JCTEI
JOURNAL OF CLINICAL TRIALS AND EXPERIMENTAL INVESTIGATIONS
Year: 2024 Volume: 3 Issue: 2

ORIGINAL ARTICLE

10.5281/zenodo.11306315

Effects of anesthesia methods applied in ureter upper end stone operations on early postoperative quality of life

Fatih Suslu[1] - Mehmet Ali Turgut[2] - Enes Celik[3] - Ilksen Donmez[4] - Fikret Salik[5]

1. Batman Traning and Research Hospital, Operating Theatre Anesthesia Department, Batman, Turkey
2. Mardin Traning and Research Hospital, Operating Theatre Anesthesia Department, Mardin, Turkey
3. Mardin Artuklu University Medical School Department of Anesthesiology and Reanimation, Mardin, Turkey
4. Istanbul Beyoglu Eye Traning and Research Hospital, Operating Theatre Anesthesia Department, Istanbul, Turkey
5. Dicle University Medical School Department of Anesthesiology and Reanimation, Diyarbakır, Turkey

Correspondence
Enes Celik, Mardin Artuklu University Medical School Department of Anesthesiology and Reanimation, Mardin Artuklu Üniversitesi Yenişehir Yerleşkesi, Diyarbakır Yolu Rektörlük Ek Bina Artuklu / Mardin.

e-mail
anestezistenescelik@gmail.com

Received: 20 February 2024
Revised: 5 May 2024
Accepted: 10 May 2024
Published: 20 May 2024

Keywords
- Anesthesia methods
- Spinal anesthesia
- Ureterorenoscopy

ORCID ID of the author(s):
FS: 0000-0002-2347-7149
MAT: 0000-0002-2622-6951
EC: 0000-0002-5546-4924
ID: 0000-0001-8581-6583
FS: 0000-0002-7715-3545

Abstract

Objective: Urinary system Stone disease (urolithiasis) is a disease that changes and is increasingly prevalent depending on many factors, and nowadays, monitoring, medical removal therapy, shock wave lithotripsy (SWL), ureterorenoscopy (URS), laparoscopic surgeries and open surgery to treat proximal ureter stones. In our study, we aimed to investigate the comparison of intraoperative tolerance and early postoperative quality of life levels of general anesthesia, spinal anesthesia and spinal anesthesia with adjuvant agent in patients to be operated for upper ureteral calculi.

Materials and methods: This study was conducted prospectively. In our study, we aimed to investigate the comparison of intraoperative tolerance and early postoperative life quality levels of patients with general anesthesia, spinal anesthesia and adjuvant spinal anesthesia in patients who will be operated on for upper ureteral stones, and for this purpose, 75 patients who were operated on and met the inclusion criteria were recruited. In our study, patients who were operated under general anesthesia were named as group 1, those who were operated under spinal anesthesia using only bupivacaine, group 2, and those who were operated using bupivacaine + fentanyl were named as group 3. Each group consisted of 25 patients. Statistical analyses were performed using SPPS v.20.0.

Results: It was observed that the duration of anesthesia, operation time, VAS pain scale, intraoperative heart rate change and intraoperative diastolic blood pressure did not show statistically significant difference between the groups. İt was determined that intraoperative systolic blood pressure was higher inboth groups that underwent spinal anesthesia compared to the group that was applied general anesthesia, and the spo2 level was lower.

Conclusions: In this study, in which we evaluated spinal anesthesia as an alternative to general anesthesia, we found that spinal anesthesia is also safe and effective in proximal ureter stone operations. Therefore we think that spinal anesthesia should be preferred more frequently due to the lower risk of postoperative nausea and vomiting, postoperative analgesia, early mobilization and early nutrition compared to general anesthesia.

Cite as: Suslu F, Turgut MA, Celik E, Donmez I, Salik F. Effects of anesthesia methods applied in ureter upper end stone operations on early postoperative quality of life. J Clin Trials Exp Investig. 2024;3(2):22-30.

