

A Comparative Evaluation of General Anesthesia versus Spinal Anesthesia Combined with Paravertebral Block for Renal Surgeries: A Randomized Prospective Study

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Abstract

Background: General anesthesia with endotracheal intubation has remained the most common technique used for open renal surgeries because of the abnormal body position and its ability to control the diaphragmatic movement during the surgery. Combined spinal and thoracic paravertebral block (TPVB) can be used as alternative technique for open renal surgery, where spinal anesthesia provides fast and reliable to start the surgery and the duration of anesthesia can be extended with a catheter in the paravertebral space.

Aim of the work: To compare general anesthesia versus combined spinal/paravertebral block in patients undergoing open renal surgeries

Patients and methods: The patients were classified according to anesthetic technique into two groups as follow: Group I: include 50 patients received combined spinal/ paravertebral block. Group II: include 50 patients received general anesthesia. Measurements: -HR and MABP - Surgeon satisfaction - Patient satisfaction - Postoperative analgesia -The time to first dose of analgesia- Side effects such as nausea and vomiting, and shivering were noted.

Results: The MABP and HR were increased significantly in group II after intubation while it maintained stable in group I. The Time to first analgesic request was statistically significant longer in group I than group II. No significant differences were found as regards to surgeon's satisfaction between both groups. The patient's satisfaction was better in group I. The incidences of side effects were higher in group II than group I.

Conclusion: Combined spinal and paravertebral block can be safely and effectively used in patients undergoing open renal surgeries.

Keywords: Open renal surgery; General anesthesia; Spinal anesthesia; Paravertebral block

Introduction

Anesthesia for renal surgeries requires certain characteristics include the ability to maintain hemodynamic stability, patients immobility, diaphragmatic control, satisfactory intraoperative and postoperative analgesia, and lower incidence of side effects such as nausea, vomiting, and shivering [1]. General anesthesia with endotracheal intubation remained the most common technique used for open renal surgeries because of the abnormal body position; ensure immobility of the patients and its ability to control the diaphragmatic movement during the operation [2].

A higher incidence of side-effects with general anesthesia leaves bad experience and make general anesthesia unwanted by the patients [3].

Regional anesthesia can be safely used for renal surgeries and associated with stable hemodynamic, decrease blood loss and blood transfusion with prolonged postoperative analgesia and fewer side effects, so, regional anesthesia better alternative to general anesthesia [1,2,4].

A paravertebral block (PVB) results in unilateral somatic and sympathetic nerve block. The PVB produces a dense afferent block that abolishes somatosensory evoked responses also it blocks the impulse pass through the thoracic sympathetic chain which explain the pre-emptive effect of this technique [5,6].

However, the disadvantages of paravertebral anesthesia include the following, technical failure, local anesthetic toxicity, bilateral block, pneumothorax. Hypotension, vascular puncture, it is more challenging to teach because it requires stereotactic thinking and needle maneuvering. A certain "mechanical" mind or sense of geometry is necessary to master it [7].

The hypothesis of the present study:

1-Combined spinal/paravertebral block is better than general anesthesia as regards to hemodynamics, patient's and surgeon's satisfaction.

2-Combined spinal/paravertebral block is associated with better postoperative analgesia.

3-Postoperative side effects (shivering, nausea and vomiting) are more with general anesthesia.

Aim of the Work

Our study was carried out to compare combined spinal/paravertebral block versus general anesthesia in patients undergoing open renal surgeries as regards to, hemodynamic parameters, surgeon's, and patient's satisfaction, postoperative analgesia and side effects.

The primary outcome was the intraoperative hemodynamic changes, patients and surgeon's satisfaction, and complication. While anesthesia time, operative time, postoperative pain scores and time to fist rescue analgesia were the secondary outcome.

