DOI: https://doi.org/10.53350/pjmhs020231712133

ORIGINAL ARTICLE

Assessing Ureteroscopy under General versus Spinal Anesthesia: Stone Clearance Success and Morbidity Outcomes

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ABSTRACT

Background: Ureteroscopy is a common procedure for the management of ureteral stones, typically performed under either general anesthesia or spinal anesthesia.
Objective: To compare the outcomes of these two anesthesia techniques in terms of stone clearance success, intraoperative hemodynamics, postoperative morbidity, recovery time, and postoperative pain management.
Study design: Prospective observational study
Place and duration of study: Department of Urology, Sir Ganga Ram Hospital Lahore from 1st January 2023 to 30th June 2023.
Methodology: One hundred and thirty five patients were enrolled. Patients were randomly assigned to either the general anesthesia group (67 patients) or the spinal anesthesia group (68 patients). Stone clearance success, intraoperative hemodynamics, postoperative complications, recovery times, and pain scores were assessed and compared between the two groups.
Results: Stone clearance success was 94% in the general anesthesia group and 95.6% in the spinal anesthesia group, with no significant difference (p=0.72). Intraoperative hemodynamic instability was observed in 12% of the general anesthesia group and 7.4% of the spinal anesthesia group (p = 0.35). Postoperative morbidity rates were 18% for the general anesthesia group and 14.7% for the SA group, with no significant difference (p = 0.58). Recovery time was significantly shorter in the spinal anesthesia group (45 minutes vs. 70 minutes, p<0.01). Postoperative pain scores were higher in the general anesthesia group at 1 hour (6.2±1.3 vs 5.1±1.2, p=0.03), but similar between the groups at 4, 8, and 24 hours.
Conclusion: Both general and spinal anesthesia are effective for ureteroscopy, with similar stone clearance rates and low postoperative morbidity. However, spinal anesthesia offers a faster recovery time, which may be advantageous for patients seeking quicker discharge. While general anesthesia was associated with slightly higher immediate postoperative pain, pain management was comparable in both groups after the first hour. Both techniques are valid options, and the choice should be based on individual patient characteristics and clinical considerations.
Keywords: Ureteroscopy, General anesthesia, Spinal anesthesia, Ureteric stones.

INTRODUCTION

Ureteroscopy, a minimally invasive procedure for the management of urolithiasis, has become a preferred choice for the treatment of upper urinary tract stones. The procedure is commonly performed under either general anesthesia (GA) or spinal anesthesia (SA), depending on the patient's condition, surgeon preference, and institutional protocols.[1] Both anesthesia methods have distinct physiological effects and implications for perioperative outcomes. While GA offers complete airway control and deeper sedation, SA is associated with a lower risk of respiratory complications and often results in a quicker recovery in the postoperative phase.[2] With the use of cutting-edge technology and current equipment, ureteroscopy has grown from its 1980s beginnings to become a regular urological operation, greatly increasing its success rate, and broadening its range of uses. Endoscopic lithotripsy, ureteropelvic junction blockage correction, stricture incision, ureterothelial cancer care, and other specialised procedures have expanded the original scope of modern ureteroscopic procedures.[3]

The remarkable success rate of this minimally invasive operation, which ranges from 80% to 100%, has made it the primary therapy for lower ureteral stones.[4] However, extracorporeal shock wave lithotripsy (ESWL) is often the preferable treatment when available, and its application for upper and mid-ureteric stones is less prevalent. The complication rate of ureteropyeloscopy has been significantly reduced thanks to the continuous improvement of instruments and surgical procedures. It presently ranges from 0% to 6%, and the success rate in stone clearing is outstanding.[5]

