

A Supracostal Approach For Percutaneous Nephrolithotomy (PCNL) Is Better With Intrathecal Dexmedetomidine Than With Intrathecal Fentanyl

Nivedita, R Chandra, J Saran

Citation

Nivedita, R Chandra, J Saran. *A Supracostal Approach For Percutaneous Nephrolithotomy (PCNL) Is Better With Intrathecal Dexmedetomidine Than With Intrathecal Fentanyl*. The Internet Journal of Anesthesiology. 2018 Volume 37 Number 1.

DOI: [10.5580/IJA.48173](https://doi.org/10.5580/IJA.48173)

Abstract

PCNL through a supracostal approach is always troublesome for patients under regional anaesthesia. In a peripheral tertiary care hospital, we encounter often patients with multiple large size renal stones. We also deal with poor paying capacity and lack of compliance. In view of the above, a single supracostal approach becomes the treatment of choice in such a setting. While the supracostal approach is the ideal surgical choice, regional anaesthesia is a practical cost effective option. However, the limiting factor is duration of anaesthesia. The aim of our study was comparing two adjuvants during spinal anaesthesia to provide better quality and smooth anaesthesia for longer duration PCNL.

Settings and Design. A randomized double blind study was conducted among 100 healthy ASA 1 and 2 patients scheduled for PCNL via supracostal approach. We did this study for 2 years at our institute SRMSIMS and included 100 patients.

Materials and Methods. Spinal block was administered in the L3 and L4 intervertebral space using 0.5% heavy bupivacaine. Adjuvant were added in group F, fentanyl 25 mcg and in group D, dexmedetomidine 5 mcg. Anaesthetic level achieved was T6. Onset time to achieve sensory motor blockade, their regression time was noted. Hemodynamic changes and requirement for other analgesic drug were also noted.

Results. 100 patients were enrolled in our study, data was recorded and analysed using statistical analysis.

Conclusion. It was found that the time to achieve a definitive block was slightly higher in group D than group F, but the depth of block was intense and prolonged in group D. The quality, duration and requirement for postoperative analgesia was better and statistically significant in group D as compared to the group F.

INTRODUCTION

The aetiology of stone formation in the kidneys is not always unknown. From open pyelolithotomy to minimally invasive, PCNL many advancements were made in recent times.

Indications for percutaneous nephrolithotomy (PCNL) are multiple kidney and upper ureteric calculi, size >2-3 cm in diameter, failed Extracorporeal Shock Wave Lithotripsy (ESWL) and staghorn calculi. Supracostal approaches may encounter increased difficulties and cause patient morbidity. However, with this approach the surgeon gets straight access to all sites of the upper collecting system for the rigid nephroscope, thus facilitating surgeries like Ureteropelvic

Junction Obstruction (UJO) with calculi, staghorn calculi, upper pole and proximal ureteric stones.

Spinal anaesthesia is now the established method to provide anaesthesia for PCNL. Benefits of spinal anaesthesia over general anaesthesia (GA) are early detection of pulmonary complications, eye, nerve injuries, or anaphylaxis (1,2). The supracostal approach is related to higher pulmonary complications, mainly intrathoracic problems (18.2% vs 4.4%) compared to subcoastal approach (20). When working in a peripheral setting where the paying capacity is low the reduced cost factor cannot be neglected. Many surgeons needed more than one puncture which prolonged the duration of surgery. So we needed an adjuvant which can

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increase the duration of surgery without adding complications. Hyperbaric bupivacaine is mostly used in subarachnoid blocks but the effective calculated dose may be associated with high blocks and haemodynamic instability.

Adding adjuncts, e.g. opioids and non-opioids, allow for a reduction in the dose of bupivacaine which provides cardiovascular stability and therefore improves and prolongs the quality of the block (3,4).

In recent times a newer α_2 agonist, dexmedetomidine, is becoming popular amongst anaesthesiologists. It is used as an adjuvant to hyperbaric bupivacaine. Studies with dexmedetomidine for PCNL are lacking. We compared it with Fentanyl.

We chose PCNL in only those patients who had stones in the upper calyces and stones in multiple sites for which supracostal puncture was required. (5)

MATERIAL & METHODS

After approval from the hospital's ethical committee we chose 100 patients for our study at SRMSIMS aged from 18 to 55 years. We excluded patients ASA III/IV, patients with significant cardiovascular, renal, hepatic dysfunction, morbidly obese patients with BMI more than 30, height <140 cm or >180 cm, and history of allergy to the drugs we were using. We also excluded patients with renal anomalies e. g. horseshoe or ectopic kidneys. We excluded patients who had absolute contraindications for regional anaesthesia, e.g. patient's refusal, coagulopathy, or infections at the local site. After full urologic workup (ultrasonography, KUB, intravenous pyelogram, isotope scan or CT scan according to the surgeon) and general physical and laboratory examination full blood count, serum urea, serum creatinine, serum electrolytes, PT/PTT, ECG and CXR, the patients admitted the day before the surgery. We counseled the patients about the regional anaesthesia.

