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Evaluation of spinal vs general anaesthesia for retrograde intrarenal procedures

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Abstract:

Patients diagnosed with kidney stones and having retrograde intrarenal surgery (RIRS) were the subjects of this research, which sought to evaluate spinal anaesthesia (SA) with general anaesthesia (GA) in terms of cost, success rate, effectiveness, and dependability.
We conducted a retrospective analysis of 82 patients who had RIRS at our clinic after a kidney stone diagnosis between 2020 and 2023. Time until stone fragmentation, duration of hospital stay, number of treatments needed, percentage of stones removed, frequency of complications, cost of anaesthesia, and length of operation were some of the metrics used to compare the groups.
Patients in the SA group had significantly older average ages and higher mean American Society of Anesthesiologists stages ($P = 0.009$, $P = 0.024$) compared to those in the GA group. When comparing the groups according to surgical time, stone fragmentation time, intraoperative double-J stent necessity, duration of hospital stay, and stone-free rate, there was no statistically significant difference ($P > 0.05$). Significantly, the SA group had a reduced anaesthesia cost ($P < 0.001$). In terms of the occurrence of complications, there was no statistically significant difference between the groups ($P > 0.05$).
One practical and efficient method for removing kidney stones is RIRS in conjunction with SA. Similar to RIRS given with GA, this method has a high success rate and a low complication rate. Since SA may be safely and effectively done with lower morbidity rates and much less cost than GA, we favour it for patients with comorbidities

Keywords: renal stone, anesthesia, spinal anesthesia, general.

More and more, people are opting for less intrusive ways to treat kidney stones. For renal stones less than 20 mm in size, some surgeons now choose the minimally invasive technique known as retrograde intrarenal surgery (RIRS) (1). Because of its reduced morbidity, less postoperative discomfort, and shorter hospital stay, RIRS is preferred over percutaneous nephrolithotomy (PNL) and extracorporeal shock wave treatment (ESWL) (2).
In order to minimise respiratory-induced renal movements, RIRS is often conducted under general

anaesthesia (GA). Yet, patients with pulmonary and cardiac comorbidities see an increase in morbidity when GA is administered. Because of the need for GA, both patients and surgeons may be hesitant to use even minimally invasive techniques like RIRS. Anaesthesia techniques that are less intrusive may enhance the success of minimally invasive surgical procedures. Anesthesiologists and patients alike choose regional anaesthesia because of its greater reliability in treating older patients with many chronic conditions. Spinal anaesthesia (SA) is one of these applications that is increasingly being employed because of its little anaesthetic administration, short hospital stay, and low postoperative discomfort (3). The fact that SA is more affordable than GA is an additional perk. Based on our previous work with SA in ureterorenoscopy, we believe that RIRS may be a reliable and efficient tool for performing flexible instrument surgeries to remove stones that have migrated into the kidney from the proximal ureter

The purpose of this research was to evaluate the relative merits of SA and GA in RIRS for renal stone treatment, taking into consideration the relative costs, effectiveness, reliability, and success rates of the two methods.

MATERIAL AND METHODS

We conducted a retrospective analysis of **82** patients who underwent RIRS at our clinic after a diagnosis of renal stones between 20**20** and 202**3**. cases who did not react to prior ESWL, had residual stones measuring less than 20 mm following PNL, and had renal stones measuring less than 20 mm (or up to 30 mm in certain cases) were all included in the research.
There was no standardisation in the size or quantity of stones; instead, patients were split into two groups according to the anaesthetic technique employed during surgery. Exclusion criteria for participation in the trial were individuals having an ASA score higher than 3.
In order to assess the patients' health prior to surgery, several imaging modalities were used, including plain films (KUB radiography), renal ultrasonography (USG), intravenous pyelography, noncontrast computed tomography (CT), and standard blood tests. During the preoperative radiological examination, the stone's size was estimated by measuring its longest axis. For kidney stones that were more than one size, the total of their biggest diameters was determined. Diabetes mellitus (DM), coronary artery disease (CAD), chronic obstructive pulmonary disease (COPD), and ASA scores were documented. An intravenous dosage of cefazolin (25-50 mg/kg for children and 1 g for adults) was administered as a prophylactic antibiotherapy prior to anaesthesia. Patients whose urine cultures came back positive were only surgically treated after taking culture-specific antibiotics and their urine had become sterile. All procedures were carried out with the use of flexible ureteroscopes after patients had given their written informed permission. Also, adults utilised Navigator HD sheaths from Boston Scientific, while minors used 9.5-11.5 F, 20- and 28-cm Cook medical ureteral access sheaths. The Holmium:YAG laser that was used was the Dornier Medilas H30 16 MPS 50/60 Hz.
The time it took to reach the stone and accomplish proper fragmentation, as well as the total time of the procedure, were all documented.

Management of anesthesia

Noninvasive blood pressure, pulse oximetry, and 3-lead electrocardiogram monitoring were performed on both groups regularly. Afterwards, before to the procedure, midazolam (0.03 mg/kg) was administered to each patient.

