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Comparison of ureterorenoscopy (URS) procedure performed under general and spinal anesthesia in ureteral stones

Differences between general and spinal anesthesia for ureterorenoscopy (URS) procedure

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Abstract
Aim: The objective of this study was to evaluate records of the patients who underwent ureterorenoscopy under general and spinal anesthesia and to determine whether the type of anesthesia affected the success of the operation and complications.
Material and Methods: Medical records of 1548 patients who underwent ureterorenoscopy [URS] were retrospectively reviewed for 10 years. Patients were divided into two groups according to the type of anesthesia as general anesthesia and spinal anesthesia groups. Routine monitoring was performed in the operating. Two groups were compared in terms of demographic data, preoperative, operative and postoperative characteristics.
Results: The mean age was statistically significantly higher in the general anesthesia group [49.57±15,31] compared to the spinal anesthesia group [47.21±13.19] [p<0.01]. There was a significant difference between the groups in terms of ASA class and stone size, while no significant difference was found in terms of previous ESWL application and stone laterality. The use of DJS was significantly less in the spinal anesthesia group compared to the general anesthesia group [p<0.001]. The use of lithotripsy was significantly more common in the spinal anesthesia group [p<0.001]. Length of stay in hospital was statistically significantly shorter in the spinal anesthesia group [p<0.001].
Discussion: Operation time and length of stay in the hospital were shorter in the spinal anesthesia group. Catheter use was less in the spinal anesthesia group. Spinal anesthesia can be readily used in URS procedures regardless of stone size.

Keywords
Ureteral Stone, Ureterorenoscopy, Stone-Free, General Anesthesia, Spinal Anesthesia

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Introduction

Urinary system stone disease [USD] is among the most important diseases that directly affect the quality of life. Stones can form anywhere in the proximal urinary tract in the presence of congenital urogenital abnormalities, urinary obstruction, or infection [1]. USD is a very frequent disease with a life-time-risk of about 10 - 15 % in industrialized countries [2]. It has been reported that the prevalence of urinary system stone disease varies between 1% and 20% [3]. The prevalence of stones in males was 1.5 times higher than in females.

The incidence of USD depends on many factors including geographical, climatic, hereditary, ethnic and nutritional status. Infectious causes, anatomic anomalies, and drug use also may play a role in stone formation [4-6]. Mostly asymptomatic stone formation occurs within the renal pelvic system, the typical clinical manifestation results when these stones enter and consequently obstruct the ureter.

Today, many methods are used in the treatment of USD, including Extracorporeal shock wave lithotripsy [ESWL], percutaneous nephrolithotomy [PCNL], ureteroscopy, open surgery and laparoscopy. In light of the innovations made in the field of endourology and the endoscopic experience gained by surgeons, open surgery has become a less preferred method in the treatment of USD. Open stone surgery has been rendered obsolete in most situations, being surpassed by antegrade and retrograde endoscopic techniques, as well as ESWL [7, 8]. Open surgery is preferred in only 1-5.4% of urinary stone cases [9, 10]. Today, ESWL and transurethral ureterorenoscopy [URS] come to the fore in the treatment of ureteral stones. However, ESWL has both a long treatment process and the need for additional treatment. Therefore, its priority in the treatment of ureteral stones is controversial [11, 12]. Treatment of ureteral stones using URS is the primary treatment option for all ureteral stones, especially middle and lower ureteral stones, stones for which ESWL has failed, or depending on patient preference [13, 14]. Today URS is commonly performed under general anesthesia. The European Association of Urology guideline recommends ureterorenoscopy be performed under general anesthesia [15, 16]. In ureterorenoscopy, anaesthesiologists prefer regional anesthesia to avoid complications due to general anaesthesia, while surgeons prefer general anaesthesia to avoid ureteral trauma [17, 18]. However, studies that compared these two anesthesia techniques are limited. The objective of this study was to evaluate records of the patients who underwent ureterorenoscopy under general and spinal anesthesia and to determine whether the type of anesthesia affected the success of the operation and complications.

Material and Methods

Medical records of 1548 patients who underwent URS due to USD in the urology clinics of the Baskent University Ankara and Konya Research Centers for 10 years were retrospectively reviewed. Patients aged >18 years who underwent URS under general or spinal anesthesia were included in the study. Patients aged under 18 years, those who underwent additional surgery at the same session, pregnant women, patients with kidney or ureter anomalies and those with missing data were excluded from the study.