Anxiolysis was done with alprazolam 0.25 mg the night before and at 6 am with sips of water. After confirming NPO status. Inj. metoclopramide 10 mg iv was given 1 hour before surgery.

In the operating room, after patient's arrival, standard monitor's ECG, SPO₂, NIBP, HR and temperature were attached. All patients were preloaded with RL 500 ml, after inserting a large i.v. bore cannula. Under local anaesthesia, by taking all aseptic precautions, an epidural catheter was inserted at L2-L3 level. Lumbar puncture was done with a

27G Quincke spinal needle in the L3-L4 space. When clear CSF came out, we injected the drug. The head of the bed was tilted 30° Trendelenberg for a few minutes. O₂ through facemask was given to each patient at 4 lpm.

In group D, we used bupivacaine 0.5%, 15 mg + 5 mcg dexmedetomidine. In group F, we used bupivacaine 0.5%, 15 mg + 25 mcg fentanyl. In group D we added preservative free normal saline to make the volume in both groups constant. After the block, we assessed the time of sensory block up to T6 and grade 3 Bromage motor block before surgery. Zero was started at the time of subarachnoid block. If the sensory block at T6 level was not achieved we considered it as block failure and we gave general anaesthesia. Bromage 0: patient has free movement of legs and feet. Bromage 1: patient is just but able to flex the knee with free movement of the feet. Bromage 2: patient is unable to flex knees but has free movement of feet. Bromage 3: the patient is unable to move the legs and feet. (6) After stabilization of anesthesia, stenting was done in lithotomy position then the patients were put in prone position.

Hypotension [SBP >30%, from baseline or <90mmHg] and bradycardia [HR <50 bpm] were noted. Other adverse effects, e. g. nausea, vomiting, shivering, pruritus, sedation, and respiratory depression were noted. We noted the time of recovery of the S2 dermatome and use of rescue analgesic drug. We used inj. diclofenac 75 mg im for this purpose. We noted vital signs, Aldrete score >8 response to pain and nausea. For nausea, we used inj. metoclopramide 10 mg iv as a rescue drug. All the patients were checked by CXR postoperatively to note pulmonary complications. Lab data were rechecked after 24 hours of operation. The nephrostomy tube was removed and patients were discharged on the 2nd or 3rd day of surgery.

RESULTS

Data was managed on an excel spreadsheet. Quantitative values were assessed for approximately normal distribution. Each of those variables was summarized by mean and SD. For comparing the two main groups the Paired t test was applied. SPSS statistical software was used for data analysis. In this study p values < 0.05 have been considered as statistically significant.

Table 1

Demographic Data

	Group F	Group D	P Value
Age in years	44.6±17.12	42.4±15.16	0.05
Height in cm	154.22±3.8	155.7±3.08	0.78
Weight in Kg	61.3±6.02	62.8±7.08	0.77
BMI	24.7±6.05	24.99±5.14	0.33

Demographic data in both groups were comparable because the p value was not significant.

In group F and group D, time to reach T6 were 4.92±0.57 minutes and 7.82±0.42 minutes respectively. It was higher in group D [P<0.05]. Times to reach Bromage grade 3 were 6.58±1.36 and 11.65±0.60 minutes respectively in groups F and D. It was also found to be significant. Regression time to S1 was 193±11.31 in group F and very long in group D with approx. 382±7.77 minutes [p<0.05]. We also checked for regression times to S1 level. It was 165± 7.07 minutes in group F and significantly longer in group D with 287±3.53 minutes [p<0.05]. Six patients failed to complete the study and they were given GA from the beginning.

Table 2

Spinal Block Characteristics

	Group F	Group D	P value
Time to reach T6[min]	4.92±0.57	7.82±0.42	0.00
Time to reach Bromage grade 3 [min]	6.58±1.36	11.65±0.60	0.00
Regression to S1[min]	193±11.31	382±7.77	0.00
Regression time to Bromage grade 0 [min]	165±7.07	287±3.53	0.00

The patients who received supplemental anaesthesia were analysed. This requirement was mainly at the time of puncture, p <0.05. So a significant number of patients in group F received supplemental anaesthesia. 6 patients in group F and 9 patients in group D developed hypotension. It was managed with inj. mephenteramine and iv fluids [p >0.05]. 2 patients in group F and 3 patients in group D had persistent hypotension. As estimation of blood loss is difficult in PCNL, so packed cells transfusion was started in those patients. The patients responded well to blood transfusion. 5 patients in group F and 4 patients in group D developed bradycardia. It responded well to inj. atropine 0.6 mg [p>0.05]. Only patients of group F had pruritus, which was absent in dexmedetomidine group. It was found to be significant [p>0.05]. Incidence of nausea in both groups were very low and not significant. We also noted surgical complications: 5 patients developed a hydrothorax. These were drained by a needle. 1 patient developed hemothorax because of the rupture of the intercostal artery. The bleeding was stopped after putting the drain of the PCNL because it created a tamponade effect.