The first set of subjects sat while a 25-gauge Quincke spinal needle was inserted into the subarachnoid space between the L3-L4 or L4-L5 vertebrae to administer SA. After ensuring that the cerebrospinal fluid could flow freely, the anesthetic—a mixture of 12.5 mg of 0.5% bupivacaine and 25 mcg of fentanyl—was injected into the subarachnoid space along with 3 mL of the fluid. Once the patients' sensory blocks reached the thoracic 8 level, they were positioned supine and the procedure began. To administer GA in the second group, the following dosages were used: 0.03 mg/kg premedication, 3 mg/kg propofol, and 1 mcg/kg fentanyl for analgesia. Induction was initiated with 0.6 mg/kg rocuronium (a relaxant) when verbal contact with the patient was lost, and tracheal intubation was accomplished using laryngoscopy. In order to keep GA alive, remifentanil and sevoflurane gas were infused into the patient

RIRS technique

The lithotomy posture was used for cystoscopy in all patients. To access the ureter, a hydrophilic-tipped guide wire was advanced. A semirigid ureteroscope (9.5-F Karl Storz endoscopy) was used for control ureteroscopy over this guide wire in order to dilate the ureter and rule out ureteral diseases and stones. Next, the proximal ureter was reached by advancing the access sheath over the guide wire using C-arm fluoroscopy. Patients with access sheaths were able to reach the renal pelvis via the guide wire, but those without had to rely on flexible ureterorenoscopy. The Holmium: YAG laser was used to break the stones into smaller pieces. A double-J (DJ) stent was inserted into the ureter in the event that access to the kidney could not be achieved owing to stenosis. The surgery was then repeated four weeks later. So that they could get through on their own, the stones were broken apart. If required, a 4.8-F DJ ureteral stent was implanted at the conclusion of the surgery.

During the first month after surgery, x-ray and USG were used to assess the percentage of patients who did not experience stones. Furthermore, noncontrast CT was used to assess individuals who had nonopaque remaining stones. Achieving a stone-free status or remaining pieces less than 3 mm were used to assess the success. Patients who still had stones after the first procedure had further treatment in the form of recurrent RIRS, URS, PNL, and ESWL. Locations of stones were classified as either lower, middle, upper, or pelvic. The duration of the procedure was determined by adding up all the time it took to insert the rigid ureteroscope and finish placing the stent. The amount of days that passed between surgery and discharge was referred to as the postoperative hospital stay.

Statistical analysis

This is done by using SPSS version 23

RESULTS

According to Table 1, which compares the patients based on demographic and clinical variables, the SA group had a significantly higher mean age and ASA stage than the GA group (P = 0.009 and P = 0.022, respectively). In terms of sex distribution, BMI, stone side, size, location, and density (Hounsfield unit, HU), co-morbidities, preoperative DJ stent necessity, and preoperative hydronephrosis degree, there was no statistically significant difference identified between the groups (P > 0.05).

Table 1 Information about the patients' demographics and preoperative health

	GA (*n* = 38)	SA (*n* = 44)	*P* value
Age (year)	41.7 ± 6.1	51.4 ± 11.4	**0.009**[a]
Male/Female (*n*)	13/24	24/21	**0.136**[b]

BMI (kg/m^2)	24.9 ± 1.47	25.8 ± 1.71	**0.216a**
Stone side (right/left), (*n*)	19/18	21/24	**0.717b**
ASA status, *n* (%)			**0.022c**
I	23 (60.5)	16 (36.4)	
II	12 (31.6)	22 (50.0)	
III	3 (7.9)	6 (13.6)	
Stone size (mm)	15 (8–30)	13 (5–30)	**0.157c**
Stone location, *n* (%)			
Lower pole	5 (13.2)	3 (6.8)	**0.502d**
Mid pole	1 (2.6)	0 (0.0)	—
Pelvis	31 (81.6)	41 (93.2)	**0.142d**
Upper pole	1 (2.6)	0 (0.0)	—
Hounsfield unit (HU) values of stones	889.3 ± 215.2	895.1±235.4	**0.837a**
Comorbidities, *n* (%)	2 (5.7)	10 (24.4)	**0.056b**
CAD	1 (2.9)	7 (17.1)	**0.063d**
DM	1 (2.9)	3 (7.3)	**0.620d**
Preoperative DJ stent, *n* (%)	9 (25.7)	9 (22.0)	**0.909b**
Preoperative hydronephrosis, *n* (%)			**0.157c**
0	8 (21.1)	16 (36.4)	
1	5 (13.2)	6 (13.6)	
2	20 (52.6)	17 (38.6)	
3	5 (13.1)	4 (9.1)	
4	**0 (0.0)**	**1 (2.3)**	

aStudent *t* test, bContinuity-corrected chi-square test, cMann–Whitney *U* test,d Fisher's exact test

In Table 2, we can see the results of the clinical outcomes compared by group. Time spent operating, time spent fragmenting stones, need for intraoperative DJ stents, duration of hospital stay, need for subsequent operations, and rate of stone-free recovery were not significantly different across the groups (P > 0.05). The cost of anaesthesia was significantly reduced (P < 0.001) in the SA group. The frequency of problems in the SA and GA groups is compared in Table 3. In terms of the occurrence of complications, there was no statistically significant difference between the groups (P > 0.05).