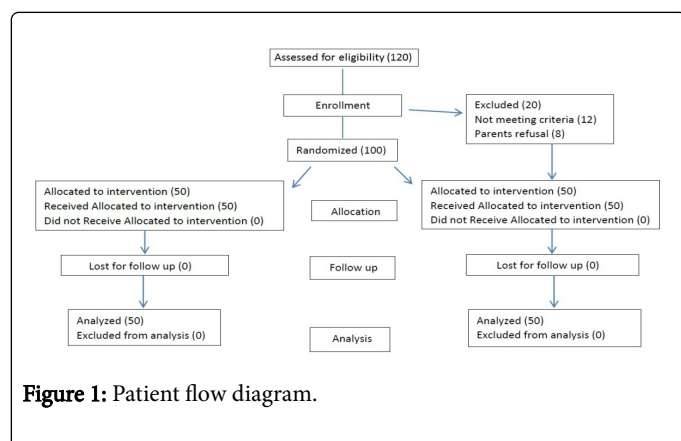
Patients and Methods

Our study was carried out on one hundred adult patients ASA I&II aged 18- 60 years undergoing open renal surgeries after approval of the ethical committee and obtaining written informed consent from each patient. All patients' data were confidential with secret codes and was used for the current study only. Any unexpected risk appears during the course of the study was cleared to the patients and the ethical committee on time and the proper measures were taken to minimize or overcome these risks. The approval code of ethical committee is 2904/11/14. The study duration was 12 months.

Open renal surgeries include pyeloplasty, pyelotomy, pyelolithotomy, nephrolithotomy and nephrectomy.

Exclusion criteria

Patients' refusal to share in the study, coagulopathy, patients' on anticoagulant or thrombolytic therapy and hemodynamic instability is the exclusion criteria (Figure 1).



Preoperative preparation

All patients were underwent preoperative assessment by history taking, physical examination and laboratory investigations which include complete blood count, liver function, renal function, prothrombin time, INR, ECG, blood group and chest x-ray.

Premedication

All patients received 150 mg ranitidine and 10 mg of metoclopramide one hour before anesthesia.

Patients were fasted for 8 hours before the time of operation. On arrival to operating room an intravenous line was inserted. All patients

were preloaded with 10 ml/kg ringers solution and were attached to monitor displaying the following: ECG, HR, NIBP, and O₂ saturation and urinary catheter for urine output monitoring. ETCO₂ was used in group II only.

The patients were randomly classified using sealed envelope technique into two equal groups according to anesthetic technique as follow:

Group I: Include 50 patients received combined spinal/paravertebral block.

Group II: Include 50 patients received general anesthesia.

Anesthetic technique in group I

PVB was performed while the patients in sitting position, shoulders and head relaxed and leaning forward.

The skin was cleaned with an antiseptic solution, the subcutaneous tissues and paravertebral muscles are infiltrated with 3 ml of Lidocaine 2%. An 18 G Touhy needle was advanced perpendicularly to the skin at T8-T9 level. After the transverse process is contacted, the needle is withdrawn to the skin level and redirected superiorly or inferiorly to "walk off" the transverse process, walking off the inferior aspect of the transverse process is recommended to reduce the risk of intra-pleural placement of the needle. Thoracic PVB space was identified by loss of resistance to air, epidural catheter was inserted 3-4 cm inside the space and 10 ml of 0.5% bupivacaine was injected in the paravertebral space.

After securing the paravertebral catheter, Spinal anesthesia was performed with 25 gauge spinal needle at L3-L4 by injecting 2.5 ml of heavy bupivacaine 0.5% into subarachnoid space.

The sensory level was checked with pin prick method while motor block was assessed with modified Bromage scale (0=no block, 1=inability to raise the extended leg, 2=inability to flex the knee and 3=inability to flex the knee and foot).

The rectus abdominis muscle (RAM) score was used to assess the degree of abdominal muscle relaxation [8].

RAM score ranged from 0 to 5 (0=full motor activity while 5=full abdominal muscle relaxation) score 3 was required for the surgery (Table 7).

The RAM-test was performed as follows: The patient was allowed to lie in the supine position and legs extended. The patient was asked to rise slowly from the supine to a sitting position and the degree of block was assessed.

Patients were placed in kidney (lateral) position after complete establishment of sensory and motor block and received ringers' solution at 5 ml/kg/h.

The patients in this group received a bolus dose of dexmedetomidine (Precedex[®], Meditera, 200 µg/2 mL) 0.5 ug/kg over 10 minutes followed by continuous infusion 0.2-0.5 ug/kg/h to maintain sedation between 3-4 by Ramsay sedation score during the surgical procedure.