Introduction

Urinary tract stone disease (urolithiasis) has a high prevalence that varies depending on climate, geography, ethnicity, diet and genetic factors. Up to 20% of urinary tract stones are ureteral stones (1,2). Important factors determining the spontaneous fall of ureteral stones are stone size and location. Patients with a stone size of ≤5 mm have a higher probability of spontaneous passage, whereas this probability is significantly lower in patients with a stone size of 10 mm or more. Proximal ureteral stones are less likely to fall spontaneously compared with stones in other parts of the ureter. The probability of spontaneous fall is 48% for proximal ureteral stones and 79% for distally located ureteral stones (3).

Currently, several methods are used to treat proximal ureteral stones, including monitoring, medical removal therapy, shock wave lithotripsy (SWL), ureterorenoscopy (URS), laparoscopic surgeries and open surgery. The current European Association of Urolithiology (EAU) urolithiasis guidelines recommend URS if the proximal ureteral stone size is >10 mm and SWL and URS as first-line treatment for stones <10 mm in size (4).

An acute symptomatic episode of stone disease is extremely painful and often results in emergency department admission. Annual direct medical cost of urinary tract stones, according to the Urological Diseases in America project funded by the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). It has been determined as 10 billion dollars, and this cost makes urinary system stone disease the most expensive urological condition (5). It is thought that obesity and diabetes are increasing day by day, and the cost of stone disease is likely to reach 1.24 billion US dollars / year by 2030 (6).

In our study, we aimed to investigate the comparison of intraoperative tolerance and early postoperative quality of life levels of general anesthesia, spinal anesthesia and spinal anesthesia with adjuvant agent in patients to be operated for upper ureteral calculi.

Materials and methods

Our study was conducted after the permission of the Ethics Committee of Kafkas University Faculty of Medicine Ethics Committee dated 30.04.2019 (Ethics No: 80576354-050-99/124) and the population of the study consisted of all patients who underwent surgery for upper ureteral calculi at Kafkas University Faculty of Medicine Health Education and Research Hospital between 01.05.2019 and 01.10.2020 and met the inclusion criteria.

In our study, it was aimed to reach the whole population by not selecting a sample and the inclusion criteria were: To be evaluated within the ASA I-II risk score, to be over 18 years of age, to undergo upper ureter stone operation, and accepting to participate in our study.

Exclusion criteria in our study were: Being under 18 years of age, middle or lower ureteral calculi, assessed in ASA III-IV-V risk scoring, patients with advanced heart failure and renal failure, and presence of advanced valvular heart disease.

In all patients included in our study, routine anesthesia examination was performed preoperatively and biochemical tests, complete blood count and bleeding parameter results were evaluated. Consent for our study was obtained from patients whose operation was not objectionable in terms of anesthesia and the patients were divided into 3 groups according to the anesthesia method applied.

Group 1 (GA): Patients under general anesthesia

Group Spinal 1 (S1): Patients undergoing spinal anesthesia with hyperbaric bupivacaine

Group Spinal 2 (S2): Patients who underwent spinal anesthesia with adjuvant (fentanyl 15 micrograms) added to hyperbaric bupivacaine.

Intraoperative vital signs (peak heart rate, non-invasive blood pressure, arterial pressure and spO2) of all patients were monitored and recorded at 5 minute intervals. On the day of the operation, intravenous (iv) vascular access was established with a 22 gauge angiocath in the preoperative room.

Protocol Applied to Patients Under General Anesthesia (GA): After IV access, 0.02 mg/kg midazolam was administered IV for premedication in the preoperative room. Anesthesia induction was achieved with 2-2.5 mg/kg propofol and 1-2 microgram/kg fentanyl IV. After the loss of eyelash reflex, 0.6 mg/kg rocuronium bromide was given and the patients were orotracheally intubated. For maintenance of anesthesia, 2-2.5% sevoflurane, 40/60% oxygen/nitrogenprotoxide mixture was used with a flow rate of 3 l/min and MAC:1. In case of intraoperative spontaneous respiration, 0.15 mg/kg rocuronium bromide was administered with an additional dose.