Table 2 Clinical results comparing the two anaesthetic groups

	GA (*n* = 38)	**SA (*n* = 44)**	***P* value**
Operative time (min)	67 (36–110)	67 (31–115)	0.385a
Stone fragmentation time (min)	46 (26–96)	49 (16–104)	0.369a
Intraoperative double-J stent, *n* (%)	35 (97.1)	40 (95.1)	>0.999b

Postoperative hospitalization (day)	1 (1-3)	1 (1-3)	0.468a
Additional procedure, *n*	11	16	0.519c
Follow-up	2	3	>0.840b
PNL	0	1	
RIRS	0	3	0.189b
ESWL	1	2	>0.945b
URS	6	5	0.385c
Anesthetic cost ($)	24.9 (15.9–36.3)	4.6 (3.85–6.6)	**<0.001**a
Stone-free status, *n* (%)			0.995c
No	12 (31.6)	15 (34.1)	
Yes	26 (68.4)	29 (65.9)	

aMann–Whitney *U* test, bFisher's exact test, ccontinuity-corrected chi-square test

Table 3 Analysing the risks associated with spinal anaesthesia (SA) vs general anaesthesia (GA) using the updated Clavien complication scale

	GA (*n* = 38)	SA (*n* = 44)	*P* value
Total number of complications	6 (15.8%)	7 (15.9%)	>0.682a
Grade I			
Fever	1 (2.6%)	0 (0.0%)	–
Flank pain	2 (5.3%)	1 (2.3%)	0.481b
Mild hematuria	1 (2.6%)	3 (6.8%)	0.614b
Minimal mucosal injury	1 (2.6 %)	1 (2.3%)	–
Grade II			
Double-J stent migration	0 (0.0%)	1 (2.3%)	–

a Continuity-corrected chi-square test,
bFisher's exact test.

Discussion

The availability and efficacy of minimally invasive surgical procedures have grown with the acceptance of laser technology and the development of miniaturised endoscopic instruments. Researchers have looked into stone-free and complication rates in an effort to find ways to make RIRS more effective (4,5). The selection of anaesthesia is another component that enhances the success and safety of RIRC. There is a worry about the development of related hematuria, which might lead to procedures utilising GA, since the increased renal movement during the surgery makes it harder to reach the stone and causes injury to the renal mucosa during the fragmentation of the stone with the Holmium laser. That is why RIRS is often done when GA is present (5-7). The viability of RIRS with SA is supported by studies comparing GA and SA in PNL, which showed no difference except for postoperative discomfort. SA is a less painful technique than PNL (8-10).Surgeons and patients alike are wary of GA because of the increased morbidity it causes in patients with comorbidities. Zeng et al. were the first to suggest the notion of integrating minimally invasive anaesthesia with minimally invasive surgical procedures. They proved that combined spinal epidural anaesthesia (CSEA) and RIRS could be used safely and reliably, similar to GA. The same research indicated that CSEA and GA were comparable in terms of operation time, early postoperative discomfort, stone-free rates, and complications; however, CSEA had a lower cost for anaesthesia. Although it was not statistically significant, the pain score was lower in the CSEA group as well (11).

We considered safely doing RIRS with SA after successfully completing proximal ureteral stone surgeries using flexible endoscopic tools in situations where the stone had pushed back into the kidney. Shorter hospital stays and decreased financial burden were observed to be associated with RIRS with SA in a prospective, double-blind, randomized-controlled study by Mohamed et al. (12). Bosio et al. found that when comparing the stone-free rates of RIRS with GA and SA administered at the same time, there was no statistically significant difference (13). Time to stone fragmentation, intraoperative DJ stent requirement, postoperative length of hospital stay, additional procedure requirement, SFR rates, incidence of complications, and overall operative time were not significantly different between the SA and GA groups in this study. Furthermore, the SA group has substantially reduced anaesthesia costs.

The outcomes for the SA group were comparable to the GA group. The fact that the SA group did not need to convert to GA demonstrated that SA could be done during RIRS just as safely as GA. Furthermore, SA was far less expensive than GA. We prefer and advise SA RIRS in all patients under comparable clinical and economic circumstances, as long as the patient's general health allows it, since the procedures are sufficiently safe and have an incredibly low morbidity rate. The lack of a pain status assessment and the study's retrospective design were its major shortcomings.

Conclusion

One practical and efficient method for removing kidney stones is RIRS with SA. When compared to RIRS given with GA, the success, stone-free, and complication rates are rather close. Since SA may be safely and successfully done with reduced morbidity rates and much lower costs, we favour it for patients with comorbidities.

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