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Effectiveness of quadratus lumborum block and erector spinae plane block for post-operative analgesia in open urological procedures

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ABSTRACT

Background: Open surgeries are associated with significant morbidities postoperatively such as pain and restricted ambulation causing delayed recovery. Among the various regional anesthesia techniques quadratus lumborum block (QLB) and erector spinae plane block (ESPB) are found to be effective alternatives. **Aims and Objectives:** The study intended to assess the post-operative analgesic efficacy of ultrasound-guided (USG) guided QLB and ESPB in open urological procedures. **Materials and Methods:** Ninety patients of ASA Grade I or II undergoing open urological procedures were divided into three groups. Group Q received USG-guided QLB, Group E received USG-guided ESPB and Group C received standard analgesia regimen. Each patient was assessed for the duration of analgesia, the total dose of rescue analgesics required in 24 h, Visual Analog Scale (VAS) score postoperatively (at 1, 2, 4, 6, 8, 12, 18, and 24 h) at post-anesthetic care unit and the incidence of any adverse events postoperatively. **Results:** The mean VAS score was higher in the control group compared to both the study groups which was statistically significant ($P<0.0001$). The mean duration of analgesia was 4.87 ± 1.01 h in Group Q and 5.13 ± 1.01 h in Group E compared to Group C 1.40 ± 0.50 h which was statistically significant ($P<0.0001$). The total rescue analgesic requirement was low in the study groups compared to the control group ($P<0.0001$). There was no incidence of any side effects found. **Conclusion:** Both USG QLB and ESPB provide effective analgesia, decrease intraoperative and post-operative analgesic consumption, and are beneficial to shorten hospital stay in patients undergoing open urological procedures.

Key words: Erector spinae plane block; Quadratus lumborum block); Post-operative analgesia, Open urological procedures

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INTRODUCTION

Open urological procedures are performed for cases such as pyeloplasty, nephrectomy, and complicated renal stone retrieval. These surgeries are associated with significant morbidity postoperatively such as pain at rest and on movement, restricted ambulation, and other daily activities which cause delayed recovery and hospital discharge.[1,2] The pathophysiology of acute pain is explained as it is mediated by inflammatory cell infiltration, activation of spinal cord pain pathways, and also by reflex muscle spasm. All these three mechanisms of acute pain are typically ameliorated during the post-operative recovery.[3]

Regional anesthesia techniques are mostly recommended for pain management in open nephrectomy as they are found to decrease parenteral opioid requirements and improve patient satisfaction.[4] Post-operative analgesic methods

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are essential to avoid respiratory and thromboembolic complications in radical or partial open nephrectomy. Post-operative pain and stress response can aggravate patients' disease, increase the incidence of complications, and prolong post-operative recovery period. A multimodal analgesic approach combining different analgesia modes with local or regional anesthesia to maximize effectiveness is essential.[5] These methods include systemic opioid drugs, systemic non-steroidal anti-inflammatory drugs, epidural analgesia, surgical site analgesia, paravertebral block, and quadratus lumborum block (QLB).[6-8] Although epidural analgesia is the gold standard for perioperative analgesia in open surgeries,[9] anesthesiologists are also searching for alternative analgesic modalities that have adequate analgesia and a lower complication risk. Non-opioid analgesia techniques are especially important in aging populations when comorbidities are considered.

QLB 1st time described by Blanco et al., in 2007, is an emerging truncal block technique,[10] which includes injecting local anesthetic (LA) into the thoracolumbar fascia (TLF) surrounding the quadratus lumborum muscle. The analgesic effect is achieved by the LA spreading along the TLF, into the thoracic paravertebral space and transversalis fascia. The anterior transmuscular quadrates lumborum block is a truncal block (ventral rami of T7-L2) that produces its analgesic effect by blocking the thoracic sympathetic trunk, the ventral rami of lower spinal nerves, the sympathetic fibers, and mechanoreceptors within the TLF, and the celiac ganglion by spread via the splanchnic nerves. It is an effective analgesic method for patients undergoing abdominal and hip surgeries.[11-14] It has been used for reducing post-operative pain after cesarean section, laparotomy, laparoscopic procedures, and hip surgeries. Later, Børglum et al., 2013 used the posterior transmuscular approach by detecting Shamrock sign and LA injected at the anterior aspect of the QL (type III QLB).[15] Blanco and McDonnell, described an another approach by injecting the LA to the posterior aspect of the muscle (type II QLB).[16] Finally, the intramuscular QLB (type IV QLB) was performed by injecting LA directly into the QL muscle.[17]

Erector spinae plane block (ESPB) was initially described by Forero et al., in 2016 for analgesia in thoracic neuropathic pain.[18] The ESPB targets the fascial plane similar to the paravertebral block without the risks of pleural, neural, or vascular injury. In this ultrasound-guided (USG) technique, LA is injected between the erector spinae and the transverse process of the thoracic vertebra leading to its spread in cephalad and caudal directions through the paravertebral space. Being an easy and safe method for use, it can be believed that it is an essential part of anesthesia management for nephrectomy.