At the end of the operation, patients were extubated by decurarization (0.01 mg/kg Atropine, 0.02 mg/kg Neostigmine) after spontaneous respiration started. Near the end of the operation, 1 mg/kg contramal and 50 mg dexketoprofen trometamol were administered iv for postoperative analgesia.

Protocol for Group Spinal 1 Anesthesia (SA-M): After 10 ml/kg ringer lactate bolus was given after IV access, the patient was taken to the operation table. The patient was given a sitting position on the table. After appropriate skin cleansing, the skin and subcutaneous tissue were infiltrated with 2 ml 2% lidocaine under asepsis conditions and spinal anesthesia was administered using 12.5 mg hyperbaric bupivacaine with a 25 gauge spinal needle in the L3-L4 range. After the application, dermatome examination was performed with pinprick test at the 5th and 10th minutes by elevating the table by 15° and positioning. After dermatome examination, sedation was achieved with 0.02 mg/kg midazolam. Intraoperative complications (bradycardia, nausea, vomiting, hypotension etc.) and medications administered for their treatment were recorded.

Protocol for Group Spinal 2 Anesthesia Patients (SA-MF): After 10ml/kg ringer lactate bolus was given after IV access, the patient was taken to the operation table. The patient was given a sitting position on the table. After appropriate skin cleansing, the skin and subcutaneous tissue were infiltrated with 2 ml 2% lidocaine under asepsis conditions and spinal anesthesia was administered with a mixture of 12.5 mg hyperbaric bupivacaine and 15 microgram fentanyl with a 25 gauge spinal needle in the L3- 4 interval. After anesthesia, a 15° position was given to the head of the table which was placed in the supine position and dermatome examination was performed with pinprick test at the 5th and 10th minutes. After dermatome examination, sedation was achieved with 0.02 mg/kg midazolam. Intraoperative complications and medications administered for their treatment were recorded.

After the operation, all groups were followed up for the presence of postoperative (postop) pain, need for additional analgesia, vital signs (blood pressure arterial, pulse, respiratory rate, fever), early recovery (mobilization, delirium and oral feeding) and the results of the evaluation were recorded. Postoperative pain was measured using thevisual analog scale (VAS). (The visual analog scale is a validated, subjective measure of acute and chronic pain. Scores were recorded by the handwritten marking on a 10 cm line representing the continuum from "no pain" to "worst pain".)

Statistical analysis

Statistical analysis of the data in our study was performed using the SPSS 20.0 package program. Quantitative data were expressed as mean±standard deviation, qualitative data as percentage, and non-normally distributed data as median. In data analysis, the distribution of continuous variables was investigated with the Kolmogorov-Smirnov normality test. Student-t test was used for comparisons of two independent groups and the ANOVA test was used for comparisons of more than two groups for data conforming to normal distribution; the Mann-Whitney-U test was used for comparisons of two groups and the Kruskal-Wallis Test was used for comparisons of more than two groups for data not conforming to normal distribution. Pearson and Spearman correlation tests were used to determine the correlation between variables consisting of continuous data and the minimum significant value $p<0.05$ was accepted in all analyses.

Results

Demographic Data;

In our study, no statistically significant difference was found between the groups in terms of age, height, weight and gender ($p>0.05$). When the patients were examined in terms of ASA score, duration of anesthesia and duration of surgery, no statistically significant difference was found between the groups ($p>0.05$) (**Table 1**).

Intraoperative and Postoperative Hemodynamic Changes;

There was no statistically significant difference between the groups in terms of preoperative, 10.min, 20.min, 30.min, 40.min and 50.min heart rates ($p>0.05$) (**Table 2**).