Ramsay sedation scale

- Patient is anxious and agitated or restless, or both
- Patient is co-operative, oriented, and tranquil
- Patient responds to commands only

- Patient exhibits brisk response to light glabellar tap or loud auditory stimulus
- Patient exhibits a sluggish response to light glabellar tap or loud auditory stimulus
- Patient exhibits no response

The paravertebral catheter was kept in place for 48 hours postoperatively for administration of local anesthetic to control the postoperative pain.

Anesthetic technique in group II

The patients in this group received general anesthesia which induced by fentanyl 2 ug/kg, propofol 2 mg/kg and cisatracurium 0.15 mg/kg. The lungs were ventilated manually for three minutes then endotracheal tube was inserted and secured. Anesthesia was maintained with isoflurane 1% in oxygen. The tidal volume 6-8 ml/kg and respiratory rate 12-14/minutes and were adjusted to achieve SpO₂ ≥ 95% and end-tidal CO₂ between 32 and 35 mmHg. Top up doses of fentanyl and cisatracurium were given as needed.

The patients were placed in kidney position where the operative site was placed upper most and received ringers solution at 5 ml/kg/h.

During skin closure, intravenous (IV) infusion of diclofenac sodium (150 mg diluted in 100 ml of normal saline) and 1gm of paracetamol were given and 100 mg of pethidine was given intramuscular for post-operative analgesia.

After completion of surgery, inhalational anesthesia was stopped and muscle relaxant was reversed with atropine and neostigmine and the patient allowed breathing spontaneously. The ETT was removed when the patients fulfilled the criteria of extubation (spontaneous eye opening, purposeful movement, intact reflex).

After completion of surgery the patients in both groups were transferred to postanesthesia care unit for 24 h and the hemodynamic and side effects were observed.

Hypotension was defined as decrease in MABP 25% below baseline and was treated by blouse fluid 250 ml of ringer's solution and 6 mg of ephedrine. Bradycardia was defined heart rate 60 beats/minutes or less and was treated by 0.5 mg of atropine.

Metoclopramide 0.15 mg/kg and dexamethasone 0.15 mg/kg were administered for prophylaxis of postoperative nausea and vomiting (PONV) before the end of surgery. Ondansetron 0.1 mg/kg was administered for treatment of PONV.

Randomization

The randomization was performed using sealed numbered envelopes indicating the group of each patient. A blind nurse who did not participate in patients follow up read the number and made group assignments.

The process of inclusion in the study went on until the required number of patients was reached.

Measurements

- Demographic data.
- HR and MABP as base line and every 5 minutes till end of surgery.

- Surgeon's satisfaction criteria with the anesthesia technique include the surgical field bleeding, immobility of the patient, and degree of muscle relaxation.
- Patient's satisfaction criteria with the anesthesia procedure include any pain, or discomfort during surgery and in the post-operative period and acceptance in the future.
- Postoperative analgesia

The pain intensity was assessed by a person who was blind to study by using VAS scale graded from 0 to 10 (0=no pain, 10=the worst possible pain) in the following time 2 hours, 4 hours, 6 hours, 8 hours, 12 hours, 18 and 24 h hours after recovery.

Postoperative analgesia was given to all patients depending on pain score. If the value was less than 5, intravenous paracetamol 1 gm was given, if the value was more than 5, tramadol 1 mg/kg was given intravenously and recorded. The time to first dose of analgesia and total amount of tramadol used were recorded in all patients.

- Postoperative side-effects such as nausea and vomiting, and shivering were noted.
- Anesthesia time was measured from start of anesthesia to extubation in group II or end of surgery in group I.
- Operative time was measured from skin incision to skin closure.

Quality of surgical field (by the operating surgeon every 30 minutes): with a predefined scale adapted from that of Dolman et al. [9].

- 1=Minimal bleeding: not a surgical nuisance.
- 2=Mild bleeding: but does not affect dissection.
- 3=Moderate bleeding: slightly compromises dissection.
- 4=Severe bleeding: significantly compromises dissection.
- 5=Massive bleeding: prevent dissection.