On extensive search of the literature, we could not find the studies that compared these two blocks for the open urological surgeries; therefore, we planned to study the efficacy of QLB and ESPB in open urological procedures.

Aims and objectives

Primary objective

To compare the analgesic efficacy of USG guided Quadratus lumborum block and Erector spinae plane block in patients undergoing open urological procedures.

Secondary objectives

- To compare rescue analgesic requirement in the first 24 hours
- To assess the patient's satisfaction for postoperative analgesia.

MATERIALS AND METHODS

This was a prospective, randomized control, double-blinded study carried out in the Department of Anesthesiology, Superspeciality Hospital, Shyam Shah Medical College, Rewa, Madhya Pradesh, from January 2021 to September 2022. After getting clearance from the Institutional Ethics Committee (IEC/MC/2020/502 date 08/01/2021), 90 adult patients of either sex with ASA Grade I and II were enrolled for the study.

Patients who refused to give consent, patients who were suffering from psychological illnesses such as language impairment, mental disease, or dementia, patients with significant systemic diseases such as asthma, diabetes, hypertension, and cardiovascular disease, and patients contraindications to nerve block were excluded from the study.

The patients fulfilling the selection criteria were randomized using computer-based randomization software, in three groups of 30 patients each (Figure 1).

Group Q (n=30): Received USG guided QLB with injection Bupivacaine 0.25% 20 mL before surgery after induction.

Group E (n=30): Received USG-guided ESPB with injection Bupivacaine 0.25% 20 mL before surgery after induction.

Group C (n=30): Received standard post-operative analgesia regimen consisting of injection Paracetamol IV 1 g and injection Diclofenac 75 mg IV.

A thorough pre-anesthetic evaluation including the airway assessment and site for block assessment was performed. A written informed consent was taken from the patients