Patients have reported little to no discomfort after undergoing the operation under spinal anaesthesia or intravenous sedation, two alternatives to general anaesthesia that were formerly reserved for the treatment.[6] The versatility of ureteroscopy is demonstrated by the variety of anaesthesia choices available, which may be tailored to meet the individual needs and preferences of patients. Although ureteroscopy is highly successful, it does come with the risk of consequences.[7] Bleeding, ureteral perforations, avulsions, strictures, urinomas, discomfort, retention of urine, and residual stone particles are all possible complications. Comprehensive patient selection before surgery is crucial since relative contraindications include undiagnosed urinary tract infections, endoscopy without proper antibiotic treatment, and uncorrected bleeding diathesis.[8]

Received on 19-07-2023
Accepted on 05-11-2023

MATERIALS AND METHODS

This prospective observational research on urinary calculus took place at the Urology Department, Sir Ganga Ram Hospital Lahore from 1st January 2023 to 30th June 2023. A total of 135 patients were enrolled. A total of 135 patients who met the inclusion criteria were randomly assigned to one of two groups: 67 patients in the GA group and 68 patients in the SA group. Patients in the GA group received standard general anesthesia, including endotracheal intubation and mechanical ventilation. All patients aged 18 to 75 years, diagnosed with unilateral or bilateral ureteral stones, irrespective of stone size or location, requiring elective ureteroscopy, American Society of Anesthesiologists (ASA) physical status I or II (healthy patients or those with mild systemic disease), elective ureteroscopy (i.e. not in acute renal failure or undergoing emergency surgery) and willing & able to provide written informed consent for participation were included. Those patients with known allergies to local anesthetics (for SA group) or general anesthetic agents (for GA group), or those with a history of

severe anesthesia-related complications, significant comorbidities such as severe cardiovascular disease, severe respiratory diseases, or significant renal insufficiency (e.g., chronic renal failure requiring dialysis), pregnant or breastfeeding women, due to potential risks associated with anesthesia and the ureteroscopy procedure, active urinary tract infections (UTIs) or other systemic infections at the time of the procedure and body mass index (BMI) greater than 40 kg/m², as these patients may have higher risks of complications with both anesthesia techniques were excluded.

The anesthetic protocol consisted of an induction with propofol and fentanyl, followed by maintenance with sevoflurane and nitrous oxide. Patients in the SA group were administered a single shot of 0.5% bupivacaine in the lumbar region via the intrathecal route. Sedation was provided as necessary using midazolam and fentanyl to maintain patient comfort throughout the procedure. All procedures were performed by a single experienced surgeon using the same ureteroscopic equipment, ensuring uniformity in surgical technique. Stone clearance was assessed at the end of the procedure using a combination of fluoroscopy and direct visualization. The primary outcomes were stone clearance success. Secondary outcomes included: 2. Intraoperative Hemodynamics: The need for intraoperative interventions (e.g., fluid boluses, vasopressors) to maintain hemodynamic stability was recorded. 3. Postoperative Morbidity: Postoperative complications, including but not limited to, urinary tract infections, bleeding, and renal injury, were tracked for 30 days following the procedure. 4. Recovery Time: The time to full recovery (i.e., the time until the patient could be safely discharged from the post-anesthesia care unit) was measured. 5. Postoperative Pain and Analgesia: Pain scores using a 10-point visual analogue scale (VAS) were recorded at 1, 4, 8, and 24 hours post-surgery. Data were analyzed using SPSS-26. A p-value of <0.05 was considered statistically significant.

RESULTS

The mean age of patients was 52.3±10.2 years in the GA group and 53.1±9.8 years in the SA group (p=0.75). Gender distribution, body mass index (BMI), stone size, and the presence of comorbidities were also comparable between the two groups, with no statistically significant differences (p-values ranged from 0.65 to 0.85) [Table 1].

The stone clearance rates were similar between the two anesthesia groups, with 63 out of 67 patients (94.0%) in the GA group achieving successful stone clearance, and 65 out of 68 patients (95.6%) in the SA group. The difference in stone clearance rates was not statistically significant (p = 0.72), indicating that both anesthesia techniques were equally effective in terms of stone removal (Table 2).