The rectus abdominis muscle (RAM) score was used to assess the degree of abdominal muscle relaxation [8].

Patients were discharged postoperatively when they had no or mild pain (VAS<3), were able to tolerate clear fluids and soft food and had no bleeding and or nausea or vomiting.

Statistical analysis

The sample size required for the study was determined based on the primary outcome measure. A power analysis suggested that a sample size of 48 patients should be adequate to detect a 20% reduction in blood pressure and heart rate with a power of 0.8 (alpha=0.05). However, to avoid potential errors, 50 patients were included in the study.

The statistical analysis was done using SPSS Version 20 for Macintosh.

Comparisons of demographic data, time of surgery, anesthesia time were done by Student's t-test. Two way analysis of variance for repeated measurements was used for heart rate and blood pressure comparison. Mann-Whitney-U test was used for nonparametric measurements including pain score. Values are reported as mean ± SD. P values <0.05 were considered significant.

Results

This study was carried out on 100 patients divided into two groups, 50 in each group. The groups were comparable as regards to demographic data including age, weight, and duration of surgery. The duration of anesthesia was significantly longer in group II than group I (Table 1).

Characters	Group I (N=50)	Group II (N=50)	P
Age (years)	48.7 ± 5.4	52.8 ± 7.5	0.75
Weight (kg)	68.5 ± 8.7	72.6 ± 7.8	0.62
Height (cm)	170.6 ± 10.4	168.4 ± 8.5	0.53
BMI (kg/m-2)	28.4 ± 3.4	26.4 ± 3.4	0.73
Mallampati score	I-III	I-III	0.69
Duration of surgery (h)	3.34 ± 3.5	3.35 ± 3.4	0.74
Duration of anesthesia (h)	3.45 ± 3.8	3.55 ± 4.5	0.03
ASA (I/II)	40/10	38/12	0.61
Male/Female	35/15	36/14	0.78
Time to first analgesic request (h)	12.4 ± 8.55	2.5 ± 1.43	0.001

Values are means ± SD (standard deviation); N=Numbers of the patients; BMI=Body Mass Index

Table 1: Demographic data, duration of surgery, duration of anesthesia, a time to first analgesia.

There were no differences in the baseline heart rates and mean arterial blood pressure in the patients in both groups.

The HR and MABP were increased significantly in group II 5 minutes, 10 minutes, and 30 minutes after intubation and while it maintained stable in group I (Tables 2 and 3).

HR	Group I (N=50)	Group II (N=50)	P value
Base line	84.6 ± 5.62	85.5 ± 7.74	0.45
T1	82.7 ± 8.56	96.5 ± 5.4	0.032
T2	84.7 ± 6.86	92.6 ± 8.65	0.042
T3	84.5 ± 7.55	94.5 ± 6.62	0.035
T4	80.5 ± 6.65	82.8 ± 8.45	0.32
T5	82.7 ± 7.45	84.7 ± 9.54	0.42
T6	84.5 ± 6.65	82.6 ± 8.65	0.54
At end of operation	86.4 ± 7.86	84.5 ± 9.75	0.65

T1=5 minutes after induction; T2=10 minutes after induction; T3=30 minutes after induction; T4=60 minutes after induction; T5=90 minutes after induction; T6=120 minutes after induction

Table 2: Heart rate (beat/minute) changes in both groups.

Pain score after 2 hours was statistically insignificant between both groups ($P>0.05$), while pain score at 4 hours, 6 hours, 8 hours, and 12

hours in group I was significantly less when compared to group II ($p<0.05$) (Table 4).

Pain score at 18 h and 24 hours postoperatively was comparable between both groups $p>0.05$ (Table 4).

MABP	Group I (N=50)	Group II (N=50)	P value
Base line	75.63 ± 9.45	74.54 ± 8.65	0.84
T1	84.6 ± 9.55	92.52 ± 8.45	0.043
T2	86.4 ± 9.65	100.6 ± 10.5	0.032
T3	80.7 ± 9.45	92.4 ± 7.55	0.02
T4	84.6 ± 9.55	88.5 ± 8.76	0.35
T5	80.7 ± 8.55	86.4 ± 9.86	0.22
T6	82.5 ± 7.65	86.6 ± 6.55	0.37
At end of operation	86.23 ± 9.54	90.45 ± 8.55	0.45

T1=5 minutes after induction; T2=10 minutes after induction; T3=30 minutes after induction; T4=60 minutes after induction; T5=90 minutes after induction; T6=120 minutes after induction

Table 3: MABP (mmHg) changes in both groups.