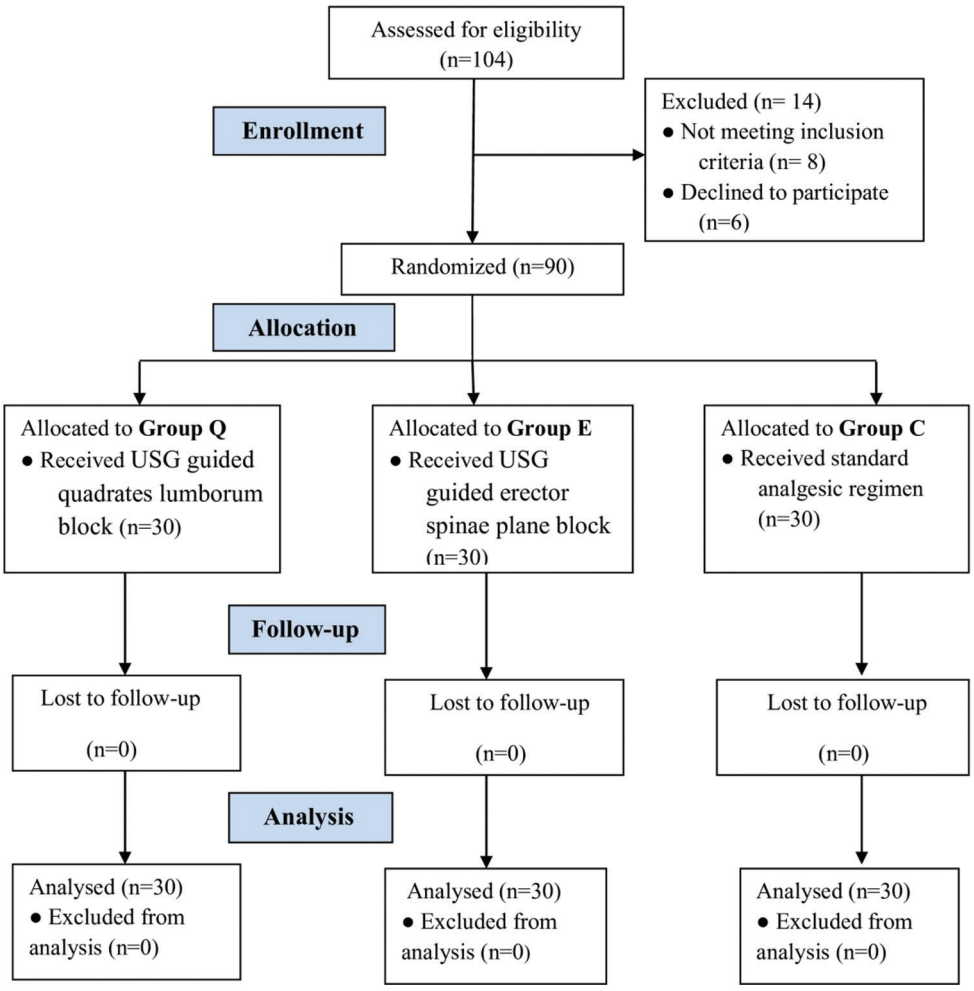

Figure 1: CONSORT flow diagram

about the surgery, anesthesia, and their participation in the study. Patients were also educated about the Visual Analog Scale (VAS) and Patient's Satisfaction Scale. Thereafter, they were shifted to the operation theatre. Intravenous line was secured. Monitors were attached, and baseline parameters, namely, heart rate, systolic and diastolic blood pressure, mean arterial pressure, SpO_2, and electrocardiogram tracings, were recorded. In the operating room, after routine monitoring and preoxygenation, the patients received IV fentanyl (2 mcg/kg), anesthesia induced with IV propofol (1–2.5 mg/kg), and atracurium (0.5 mg/kg) was used to facilitate endotracheal intubation. Anesthesia was maintained with nitrous oxide (60%) and isoflurane (MAC 0.8–1%) in oxygen.

Following induction patients were placed in lateral decubitus position with the affected side up and prepared for the administration of respective blocks under USG guidance (Mindray DC 30). In patients belonging to Group Q, depending on the chosen surgical site, the patient was placed in the lateral decubitus position, and low-frequency convex probe was used to give blocks. A 22 gauge 80 mm echogenic needle was inserted in-plane relative to the ultrasound probe, passing through the quadrates lumborum muscle in a posterior to anterior direction at the border between the quadrates lumborum and psoas muscles. After confirming negative aspiration, and 1 ml normal saline for the hydrodissection to confirm needle tip, 20 mL bupivacaine 0.25% was injected.

In patients belonging to Group E, a high-frequency probe was placed on the L1 spine and moved laterally to identify the transverse process of L1. The probe was then moved in the sagittal plane to visualize the erector spinae under the trapezius. A 22 gauge 80 mm echogenic needle was inserted medially in-plane to the ultrasound probe and directed toward the transverse process. Once the needle is under the anterior fascia of the erector spinae, 1 mL of normal saline injected for a hydrodissection to check the tip of the needle and a volume of 20 mL 0.25% bupivacaine was injected.

A standard analgesic regimen consisting of injection Paracetamol 1 g intravenously and injection Diclofenac

75 mg/mL intravenously was given 30 min before the end of surgery. Patients were moved to the post-anesthetic care unit (PACU) after the surgery.

The presence and severity of pain was assessed systematically. This assessment was performed in the PACU by a trained staff nurse blinded of the block procedure at 0, 1, 2, 4, 6, 8, 12, and 24 h. All patients were asked to give scores for their pain at rest. Pain severity was measured using a (VAS, 10 cm unmarked line which shows 0 cm=no pain and 10 cm=worst pain imaginable). If the VAS score for the patient is ≥4, even after the administration of an institutional post-operative analgesic regimen, intravenous tramadol at an incremental dose of 2 mg/kg was given as rescue analgesia. The time to first dose of rescue analgesic given was recorded. The total consumption of tramadol over 24 h was also noted.

Each patient was also assessed using a 5-point patient's satisfaction scale to evaluate the level of post-operative analgesic satisfaction which was classified as: A. Highly Satisfied. B. Satisfied. C. Neither Satisfied nor Dissatisfied. D. Dissatisfied. E. Highly Dissatisfied.

Any signs of local site infection, hematoma formation, LA toxicity due to intravascular injection of anesthetic agents (such as dizziness, tinnitus, perioral numbness and tingling, lethargy, seizures), signs of cardiac toxicity such as atrioventricular conduction block, arrhythmias, myocardial depression, and cardiac arrest were noted. The study ended 24 h after the surgery.