There was a statistically significant difference between the groups in terms of intraoperative systolic blood pressure changes at 20.min, 30.min, 40.min ($p<0.05$) (**Table 3**).

The p values at the minutes of statistically significant difference were compared between the groups and shown in **Table 4**.

There was no statistically significant difference between the groups in terms of preoperative, 10.min, 20.min, 30.min, 40.min and 50.min diastolic blood pressure ($p>0.05$). When the intraoperative spO2 changes at 10.min, 20.min, 30.min, 40.min and 50.min were analyzed between the groups, Group 1 had a statistically higher spO2 level than the other groups and showed a statistically significant difference ($p<0.05$) (**Table 5**).

Groups with statistically significant differences were evaluated with Bonferroni test and shown in **Table 6**.

Statistical comparison of postoperative VAS Score, mobilization, fasting and time to discharge between the groups showed no significant difference ($p>0.05$). When the development of postoperative complications between the groups was compared statistically, no statistically significant difference was found between the groups ($p>0.05$). Among all patients, 14 patients developed postoperative complications and 6 patients had vomiting, 7 patients had headache, and 1 patient had both vomiting and headache.

Discussion

In our study, general anesthesia, spinal anesthesia using hyperbaric bupivacaine and spinal anesthesia using hyperbaric bupivacaine + fentanyl mixture were compared in terms of intraoperative hemodynamics, presence of postoperative pain, vital signs (blood pressure arterial, pulse, respiratory rate, fever), early recovery (mobilization, delirium and oral feeding) and development of postoperative complications in patients operated for upper ureteral calculi.

Ureteroscopy (URS), one of the most commonly used surgeries in urological surgery, is used to diagnose and treat problems in the urinary tract, such as ureteral stones. URS is the most common procedure

Table 1: Distribution of demographic data (Mean ± SD)

	Group 1 (n=25)	Group 2 (n=25)	Group 3 (n=25)	p-value
Age (years)	45.96±13.2	49.84±15.6	51.56±17.4	0.431
Weight (kg)	80.76±15.3	75.24±12.9	79.24±19.9	0.473
Height (cm)	171.40±6.9	166.36±7.7	166.84±8.8	0.050
Sex(M/F) (n)	19/6	14/11	18/7	0.276
ASA^{+} (I/II) (n)	13/12	19/6	16/9	0.210
Anesthesia Duration (min)	75.84±31.6	62.76±21.5	62.52±28.2	0.153
Operation Duration (min)	63.32±32.7	52.60±21.8	54.88±28.2	0.366

$^{+}$ **ASA** = American Society of Anesthesiologists Score

Table 2: Intraoperative heart rate changes (Mean ± SD)

	Group 1 (n=25)	Group 2 (n=25)	Group 3 (n=25)	p-value
Pre-op	81.68±16.2	81.12±10.9	8.44±12.38	0.989
10 min.	80.92±16.1	79.24±12.5	76.88±12.24	0.583
20 min.	77.48±18.3	76.36±12.2	77.92±16.2	0.938
30 min.	73.24±13.9	75.24±13.8	74.76±14.8	0.875
40 min.	68.24±14.3	73.72±14	74.04±16	0.305
50 min.	67.12±1.6	73.48±13.4	70.84±14.5	0.325

Table 3: Intraoperative systolic blood pressure changes, (Mean ± SD)

	Group 1 (n=25)	Group 2 (n=25)	Group 3 (n=25)	p-value
Pre-op.	143.16±22.2	143.16±33.5	151.52±16.4	0.401
10 min	123.92±21.1	135.28±22.1	135.76±16.5	0.06
20 min	116.12±24.4	134.12±20.3	124.20±19.9	0.01*
30 min	110.84±15.2	127.6±19.1	124.80±20.4	0.00*
40 min	112.56±15.2	128.44±18.2	125.44±16.1	0.00*
50 min	120.80±24.7	128.96±18.7	125.76±17.3	0.37