Time	Group I (N=50)	Group II (N=50)	P value
2 h	0.85 ± 0.73	0.95 ± 0.86	0.65
4 h	0.95 ± 0.87	4.65 ± 0.95	0.001
6 h	2.50 ± 0.61	5.25 ± 0.89	0.004
8 h	2.30 ± 0.37	5.90 ± 0.79	0.001
12 h	3.2 ± 0.83	5.55 ± 1.06	0.02
18 h	3.35 ± 0.9	4.40 ± 0.65	0.33
24 h	3.35 ± 0.6	3.45 ± 0.62	0.43

Table 4: Visual analogue scale in both groups.

The Time to first analgesic request was statistically significant longer in group I than group II (Table 1).

The surgeon satisfaction's criteria were comparable between both groups as regards to (degree of muscle relaxation, immobility of the patients and bleeding) and were accepted in the 95% of the patients in group I and 96% in group II (Table 5).

Features	Group I (N=50)	Group II (N=50)	P value
bleeding	48 (96%)	46 (92%)	0.25
muscle relaxation	47 (94%)	48 (96%)	0.74
immobility of the patient	48 (96%)	50 (100%)	0.62
Overall	95%	96%	0.73

Table 5: Surgeon's satisfaction.

The patient's satisfaction criteria were better in group I than group II (Table 6).

The incidences of postoperative side effects were higher in group II than group I as regards to coughing/laryngospasm, sore throat, nausea and vomiting and shivering (Table 8).

Features	Group I (N=50)	Group II (N=50)	P value
Pain relief [n (%)]	48 (96%)	46 (92%)	0.042
Comfort [n (%)]	48 (96%)	46 (92%)	0.03
Overall satisfaction [n (%)]	48(96%)	46 (92%)	0.04
Accept the same anesthesia	48 (96%)	46(92%)	0.02

Table 6: Patient's satisfaction. N= Numbers of the patients.

Muscle power (%)	RAM score	criteria
100	0	Able to rise from supine to sitting position with hands behind head
80	1	Can sit only with arms extended
60	2	Can lift only head and scapulae off bed
40	3	Can lift only shoulders off bed
20	4	An increase in abdominal muscle tension can be felt during effort; no other response
0	5	Full abdominal muscle relaxation

Table 7: Rectus abdominis muscle score. RAM: Rectus Abdominis Muscle.

Characters	Group I (N=50)	Group II (N=50)	P value
Coughing	0%	6 (12%)	0.001
Laryngospasm	0%	6 (12%)	0.001
Sore throat	0%	1 (2%)	0.001
Nausea and vomiting	2 (4%)	10 (20)	0.033
Shivering	3 (6%)	12 (24%)	0.023

Table 8: The incidence of postoperative adverse events. N= Numbers of the patients.

Discussion

Our study demonstrated that, combined spinal/ paravertebral block anesthesia provides good surgical condition with stable hemodynamic, prolonged postoperative analgesia and fewer side effects when compared to general anesthesia group.

While surgeon's satisfaction was comparable in both groups the patient's satisfaction criteria was better in group I than group II.

Our result could be explained by the fact that, the administration of two different anesthesia by different routes on the same patient resulted in improved quality, effectiveness and less side effects.

Combined Spinal /paravertebral anesthesia was chosen in our study; because spinal anesthesia provides fast, reliable anesthesia and good muscle relaxation to start the surgery and the duration of anesthesia can be prolonged with a catheter in the paravertebral space. The Combined Spinal /paravertebral block have many advantages which include, small doses of local anesthetic is used, adequate motor block, and excellent analgesia, no airway manipulation, intact reflexes, and no risk of aspiration.

