly compared, it has been indirectly implied that the preferred anesthesia type does not exhibit a significant effect on the outcome of the operation. In our study, we detected no significant difference in any of the parameters besides the postoperative pain severity measurement. Postoperative pain being low in the SA group was attributed to the superiority of the method employed over GA. In our study, the rates of successful sURS operations in both groups were similar (95% in SA group and 93.7% in GA group). Our results show that both anesthesia types can be performed reliably and effectively and have similar complication rates.

Spinal anesthesia has some disadvantages such as bradycardia, hypotension (owing to sympathetic blockage), which can be cured with appropriate treatment; headache, which can require a longer hospitalization; and extended urinary retention. There is a common belief that possible negative effects of SA are widely observed during and after the treatment of proximal ureteral stones. No instances of hypotension or bradycardia were observed related to SA in any of our patients. We correlate this to the adequate hydration of patients in the waiting room and the involvement of experienced anesthesiologists during the operation. In our study, nausea was observed in one patient as a side effect of SA during the operation, and the patient was treated with metoclopramide, which was administered intravenously. In SA, slight pain was experienced by two patients, and these patients were treated with increasing the intravenous sedation.

Advantages of SA over GA are that its effect begins quicker; the hospitalization length, nausea/vomiting at the end of the operation, mortality, morbidity and need for postoperative analgesic are lower; patient satisfaction is greater, and it provides more localized and intense blockage than epidural anesthesia [17, 18]. In some patients and operations, SA may be a more appropriate option; for example, SA is usually preferred for pregnant women because the transfer of the administered medication to the fetus is minimized. In our study, we did not compare the cost of the medication used for anesthesia, need for postoperative analgesic, and patient satisfaction.

The most important limitations in our study were that it was retrospective and single centered, and the relatively small number of patients. Other limitations were that the complications caused owing to the two compared anesthesia types were not examined in the study, and the two types were not compared in terms of cost and surgeon satisfaction. Despite these limitations, our study is the first study to compare the anesthesia types for proximal ureteral stones.

CONCLUSIONS

Our results show that sURS is a feasible and safe surgical modality for the treatment of proximal ureteral stone disease under either SA or GA. SA appears to be superior to GA in terms of postoperative pain. SA can be considered an alternative for patients in

whom GA is contraindicated and for those who are concerned about and/or afraid of GA. Further studies are needed from multiple centers, and including more patients.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

References

- Sancak EB, Kılınc MF, Yücebaş SC. Evaluation with decision trees of efficacy and safety of semirigid ureteroscopy in the treatment of proximal ureteral calculi. *Urol Int.* 2017; 99: 320-325.
- Reis Santos JM. Ureteroscopy from the recent past to the near future. *Urolithiasis.* 2018; 46: 31-37.
- Coll DM, Varanelli MJ, Smith RC. Relationship of spontaneous passage of ureteral calculi to stone size and location as revealed by unenhanced helical CT. *AJR Am J Roentgenol.* 2002; 178: 101-103.
- Türk C, Neisius A, Petrik A, Seitz C, Thomas K. Guidelines on urolithiasis. European Association of Urology, Arnhem 2018. Available at <http://www.uroweb.org/gls/pdf>.
- Mehrabi S, Karimzadeh Shirazi K. Results and complications of spinal anesthesia in percutaneous nephrolithotomy. *Urol J.* 2010; 7: 22-25.
- Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg.* 2004; 240: 205-213.
- Yalçinkaya F, Topaloğlu H, Özmen E, Unal S. Is general anesthesia necessary for URS in women? *Int Urol Nephrol.* 1996; 28: 153-156.
- Large T, Heiman J, Ross A, Anderson B, Krambeck A. Initial experience with narcotic-free ureteroscopy: a feasibility analysis. *J Endourol.* 2018; 32: 907-911.
- Zisman A, Siegel YI, Lindner A. Ureteroscopy for ureterolithiasis with sedation only. *Eur Urol.* 1995; 27: 151-153.
- Hosking DH, Smith WE, McColm SE. A comparison of extracorporeal shock wave lithotripsy and ureteroscopy under intravenous sedation for the management of distal ureteric calculi. *Can J Urol.* 2003; 10: 1780-1784.
- Chan PS, Fenn J, Li AK. Transurethral ureterorenoscopic lithotripsy and retrieval of ureteric calculi under local anaesthesia and sedation. *Br J Urol.* 1990; 65: 141-143.
- Whitehurst LA, Somani BK. Semi-rigid ureteroscopy: indications, tips, and tricks. *Urolithiasis.* 2018; 46: 39-45.
- Galal EM, Anwar AZ, El-Bab TK, Abdelhamid AM. Retrospective comparative study of rigid and flexible ureteroscopy for treatment of proximal ureteral stones. *Int Braz J Urol.* 2016; 42: 967-972.
- Park HK, Paick SH, Oh SJ, Kim HH. Ureteroscopic lithotripsy under local anesthesia: analysis of the effectiveness and patient's tolerability. *Eur Urol.* 2004; 45: 670-673.
- Al-Naimi A, Alobaidy A, Majzoub A, Ibrahim TA. Evaluation of ureteroscopy outcome in a teaching hospital. *Turk J Urol.* 2016; 42: 155-161.
- Hollenbeck BK, Schuster TG, Faerber GJ, Wolf JS Jr. Comparison of outcomes of ureteroscopy for ureteral calculi located above and below the pelvic brim. *Urology.* 2001; 58: 351-356.
- Rodgers A, Walker N, Schug S, et al. Reduction of postoperative mortality and morbidity with epidural or spinal anesthesia: results from overview of randomized trials. *BMJ.* 2000; 321: 1493.
- Dagli R, Dagli SS. Anesthetic method preference of obstetricians for caesarean section. *Turk J Anaesthesiol Reanim.* 2015; 43: 41-46. ■