Sample size calculation

Assuming that mean ± SD of cumulative tramadol requirement in Group C, group Q, and Group E was (226±35.85 mg, 137±38.12 mg, and 130±50.99 mg, respectively) in the study by Tulgar et al., so sample size was calculated by open Epi program to be 90 cases allocated into three equal groups, 30 in each group, with confidence level of 95% and power of test 80% with taking in consideration 10% non-response rate.

Statistical analysis

All recorded data were tabulated and statistically analyzed by appropriate statistical test. The data collected was analyzed, continuous variables were presented as mean with standard deviation (SD) and categorical variables were presented as frequency and percentages. Student's t-test was used for testing the significance of mean in both groups. Qualitative data were analyzed using the Chi-square test. All the statistical results were considered significant at P<0.05.

RESULTS

The three groups were comparable with respect to their age, sex, weight, height, and duration of surgery without any statistically significant difference (Table 1).

From Table 2 and Figure 2, it is evident that the VAS score was higher in Group C compared to Group Q and Group E at all the time intervals and the difference was statistically significant (P<0.0001). However, there was no significant difference between Group Q and Group E.

Table 3 shows that the time of the first request to rescue analgesic for Group Q is (4.87±1.01) h, Group E is (5.13±1.01) h, and Group C (1.40±0.50) h showing that there is a significant difference on comparing Group C with Group Q and Group E (P<0.001). The total tramadol requirement in the first 24 h postoperatively was (143.33±62.61) mg in Group Q, (130.00±46.61) mg in Group E, and (226.67±63.97) mg in Group C. Tramadol requirement was higher in Group C compared to Group Q and Group E which was statistically significant (P<0.0001) but there was no significant difference between Group Q and Group E.

Table 4 shows that the percentage of highly satisfied patients was 45%, 50%, and 00% in, Group Q, Group E, and Group C, respectively, on the patient satisfaction scale. None of the patients were highly dissatisfied in Group Q and Group E as compared to Group C. The highly dissatisfied patients were 16.7% (5 patients) in Group C.

Table 1: Demographic profile and clinical characteristics of patients

Variable	Group Q	Group E	Group C	Group Q Versus Group C		Group E versus Group C		Group Q versus Group E	
	Mean±SD	Mean±SD	Mean±SD	t-test	P-value	t-test	P-value	t-test	P -value
Age	42.07±16.92	38.07±13.89	41.30±14.51	0.188	0.851	0.882	0.382	1.001	0.321
Height	148.10±9.49	152.57±5.76	150.90±7.27	1.283	0.205	0.984	0.329	2.204	0.032
Weight	51.97±9.21	52.30±6.75	52.53±8.34	0.25	0.804	0.119	0.906	0.16	0.874
Sex M: F Ratio	18:12	14:16	17:13	P=0.654					
Duration of surgery	131.17±12.91	130.50±9.77	130.50±10.45	0.22	0.827	0	1	0.226	0.822

Table 2: Post-operative VAS Score at different time intervals

VAS	Group Q	Group E	Group C	Group Q versus Group C		Group E versus Group C		Group Q versus Group E	
	Mean±SD	Mean±SD	Mean±SD	t-test	P-value	t-test	P-value	t-test	P-value
Immediately after surgery	0.00±0.00	0.00±0.00	0.00±0.00	-	-	-	-	-	-
After 1 h	0.13±0.35	0.13±0.35	3.33±0.96	17.19	<0.0001	17.6	<0.0001	0.4	0.694
After 2 h	1.57±0.73	1.53±0.68	3.23±0.90	7.76	<0.0001	8.26	<0.0001	0.37	0.715
After 4 h	2.00±0.59	1.73±0.74	3.90±0.48	7.21	<0.0001	7.35	<0.0001	0.55	0.582
After 6 h	2.87±1.01	2.87±1.14	4.73±0.83	7.84	<0.0001	7.27	<0.0001	0	1
After 8 h	2.80±1.00	2.40±1.04	4.60±0.56	8.61	<0.0001	10.21	<0.0001	1.52	0.133
After 12 h	2.63±0.72	2.93±0.69	4.73±0.74	11.15	<0.0001	9.74	<0.0001	1.65	0.105
After 18 h	3.80±0.61	3.53±0.73	4.87±0.90	5.37	<0.0001	6.30	<0.0001	1.53	0.130
After 24 h	3.73±0.91	3.57±0.82	4.77±0.90	4.43	<0.0001	5.41	<0.0001	0.75	0.458
Mean VAS Score	2.32±1.55	2.23±1.52	3.92±1.71	11.39	<0.0001	12.09	<0.0001	0.65	0.519