Patients were divided into two groups according to the type of anesthesia as general anesthesia and spinal anesthesia groups. Induction and intubation were performed with 2 mg/kg propofol and 0.1 mg/kg vecuronium bromide. The maintenance was made with 50% N2O and propofol perfusion. Routine monitoring was performed in the operating room.

Patients in the spinal anesthesia group were given a sitting position, and following sterilization, a 25 G needle was entered at the level of L4-L5 in the midline and spinal anesthesia was achieved using 2 mL 0.5% hyperbaric bupivacaine. The patients were then given the supine position. Anesthesia level of the patients was evaluated with the pin-prick test. In addition, 2.5 mg i.v. midazolam was administered for sedation.

The URS Procedure

Intravenous cephalosporin was administered prophylactically before the operation to the patients who underwent general anesthesia and spinal anesthesia. After the appropriate position and cover, a 10 F feeding tube was placed in the bladder, the bladder was entered with the ureteroscope under the guidance of the feeding tube, and the localization and characteristics of the orifice were evaluated.

A 9.5 F Storz [Storz/Germany] ureteroscope was used for ureteroscopy. If the ureteral orifice was of appropriate width, the ureter was accessed. The ureter was accessed with the help of a guide wire when access to the ureter was not possible. A Stone Cone [Cook Medical Co] was placed proximal to the stone in patients whose stone was predicted to be able to migrate proximally. While some of the stones were directly extracted with stone forceps, pneumatic lithotripsy [ELMED vibrolith, 0311VB257] device and 3-4 F rigid probes were used to break the large stones.

Lithotripsy was performed until the stones were broken into very small pieces and broken completely. Large pieces were removed with stone forceps or a basket, while small pieces were left to pass. It was evaluated whether the stone was completely broken or not, by controlling the ureter by passing to the proximal part of the stone and using a scopy in doubtful cases. Double J stent [DJS] was not routinely used after ureterorenoscopic lithotripsy. 6F-26 cm double J was used in cases where there was severe damage or perforation of the mucosa, and in patients who had a large number of residual stone fragments and were thought to cause problems in spontaneous passing. DJSs were removed after 2-4 weeks.

Data evaluation

Two groups were compared in terms of demographic data, preoperative, operative and postoperative characteristics. Demographic data included age and gender. Preoperative characteristics included a history of ESWL [цhether ESWL was applied before URS], stone localization [upper ureter, middle ureter, lower ureter], laterality [right, left], stone size [millimetres and ASA scores]. Operative characteristics included operation time [minutes], use of catheter during URS [basket, stone cone, catheter free], method used in stone extraction [lithotripsy vs extraction] and use of DJS following URS. Postoperative characteristics included operation outcome [stone free, residual fragments], postoperatively used analgesics [NSAIDs, narcotic analgesic], length of stay in hospital [days] and postoperative complications.

Postoperative complications were grouped according to the Clavien classification. Among the complications; nausea, postoperative fever and headache were evaluated as Clavien I, pyelonephritis and thromboembolism as Clavien II and ureteral avulsion and perforation as Clavien III.

Statistical analysis

Power analysis was performed for pre-evaluation of biostatistics before the study. Since categorical variables were also included in the power analysis, the required sample size was determined as 228 individuals in each category and at least 456 individuals in each group. According to the power analysis, the power of the test was expected to be 0.801545. The normality of continuous variables was evaluated with the Shapiro-Wilk test, and the homogeneity of the group variances was checked with Levene's test. Since the assumptions of the parametric tests were not met, the Mann-Whitney U test was used to compare the medians of two independent groups. Results were expressed as mean±standard deviation and median value, min.-max. and interquartile range [IQR]. Categorical data were analyzed with Fisher's Exact Test and Pearson's Chi-square test. p<0.05 values were considered statistically significant. Data obtained in this study were evaluated using the SPSS version 17.0 [SPSS, Social Package for Social Sciences, IBM Inc., Chicago, IL, USA] software.

Ethical Approval

Ethics Committee approval for the study was obtained.

Results

A total of 1305 patients who underwent URS and met inclusion criteria were included in the study. Of these, general anesthesia was performed in 461 [35.3%] and spinal anesthesia in 884 [64.7%] patients. The mean age was statistically significantly higher in the general anesthesia group [49.57±15,31] compared to the spinal anesthesia group [47.21±13.19] [p<0.01]. In the general anesthesia group, 314 [69.5%] patients were male and 138 [30.5%] patients were female. In the spinal anesthesia group, 568 [67%] were male and 280 [33%] were female. No significant difference was found between the groups in terms of gender [p=0.383].