* p-value <0.05 is considered as statistically significant difference

Tablo 4: Intraoperative Systolic Blood Pressure changes (Comparison between groups)

Variable	**Group**	**Group**	**P Value**
20 min.	Group 1	Group 2	0.013*
		Group 3	0.574
20 min.	Group 2	Group 1	0.013*
		Group 3	0.330
30 min.	Group 1	Group 2	0.006*
		Group 3	0.027*
30 min.	Group 2	Group 1	0.006*
		Group 3	1.000
40 min.	Group 1	Group 2	0.003*
		Group 3	0.023*
40 min.	Group 2	Group 1	0.003*
		Group 3	1.000

*P-value <0.05 is considered as statistically significant difference

Table 5: Intraoperative Spo2 Changes (Mean ± SD)

	Group 1 (n=25)	Group 2 (n=25)	Group 3 (n=25)	p-value
Pre-op	95.92±3.9	95.24±2.7	94.84±3.5	0.539
10 min.	98.96±1	97.56±1.4	96.20±3.2	0.000*
20 min.	99.04±0.9	9756±1.7	96.20±3.3	0.000*
30 min.	99.08±0.8	97.88±1.8	96.88±3.05	0.002*
40 min.	99.04±0.9	98.32±1.6	96.88±2.9	0.001*
50 min.	99.24±0.7	98.24±1.5	96.88±3.2	0.001*

*P-value <0.05 is considered as statistically significant difference

Table 6: Intraoperative Spo2 Changes (Comparison between groups)

Variable	Group	Group	P
10 min.	Group 1	Group 2	0.069
		Group 3	0.000*
10 min.	Group 2	Group 1	0.069
		Group 3	0.081
20 min.	Group 1	Group 2	0.071
		Group 3	0.000*
20 min.	Group 2	Group 1	0.071
		Group 3	0.111
30 min.	Group 1	Group 2	0.145
		Group 3	0.001*
30 min.	Group 2	Group 1	0.145
		Group 3	0.295
40 min.	Group 1	Group 2	0.629
		Group 3	0.001*
40 min.	Group 2	Group 1	0.629
		Group 3	0.041*
50 min.	Group 1	Group 2	0.312
		Group 3	0.001*
50 min.	Group 2	Group 1	0.312
		Group 3	0.085

* p-value <0.05 is considered as statistically significant difference

performed by urologists worldwide. This procedure was first performed by Young in 1902 in a patient with a proximal ureteral stone. It became more popular in urology following advances in rod-lens optical systems by Dr. Hopkins in the 1960s and fiberoptic cables and cold light sources by Karl-Storz (7).

URS dilates the renal capsule, ureter and renal collecting system, thereby stimulating nociceptors, resulting in pain and reflex muscle spasm. This procedure should therefore be performed under adequate anesthesia (8,9). In our study, we analyzed the patients who underwent upper end ureteral stone operation with URS.

Katafigiotisltay et al. retrospectively evaluated 570 consecutive patients referred for ureteroscopy or ureterorenoscopy for the treatment of ureteral or renal stones and reported that the type of anesthesia affected the duration and efficacy of the operation (10). According to Katafigiotisltay et al., the mean operation time under general anesthesia was 89.76 minutes, while this time was significantly shorter under spinal anesthesia (mean 69.07 minutes). In our study, by the literature, the mean operation time of the general anesthesia group (63.32 min) was higher than the mean operation time of the group operated under spinal anesthesia (mean 52.74 min), but there was no statistically significant difference. We think that the operation time under general anesthesia technique may be prolonged in studies due to reasons such as longer preparation time, intubation of the patient and longer postoperative awakening times; we also think that verbal communication with the patient while the

patient is given pron position in spinal anesthesia and the patient's good response to the orders given may be factors that shorten the operation time.