Table 3

Side Effects

Side effects	Group F	Group D	P value
Hypotension	6	9	0.34
Bradycardia	5	4	0.45
Pruritus	8	0	0.00
Nausea	5	8	0.36
Need for intra operative analgesia	10	2	0.00

8 patients developed sepsis. It was due to high grade bacteremia. Broad spectrum antibiotics were given for that.

DISCUSSION

Neuraxial block is a well-established method to provide anaesthesia for PCNL (1,7, 8). Salonia, found that spinal anaesthesia allowed good muscle relaxation, less intraoperative blood loss, less postoperative pain and a faster postoperative recovery than GA in patients undergoing retropubic prostatectomy. Although we did not have a control group of GA and we did not require muscle relaxation for PCNL. The patients tolerated the operation and were satisfied with it. There are high chances of fluid absorption and electrolyte imbalance in this surgery because of large amount of irrigating solutions. (9) RA Kukreja, MR Desai studied fluid absorption during PCNL and said this fluid absorption may be clinically significant in patients with compromised cardiorespiratory or renal status leading to fluid overload. In regional anaesthesia, these signs can be detected early and managed promptly. (10)

We compared two drugs as adjuvants to spinal anaesthesia. Fentanyl has become a standard drug as adjuvant in spinal anaesthesia. (11)

In comparison to fentanyl, dexmedetomidine, a central α_2 agonist is on the way to be added in the list of adjuvants to spinal anaesthesia. Most published studies described its intrathecal use in animals. The analgesic effects of α_2 agonists were first described in 1974, when clonidine was administered to rats and nociceptive thresholds were increased. α_2 receptors are found in the peripheral nervous system, CNS, platelets, liver, kidney, pancreas and eye. They have presynaptic, postsynaptic and extrasynaptic sites of action. The stimulation of α_2 receptors decreases calcium entry into nerve terminals, which may contribute to its inhibitory effect on neurotransmitter release, leading to hypotension, bradycardia, sedation and analgesia. (12,13) Previous studies, showed prolongation of spinal block by intrathecal 5 mcg and 10 mcg dexmedetomidine with no effect on BP or HR. (14,15,16)

Intrathecal dexmedetomidine did not potentiate the effect of bupivacaine on BP because local anaesthetics reduce BP by decreasing the sympathetic outflow. But the intrathecal bupivacaine already produces maximum blockade of sympathetic outflow. So intrathecal dexmedetomidine does not have the potential to further lower BP (17,18). This explains the absence of large variations in haemodynamic profiles in our study even if we used large amount of the drug intrathecally. This may explain the observation that 150 mcg clonidine added to a high dose of bupivacaine [15 mg or more] did not produce a decrease in BP compared to bupivacaine alone (17,18,19,20). Subhi M, Al Ghanem reported that in women undergoing vaginal reconstruction surgery under spinal analgesia, 10 mg plain bupivacaine supplemented with 5 mcg dexmedetomidine prolonged motor and sensory block compared with 25 mcg fentanyl. The time to reach the maximal sensory block was 19.34+287 min for group D and 18.39+2.46 min in group F (14).

In our study, late onset of block was seen in group D. But Patients in group D tolerated intercostal punctures without any difficulty whereas patients in group F. 10 patients needed supplemental analgesic through the epidural route. Requirements for postoperative pain was also delayed in this group. We used inj. diclofenac postoperatively in group F.

For supracostal access we used a puncture below the 11th rib. According to Pedro RN, pulmonary complications are very low if we puncture it below the 11th in comparison to a puncture above it. The complications rate of supracostal access in comparison to subcostal access is (18.2% vs 4.4%) respectively. (2,20) We avoided this complication by puncturing during deep expiration. During puncture, if the patient is under GA, detection of this complication is also delayed. (2,11)

CONCLUSION

Increasing incidence of occurrence of renal stones have made PCNL a routine surgery. Advantage of spinal anaesthesia over general anaesthesia for PCNL is well known. Use of dexmedetomidine as adjuvant in spinal anaesthesia has made supracostal punctures easy. Patients tolerated long surgery times better in group D than in group F. Requirements for intraoperative analgesic supplementation were very high in group F. Although achievement of the particular level of block was delayed in group D compared to group F the requirement of postoperative analgesia was also reduced in group D compared to group F. Side effects like hypotension,

bradycardia, and nausea was similar in both groups.

Incidence of pruritus was absent in group D. In conclusion, in our study dexmedetomidine supplementation as adjuvant gave better intraoperative conditions and prolonged postoperative analgesia compared to fentanyl.

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Author Information

Nivedita

Sri Ram Murti Smarak Institute of Medical Sciences (SRMSIMS)
Bareilly, Uttar Pradesh, India

Richa Chandra, MBBS, DNB, MNAMS

Sri Ram Murti Smarak Institute of Medical Sciences (SRMSIMS)
Bareilly, Uttar Pradesh, India

Juhi Saran

Sri Ram Murti Smarak Institute of Medical Sciences (SRMSIMS)
Bareilly, Uttar Pradesh, India