Considering preoperative characteristics, there was a significant difference between the groups in terms of ASA class and stone size, while no significant difference was found in terms of previous ESWL application and stone laterality (Table 1).

Comparison of operative characteristics according to the types of anesthesia is given in Table 2.

Comparison of the postoperative characteristics between the groups is given in Table 3.

Whether stone localization affects the outcomes of URS according to the type of anesthesia was evaluated. In the patients with upper ureter stones, stone free rate was significantly higher in the spinal anesthesia group [p<0.05]. Operation time and length of stay in hospital were higher in the general anesthesia group with upper ureter stones [both, p<0.01].

In the patients with middle ureter stones, the stone size was significantly greater in the spinal anesthesia group [p<0.01]. Operation time and length of stay in hospital were higher in the general anesthesia group with middle ureter stones [both, p<0.01].

In the patients with lower ureter stones, the stone size was significantly greater in the spinal anesthesia group [p<0.01]. Operation time and length of stay in hospital were higher in the general anesthesia group with middle ureter stones [both, p<0.01].

Table 1. Comparison of preoperative characteristics between the types of anesthesia.

		General Anesthesia	Spinal Anesthesia	p value
Stone Localization N [%]	Upper Ureter	84 [%18.9]	22 [%15.2]	p<0, 001
	Middle Ureter	123 [%27.6]	155 [%19.3]	
	Lower Ureter	238 [%53.5]	527 [%65.5]	
ASA Class N [%]	Mild	203 [%45.7]	467 [%58.2]	p<0, 001
	Medium	210 [%47.3]	312 [%38.9]	
	Severe	31 [%7]	24 [%3]	
ESWL N [%]	Yes	103 [%23.3]	177 [%22.4]	0.723
	No	339 [%76.7]	613 [%77.3]	
Stone Size [mm]	Mean ± SD	9.07 ± 3.82	9.38 ± 3.51	p<0, 001
Stone Laterality N [%]	Right	243 [%54.5]	424 [%52.7]	0.555
	Left	203 [%45.5]	380 [%47.3]	

Table 2. Comparison of operative characteristics between the types of anesthesia.

		General Anesthesia	Spinal Anesthesia	p value
Use of DJS N [%]	Yes	269 [%60.6]	261 [%32.5]	p<0.001
	No	175 [%39.4]	543 [%67.5]	
Operation Time [min]	Mean ± SD	68.34±37.62	53.15± 31.71	p<0.001
Stone removal method N [%]	Lithotripsy	149 [%33.6]	749 [%93.3]	p<0.001
	Extraction	295 [%66.4]	54 [%6.7]	
Catheter use in USR N [%]	Basket	30 [%6.8]	167 [%20.8]	p<0.001
	Stonecore	0 [%0]	10 [%1.2]	
	None	414 [%93.2]	627 [%78]	

Table 3. Comparison of postoperative characteristics between the types of anesthesia.

		General Anesthesia	Spinal Anesthesia	p value
Operation outcome N[%]	Stone free	336 [%75]	639 [%79]	0.105
	Residual fragments	112 [%25]	170 [%21]	
Use of analgesics N [%]	NSAID	383 [%86.3]	687 [%85.6]	0.799
	Narcotic analgesics	61 [%13.7]	116 [%14.4]	
Length of stay [days]	mean ± SD	2.61±2.23	1.12±0.72	p<0.001
Postop Complications [Clavien]	No	429 [%94.9]	817 [%96.3]	0.423
	Clavien I	14 [% 3.1]	19 [%2.3]	
	Clavien 2	1 [%0.2]	3 [%0.3]	
	Clavien 3	8 [%1.7]	9 [%1.1]	

Discussion

Majority of stones in the urinary system are ureter stones. The aim of the treatment of ureteral stones is to ensure that the patient is completely stone free with minimal complications. Today, ESWL and USR are commonly used for this purpose. URS is preferred in the treatment of all ureter stones and especially middle and lower ureter stones in the cases where ESWL fails and depending on the patient's preference.

USR is usually performed under general anesthesia. The purpose of performing URS with general anesthesia is to keep the patient still, to provide breath control and thus to reduce the risk of ureteral injury. The use of spinal anesthesia in URS is becoming widespread due to the reduction of hospital stay, reduction of postoperative analgesic use and complications, early oral feeding, less neurological complications and less risk of anaphylaxis due to the anesthetic agent used. In the present study, we compared preoperative, operative and postoperative characteristics of USR procedure under general and spinal anesthesia.