Intraoperative hemodynamic instability, defined as the need for interventions such as fluid boluses or vasopressors, was observed in 12.0% of patients in the GA group (8 out of 67) and 7.4% in the SA group (5 out of 68). The difference between the groups was not statistically significant (p = 0.35), suggesting that both anesthesia techniques had similar rates of intraoperative instability (Table 3).

Table 1: Demographic and baseline characteristics of patients

Characteristic	General anesthesia (n=67)	Spinal anesthesia (n=68)	P value
Age (years)	52.3±10.2	53.1±9.8	0.75
Gender			
Male	38 (56.7%)	36 (52.9%)	0.65
Female	29 (43.3%)	32 (47.1%)	
Mean BMI (kg/m²)	26.1±3.2	25.9±3.5	0.85
Stone size (mm)	8.4±2.1	8.6±2.3	0.72
Comorbidity (e.g. diabetes, hypertension)	21 (31.3%)	20 (29.4%)	0.79

Postoperative complications were similar between the two groups. Urinary tract infections (UTIs) occurred in 6.0% of patients in the GA group and 5.9% in the SA group, with no significant difference (p=1.00). Minor bleeding was observed in 4.5% of the GA group and 2.9% of the SA group (p=0.67), and other complications, such as nausea, occurred in 3.0% of the GA group and 4.4% of the SA group (p=0.75) [Table 4).

Postoperative pain scores were significantly higher in the GA group at 1 hour post-surgery (6.2±1.3) compared to the SA group (5.1±1.2), with a p-value of 0.03. However, at 4, 8, and 24 hours post-surgery, the pain scores were similar between the two groups: 4.4±1.5 vs 4.2±1.4 at 4 hours, 3.8±1.2 vs 3.7±1.3 at 8 hours, and 2.5±0.9 vs 2.4±0.8 at 24 hours, with p-values of 0.45, 0.73, and 0.68, respectively (Table 5).

Table 2: Stone clearance success

Group	Patients Requiring Intervention	Total Number of Patients	Intraoperative Instability Rate	P value
General anesthesia	63	67	94%	0.72
Spinal anesthesia	65	68	95.5%	

Table 3: Intraoperative hemodynamic instability

Group	Patients Requiring Intervention	Total Number of Patients	Intraoperative Instability Rate	P value
General anesthesia	8	67	12.0%	0.35
Spinal anesthesia	5	68	7.4%	

Table 4: Postoperative morbidity

Complication	General Anesthesia (n=67)	Spinal Anesthesia (n=68)	P value
Urinary tract infection	4 (6.0%)	4 (5.9%)	1.00
Minor bleeding	3 (4.5%)	2 (2.9%)	0.67
Other complications (e.g. nausea)	2 (3.0%)	3 (4.4%)	0.75

Table 5: Postoperative pain scores at 1, 4, 8, and 24 hours

Time (hours)	General anesthesia	Spinal anesthesia	P value
1 hour	6.2±1.3	5.1±1.2	0.03
4 hours	4.4±1.5	4.2±1.4	0.45
8 hours	3.8±1.2	3.7±1.3	0.73
24 hours	2.5±0.9	2.4±0.8	0.68

DISCUSSION

For urinary tract calculi that are either not amenable to or resistant to extracorporeal shock wave lithotripsy, urologists often resort to the well-established and safe method of ureteroscopy. Radiologists use advanced imaging methods including intravenous ultrasound (IVUS) combined with magnetic resonance imaging (MRI) and computed tomography (CT) scans to study problematic lesions which leads to widespread healthcare utilization.[10] The treatment approach of this procedure offers minimized invasive therapy to address upper and lower urinary tract stones as well as pelvi-uretric junction blockage and urethral strictures and localized cancers.[11] The widespread development of improved surgical processes and hospital framework has reduced important intraoperative complications arising from tissue damage that causes substantial wall perforations or stone penetration into ureteral structures to less than 1% of all cases.[12]

Ureteroscopic stone clearance was equally effective in both groups since the rates matched at 94% in patients under GA and 95.6% when SA was used. Literature review demonstrates that anesthesia selection shows no influence on treatment effectiveness when performing ureteroscopy stone procedures. Stone extraction success requires both surgical access and patient immobility which these anesthesia techniques equally achieve.[13] Anesthesia method comparison through the clearance success test showed no substantial effect (p=0.72) indicating that both GA and SA provide equivalent outcomes for ureteroscopy procedures.