In the present study, The HR and MABP showed significant increase in group II after intubation which can be explained by the stress response to laryngoscopy and intubation. While the hemodynamic parameters remained almost stable in group I.

Injection of local anesthetic into the paravertebral space results in unilateral block of somatic and sympathetic nerve which lead to anesthesia which resemble unilateral epidural block which associated with stable hemodynamic and less hypotension and bradycardia.

Abdallah et al. [10] and Nakano et al. [11] found the HR and MABP were increased in patients received general anesthesia than in patients underwent regional block which support our findings.

Also, Moawad et al. [12] concluded that, single injection PVB resulted in greater hemodynamic stability than epidural analgesia in patients undergoing renal surgery.

Moreover, Pintaric et al. [13] concluded that, Thoracic paravertebral blockade resulted in more stable hemodynamics and equivalent analgesia when compared to thoracic epidural analgesia.

While the operative time was comparable between both groups the duration of anesthesia was significantly longer in general anesthesia group when compared to combined spinal/paravertebral group.

We keep in mind that, there are many factors affect the operative time and anesthesia time which include, the skill of anesthesiologist and surgeon, and the nature of surgery and type of anesthesia used. Although in our study, operative time is similar in both the groups. This difference is mainly due to anesthesia time which could be explained by the time taken for reversal of muscle relaxant and extubation in the general anesthesia group.

The time to first analgesic request was shorter in general anesthesia group than spinal/paravertebral group and this difference was statistically significant ($p < 0.05$).

Our finding was in agreement with other studies [14-18] which demonstrated that paravertebral block was associated with prolonged postoperative analgesia.

Additionally, Kumar et al. [19] found that the PVB was associated with prolonged postoperative analgesia extended up to 24 hours after surgery and single dose of tramadol was used in the second postoperative day in 48% of the patients.

The exact mechanism of prolonged analgesia of paravertebral block (PVB) was unknown but it may be due to the unique property of producing dense afferent blockade combined with complete block of transmission within the sympathetic chain may be factors that are associated with the extended duration of PVB. Also PVB produces a direct action of the local anesthetic on the spinal nerve, lateral extension along with the intercostal nerves and medial extension into the epidural space through the intervertebral foramina [6].

As regards to surgeon's satisfaction in our study we found no significant differences between both groups.

As our study Haberal et al. [20] did not observe any significant difference in the levels of surgeon's satisfaction during the perioperative period in patients undergoing Living-donor nephrectomy under combined spinal-epidural anesthesia.

Also Karacalar et al. [21] found no difference in the surgeon's satisfaction in patients undergoing percutaneous nephrolithotripsy under Spinal-epidural anesthesia or general anesthesia.

The patient's satisfaction was better in group I and this could be explained by less postoperative nausea and vomiting with prolonged analgesia compared to group II in which the patients received more opioid to control postoperative pain which associated with increased incidence of postoperative nausea and vomiting.

In agreement of the present study, Tangpaitoon et al. [22] found that better patients satisfaction, in patients received regional anesthesia compared to general anesthesia.

Moreover, Bajwa et al. [23] found in their study the surgeon's satisfaction scores were comparable in both groups while patient's satisfaction scores were better in regional anesthesia.

In contrast to our study Singhal et al. [24] found that there was no statistical difference between the general anesthesia group and regional anesthesia group in terms of surgeon and patients satisfaction in patients undergoing total abdominal hysterectomy.

The incidence of side-effects in our study such as nausea and vomiting and shivering were statistically significant higher in general anesthesia group which may be due to use of opioid for intraoperative and postoperative analgesia was linked to nausea and vomiting, while the inhalational anesthetics, unhumidified anesthetic gases, and infusion of unwarmed fluids used during surgery explain the increase in the incidence of shivering in general anesthesia group.

The limitations of the present study, include the following; no control group, we did not measure the amount of blood loss, the scale used for assess the quality of surgical site bleeding was subjective, we did not use ultrasound for paravertebral block, and the general anesthesia group not received regional block.

Conclusion

Combined spinal/ paravertebral block can be safely and effectively used in patients undergoing open renal surgeries, as it provides stable hemodynamic, prolonged postoperative analgesia with better surgeon and patients' satisfaction and fewer side effects.

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