In our study the mean age was 49.57 years in the general anesthesia and 47.21 years in the spinal anesthesia group. Our findings are in the range specified in the literature [17,19,20].

In our study, the mean stone size was 10.94± 4.42 mm in the general anesthesia and 9.8±3.20 in the spinal anesthesia group, without significant difference between them [p=0.161]. Cai et al. found the stone size as 11.45 ± 3.49 mm in the general anesthesia and 11.11 ± 2.89 in the spinal anesthesia group [p=0.286] [20]. In a study by Topaktas et al., the mean stone size was 11.1 ±2.1 in the general anesthesia and 10.1 ±2.2 in the spinal anesthesia group [19]. In a study by Bosio et al. with 234 patients who underwent URS under spinal anesthesia, the stone size was 13.5 ± 6.6 mm [21].

Operation time and length of stay in the hospital are two important characteristics of USR procedures. Cai et al. compared the effects of general, spinal and epidural anesthesia on surgical outcomes during flexible URS for single stone removal surgeries. They found that the lithotripsy time [p=0.359], operation time [p=0.449], intraoperative complications [p=0.058], and length of hospital stays [p=0.057] of patients were similar among anesthesia groups [20]. In our study, operation time and length of stay in hospital were significantly shorter in the spinal anesthesia group [both, p<0.001]. In the study by Bosio et al. the mean operation time was 76.9 ± 34.6 min [21]. In a study by Topaktas the mean operation time was similar between the general and spinal anesthesia groups. Patients were discharged on the same day of surgery [19]. The differences among the studies might result from our higher number of patients included.

Another important indicator of procedural success is stone free rate. In the present study, stone-free rate was found as 75% in the general anesthesia and 79% in the spinal anesthesia groups. In the study by Cai et al. stone-free status was reported as 88% with general anesthesia and 85% with spinal anesthesia [20].

Ureter stone laterality may affect the treatment outcome [22]. In our study, 54.5% of the stones were on the right side and 45.5% were on the left side in the general anesthesia group and 52.7% on the right side and 47.3% on the left side in the spinal anesthesia group. In the study by Topaktas, 53.1% of the stones were on the right side and 46.8% were on the left side in the general anesthesia group and 52.5% on the right side and 47.5% on the left side in the spinal anesthesia group [19]. Laterality of the stones in our study was consistent with the other studies.

Stone location is one of the important factors affecting the surgical procedure. In the present study, the rate of stones in the lower ureter was higher in both general and spinal anesthesia groups [p<0.001]. In a study by Oztekin et al., there was no significant difference between the stone localization in both groups [p=0.965] [17]. It can be explained by a small number of patients in their study.

Postoperative complications were measured using Clavien classification. In our study no significant difference was found between the groups in terms of Clavien classes. Similarly, Cai et al. reported no significant difference between the general, spinal and epidural anesthesia group in terms of postoperative Clavien classification except for nausea and vomiting that were significantly more common with general anesthesia [20] [p=0.013].

Study Limitations

The major limitations of this study are its retrospective design and being conducted in a single center. In addition, comorbidities could not be studied. Finally, we could not compare our results exactly due to the scarcity of studies on this issue. However, the number of patients in our study was relatively large. Given the limited number of studies on this topic, we believe that our findings will be guiding for future more comprehensive multi-center studies.

Conclusion

Despite stone size being greater in the spinal anesthesia group, URS outcomes and postop complications were similar between the two groups. Operation time and length of stay in hospital were shorter in the spinal anesthesia group. Catheter use was less in the spinal anesthesia group. Spinal anesthesia can be readily used in URS procedures regardless of stone size. However, further comprehensive randomized controlled prospective studies are needed to support these findings.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

References

1. Kirkali Z, Rasooly R, Star RA, Rodgers GP. Urinary Stone Disease. Progress, Status, and Needs Urology. 2015 ;86(4):651-3.
2. Umbehr MH, Müntener M. Urolithiasis. Ther Umsch. 2021;78(5):215-21.
3. Türk C, Petřík A, Sarica K, Seitz C, Skolarikos A, Straub M, et al. EAU Guidelines on Interventional Treatment for Urolithiasis. Eur Urol. 2016;69(3):475-82.
4. Guner E, Seker KG. Contents of Urinary System Stones in North Marmara Region and Their Distribution by Gender. J Urol Surg. 2020;7(1):33-36.