Barut et al. 82 patients who underwent PCNL (percutaneous nephrolithotomy) operation investigated the efficacy and safety of PCNL operations performed under spinal and general anesthesia. They found the length of hospital stay to be 51.08±11.27 hours in the operation performed under general anesthesia and 50.12±11.18 hours in the operation performed under spinal anesthesia and reported no statistically significant difference (11). We found no statistically significant difference in our study.

In a prospective study by Bartels et al. 936 patients who underwent general anesthesia alone were compared with 266 patients who underwent regional anesthesia in addition to general anesthesia in terms of postoperative pulmonary complications (12). Similarly, there was no significant difference in postoperative complications in our study.

Öztekin et al. in a prospective randomized study of 105 patients investigated the effect of anesthesia method in reaching ureteral calculi in patients undergoing URS. In their study, they emphasized that regional anesthesia methods may be preferred to reduce the risks associated with general anesthesia (13). Cai et al. In their study of 392 patients, they investigated the effect of anesthesia method on surgical outcomes. And in their study, they emphasized that surgical results depend on the surgery itself rather than the anesthesia method (14). The common feature of these two studies is that general anesthesia caused earlier dilatation of the ureter. Bosio et al. reported better postoperative pain control and shorter hospital stay compared to general anesthesia in their study of 234 patients who underwent flexible URS with spinal anesthesia. They also emphasized that spinal anesthesia can be used not only when the risks of general anesthesia are avoided but also in routine practice (15). In our study, we found that the method of anesthesia did not directly affect the surgical results and the frequency of postoperative complications. Therefore, we think that general anesthesia is not a standard method for URS and spinal anesthesia can be used safely.

Sahan et al. showed that there was no difference between anesthesia methods in terms of postoperative pain in their prospective, randomized study comparing regional and general anesthesia in patients undergoing flexible URS. In their study, more bradycardia was observed in patients who received 15 mg hyperbaric bupivacaine intrathecally for combined epidural anesthesia compared to general anesthesia (16). In our study, heart rate was measured at preoperative, 10 min, 20 min, 30 min, 40 min and 50 min and no statistically significant difference was found between the groups. In our study, in terms of intraoperative hemodynamics, we found that systolic blood pressure was higher in the spinal anesthesia group than in the general anesthesia group. We think that this may be explained by the stress response due to the open consciousness in the spinal anesthesia group and that the lower systolic blood pressure in the bupivacaine + fentanyl group compared to the bupivacaine only group may be explained by the hypotensive effect of fentanyl (17).

Considering that there are a limited number of studies on this subject in the literature and most of these studies are related to general anesthesia, we can say that spinal anesthesia is also safe and effective in upper end ureteral stone operations. Therefore, we think that spinal anesthesia should be preferred more frequently because it has a lower risk of postoperative nausea and vomiting compared to general anesthesia and provides postoperative analgesia, early mobilization and early feeding.

Conclusions

Our study results show that all three methods can be safely applied. General anesthesia may be preferred in cases where rapid induction is required and in cases where sympathetic blockade may cause dilation of the vascular bed. Spinal anesthesia may be preferred because the patient is awake, the risk of aspiration is minimal and reflexes such as coughing and swallowing are preserved.

Conflict of interest

The authors report no conflict of interest.

Funding source

No funding was required.

Ethical approval

The study was conducted in accordance with the Declaration of Helsinki and approved by the Local Independent Ethics Committee. The permission of

the Ethics Committee of Kafkas University Faculty of Medicine Ethics Committee dated 30.04.2019 (Ethics No: 80576354-050-99/124)

Informed consent

Written informed consent was obtained from all individual participants and/or their gaurdians.

Acknowledgments

This study is based on the thesis of Dr. Fatih Suslu's medical specialty thesis. YOK Tez No: 687297.