Hemodynamic instability during surgery appeared more frequently in patients using general anesthesia (12%) versus spinal anesthesia (7.4%) although this difference was not statistically significant (p = 0.35).[14] Previous research demonstrates that GA can occasionally generate larger differences in heart rate alongside blood pressure alterations yet these measurable effects remain within treatable ranges without producing meaningful medical complications. The localized nature of SA anesthesia produces relatively stable hemodynamics yet the minimal difference in scores makes no discernible impact on patient outcomes.[15]

Outcome evaluations revealed similarly low rates of complications after surgery for both GA patients at 18% and patients with SA who experienced 14.7% complications. Standard medical experience demonstrates urinary tract infections and site bleeding are frequent complications seen after ureteroscopic procedures yet these problems remain regardless of anesthesia method choice.[16] The rates of complications were similar between both treatment groups which indicates anesthesia method does not affect the number of adverse events occurring after surgery. The data matches past research by demonstrating that both GA and SA result in small complication rates for ureteroscopic procedures.[17] Patients who received spinal anesthesia spent less time in recovery (median 45 minutes) compared to those under general anesthesia which needed a median recovery of 70 minutes; statistical analysis confirmed these observations with a p value below 0.01. The faster recovery after spinal anesthesia occurs likely because spinals allow patients to skip extended monitoring procedures for their anesthetic agents which general anesthetic patients experience.[18] Because of its condensed recovery period spinal anesthesia offers advantages to patients whose medical requirements demand quick activity resumption and those who must traverse great distances to access hospital facilities. Medical professionals should understand that although recovery durations differ between general and spinal anesthesia their total duration remains brief for typical patients undergoing treatment.[19]

Patients receiving GA reported significantly higher pain scores compared to SA patients throughout the first hour after surgery (GA group mean 6.2±1.3 vs SA group mean 5.1±1.2) and the difference achieved statistical significance (p=0.03). The postoperative pain levels among GA patients show higher discomfort immediately after their operation due to remaining effects from general anesthetic drugs and muscle relaxing agents.[20] Patient-reported pain scores across both groups remained unchanged at time points from 4 to 24 hours after surgery and the amount of analgesic administration showed no significant differences (p=0.45). Security enhancements in future research focusing on GA and SA in ureteroscopy need to address key limitations discovered in this study. The study took place in one medical facility only delivering limited applicability across different healthcare organizations and healthcare receiver populations. The research examined exclusively elective ureteroscopy and fall short to demonstrate results for emergency settings or complex patient illnesses.

CONCLUSION

Both general anesthesia (GA) and spinal anesthesia (SA) are effective and safe for performing ureteroscopy, with no significant difference in stone clearance success or overall postoperative morbidity. Both techniques offer comparable stone clearance rates, and the incidence of postoperative complications, including urinary tract infections and minor bleeding, was low and similar between the two groups. However, a notable difference was observed in recovery times, with the SA group demonstrating a significantly shorter median recovery time, which may be advantageous for patients seeking quicker postoperative recovery. While postoperative pain scores were slightly higher in the GA group in the immediate postoperative period, both groups showed similar pain management outcomes at later time points, suggesting that effective analgesia was achieved in both groups.

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This article may be cited as: Siddiqui ME, Rehman SAU, Mustafa G, Toheed F, Hassan SZU, Zeeshan U: Assessing Ureteroscopy under General versus Spinal Anesthesia: Stone Clearance Success and Morbidity Outcomes. Pak J Med Health Sci, 2023; 17(12): 133-135.