Table 3: Comparison of analgesic requirements between the groups

Analgesic Outcomes	Group Q Mean±SD	Group E Mean±SD	Group C Mean±SD	P-values		
				Group Q versus Group C	Group E versus Group C	Group Q versus Group E
Duration of Analgesia (in hours)	4.87±1.01	5.13±1.01	1.40±0.50	<0.0001	<0.0001	0.31
Total analgesic requirement (in mg)	143.33±62.61	130.00±46.61	226.67±63.97	<0.0001	<0.0001	0.353

Table 4: Patient Satisfaction Score

Patient satisfaction scale	Group			Total
	Group Q	Group E	Group C	
Highly Dissatisfied				
N	0	0	5	5
%	0.0%	0.0%	16.7%	5.6%
Dissatisfied				
N	2	1	15	18
%	6.7%	3.3%	50.0%	20.0%
Neither dissatisfied nor satisfied				
N	5	3	5	13
%	17%	10.0%	16.7%	14.4%
Satisfied				
N	9	11	5	28
%	31.3%	36.7%	16.6%	31.1%
Highly satisfied				
N	14	15	0	26
%	45%	50.0%	0.0%	28.9%
Total				
N	30	30	30	90
%	100.0%	100.0%	100.0%	100.0%

DISCUSSION

Nerve blocks are simple and effective analgesic techniques which are quite frequently used these days as a part of multimodal analgesia. In the last few years, there has been a shifting trend from thoracic epidural analgesia which was considered as the gold standard analgesic technique for long to regional block techniques. This was due to the associated difficulty in ambulation, hypotension, excessive fluid administration, and other complications of neuraxial technique.

We did a study to find the efficacy of ESPB and QLB for open urological procedures and we observed that the VAS score in the first 24 h postoperatively was higher in the control group compared to QLB group and ESPB group but there was no statistically significant difference between both the study groups. Our study was in accordance with Abd Ellatif and Abdelnaby,[19] Kang et al.,[20] Bakshi et al.,[21] and Onay et al.,[22] where they found lower VAS scores at rest and at movement in intervention groups without any significant difference between the groups.

Figure 2: Post-operative Visual Analog Scale score at different time intervals

Similarly, the duration of analgesia was higher in interventional groups as compared to the control group. The study done by Abd Ellatif and Abdelnaby,[19] showed similar results where they compared QLB and ESPB for post-operative analgesia in patients undergoing open nephrectomy. They found that the duration of analgesia was significantly higher in quadratus lumborum Group (281.2±18.5) min, ESPB Group (268.1±13.8) min compared to the control group (60.2±8.2) min (P<0.0001). However, there was no statistically significant difference between both the study groups. Similar results were observed by Bakshi et al.,[21] in their study when they compared Quadratus lumborum and ESPB for post-operative analgesia in cesarean section parturients under spinal anesthesia.

The total analgesic requirement in the first 24 h postoperatively was higher in Group C as compared to Group Q and Group E which was statistically significant (P<0.0001) while between Group Q and Group E difference was statistically not significant (Table 3). Our results were similar with a study by Tulgar et al.,[23] Joshi et al.,[24] where they concluded that post-operative tramadol consumption was higher in the control group as compared with QLB and ESPB group with a statistically significant difference. Similar analgesic use was shown in the studies done by Elkotory et al.,[25] Herman et al.,[26] Onay et al.,[22] where the cumulative morphine consumption in the QLB and ESPB group was not significantly different.

Limitations of the study

There are a few limitations of our study: -

1. The post-operative pain, which is a subjective experience and can be difficult to quantify objectively
2. We did not assess the pain scores at rest and on movement separately
3. The other major limitation is dermatomal limitation of block. We did not assess block success by evaluation of dermatomal sensory loss
4. The study was conducted in a single center
5. A longer study period would have been better.

CONCLUSION

From the present study, it is concluded that both QLB and ESPB are effective methods for post-operative analgesia and also improve the quality of multimodal analgesia when compared to the control group, in open urological procedures.

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Authors' Contribution:
APS- Definition of intellectual content, literature survey, prepared the first draft of manuscript, implementation of the study protocol, data collection, data analysis, manuscript preparation and submission of article; **RP-** Concept, design, clinical protocol, manuscript preparation, editing, and manuscript revision; **RD-** Design of study, statistical analysis and interpretation, review manuscript.

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