5. Alelign T, Petros B. Kidney Stone Disease: An Update on Current Concepts. Adv Urol. 2018;2018:3068365. DOI: 10.1155/2018/3068365.
6. Worcester EM, Coe FL. Nephrolithiasis. Prim Care. 2008; 35(2):369-91.
7. Aboelkher KM, Abd-Elgawad OA, Abd-Elbaky TM, Elsherif EA. Percutaneous nephrolithotomy versus extracorporeal shock wave lithotripsy for moderate-sized kidney stones. Menoufia Med J.2017; 30 (2):372-7.
8. Paik ML, Resnick MI. Is there a role for open stone surgery? Urol Clin North Am. 2000;27(2): 323-31.
9. Honeck P, Wendt-Nordahl G, Krombach P, Bach T, Häcker A, Alken P. Does open stone surgery still play a role in the treatment of urolithiasis? Data of a primary urolithiasis centre. J Endourol. 2009;23:1209-12.
10. El-Husseiny T, Buchholz N. The role of open stone surgery. Arab J Urol. 2012; 10(3):284-8.
11. Yazici O, Tuncer M, Sahin C, Demirkol MK, Kafkasli A, Sarica K. Shock Wave Lithotripsy in Ureteral Stones: Evaluation of Patient and Stone Related Predictive Factors. Int Braz J Urol. 2015; 41(4):676-82.
12. Younesi Rostami M, Taghipour-Gorgikolai M, Sharifian R. Treatment of Kidney Stones Using Extracorporeal Shock Wave Lithotripsy (ESWL) and Double-J Stent in Infants. Adv Urol. 2012;2012:589038.
13. Matlaga BR, Jansen JP, Meckley LM, Byrne TW, Lingeman JE. Treatment of ureteral and renal stones: A systematic review and meta-analysis of randomized, controlled trials. J Urol. 2012;188(1):130-7.
14. Wason SE, Monfared S, Ionson A, Klett DE, Leslie SW. Ureteroscopy. In: StatPearls (Internet). Treasure Island (FL): StatPearls Publishing; 2022.
15. Koo CH, Ryu JH. Anesthetic considerations for urologic surgeries. Korean J Anesthesiol. 2020 ;73(2):92-102.
16. Turk C, Petrik A, Sarica K, Seitz C, Skolarikos A, Straub M, Knoll T. EAU guidelines on interventional treatment for urolithiasis. Eur Urol. 2016;69(3) 475-82.
17. Oztekin U, Caniklioglu M, Atac F, Kantekin CU, Gurel A, Isikay L. Comparison of Safety and Efficiency of General, Spinal and Epidural Anesthesia Methods Used for the Endoscopic Surgical Treatment of Ureteral Stones: Which One is Better to Access The Ureter and Reach The Stone? Urol J. 2020;17(3):237-42.
18. Fuat K, Bora I, Volkan S, Erbatu O, Ongün S, Yıldız A, et al. Effect of the anesthetic method on the outcomes of ureteroscopy for proximal ureteral stones: A multi-center study of the society of urological surgery aegean study group. J Urol Surg. 2018;5(4):170-5.
19. Topaktas R, Altin S, Aydin C, Akkoc A, Urkmez A, Aydin ZB. Is spinal anesthesia an alternative and feasible method for proximal ureteral stone treatment? Cent European J Urol. 2020;73(3):336-41.
20. Cai H, Wu X, Chen X, Chen W. Comparison of the effects of general, spinal and epidural anesthesia on ureter access and surgical outcomes during flexible ureterorenoscopy for transurethral single stone removal surgeries: a monocentric retrospective study. Ann Med. 2021;53(1):2110-19.
21. Bosio A, Alessandria E, Dalmasso E, Agosti S, Vitello F, Vercelli E, et al. Flexible Ureterorenoscopy Versus Shockwave Lithotripsy for Kidney Stones ≤2 cm: A Randomized Controlled Trial. Eur Urol Focus. 2022; 8(6):1816-22.
22. Gunlusoy B, Degirmenci T, Arslan M, Kozacioglu Z, Nergiz N, Minareci S, et al. Ureteroscopic Pneumatic Lithotripsy: Is the Location of the Stone Important in Decision Making? Analysis of 1296 Patients. J Endourol. 2008; 22 (2):291-4.

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