Peer-review

Externally. Evaluated by independent reviewers working in at least two different institutions appointed by the field editor.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Contributions

Research concept and design: FS, ID, FS

Data analysis and interpretation: FS, FS

Collection and/or assembly of data: FS, FS

Writing the article: FS, MAT, EC, FS

Critical revision of the article: FS, EC, ID, FS

Final approval of the article: MAT, FS, ID, FS

All authors read and approved the final version of the manuscript.

References

1. Sancak EB, Kılınç MF, Yücebaş SC. Evaluation with decision trees of efficacy and safety of semirigid ureteroscopy in thetreatment of proximal ureteral calculi. Urol Int. 2017;99(3):320-5.
2. Reis Santos JM. Ureteroscopy from the recentpastto the near future. Urolithiasis. 2018;46(1):31-7.
3. Coll DM, Varanelli MJ, Smith RC. Relationship of spontaneous passage of ureteral calculitostone size and location as revealed by unenhancedhelical CT. AJR Am J Roentgenol. 2002;178(1):101-3.
4. Türk C, Neisius A, Petrik A, Seitz C, Thomas K. Guidelines on urolithiasis. Arnhem: European Association of Urology; 2018. Available at http://www.uroweb.org/gls/pdf.
5. Litwin MS, Saigal CS. National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, PublicHealth Service, US Department of Healthand Human Services. Urologic Diseases in America; Washington, DC: 2012. Table 14-47: Economic impact of urologic disease; p. 486. NIH publication 12-7865.
6. Antonelli JA, Maalouf NM, Pearle MS, Lotan Y. Use of the National Health and Nutrition Examination Survey to calculate the impact of obesity and diabetes on cost and prevalence of urolithiasis in 2030. Eur Urol. 2014;66(4):724-9.
7. Kılınç MF, Doluoğlu ÖG, Karakan T, Dalkılıç A, Sönmez NC, Yücetürk CN, et al. The effect of ureteroscope size in the treatment of ureteral stone: 15-year experience of an endoscopist. Turk J Urol. 2016;42(2):64-9.
8. Hosking DH, Bard RJ. Ureteroscopy with intravenous sedation for treatment of distal ureteral calculi: a safe and effective alternative to shockwave lithotripsy. J Urol. 1996;156(3):899-901.
9. Chan PS, Fenn J, Li AK. Transurethral ureterorenoscopic lithotripsy and retrieval of uretericcalculi under local anaesthesia and sedation. Br J Urol 1990;65(2):141-3.
10. Katafigiotis I, Sabler IM, Heifetz EM, Isid A, Sfoungaristos S, Lorber A, et al. Factors Predicting Operating Room Time in Ureteroscopy and Ureterorenoscopy. Curr Urol. 2019;12(4):195-200.
11. Barut O, Resim S. Comparison Of Different Anesthesia Methods In Patients With Percutaneous Nephrolithotomy. The New J Urol. 2020;15:1-6.
12. Bartels K, Frendl G, Sprung J, Weingarten TN, Subramaniam B, Martinez Ruiz R, et al. Postoperative pulmonary complications with adjuvant regional anesthesia versus general anesthesia alone: a sub-analysis of the Perioperative Research Network study. BMC Anesthesiol. 2022;22(1):136.
13. 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.
14. 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):2110-9.

15. Bosio A, Alessandria E, Vitiello F, Vercelli E, Agosti S, Gontero P. Flexible Ureterorenoscopy under Spinal Anesthesia: Focus on Technique, Results, Complications, and Patients' Satisfaction from a Large Series. Urol Int 2022;106(5):455-60.

16. Sahan M, Sarilar O, Akbulut MF, Demir E, Savun M, Sen O, et al. Flexible ureterorenoscopy and laser lithotripsy with regional anesthesia vs general anesthesia: A prospective randomized study. Int Braz J Urol. 2020;46(6):1010-8.

17. Billard V, Moulla F, Bourgain JL, Megnigbeto A, Stanski DR. Hemodynamic response to induction and intubation. Propofol/fentanyl interaction. Anesthesiology 1994;81(6):1384-93.