Comparative study of injection 0.5% Bupivacaine and injection 0.75% Ropivacaine for their duration of anaesthesia/analgesia in Transversus Abdominis Plane block for unilateral inguinal hernia repair

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Abstract

Background: The Transversus Abdominis Plane block is a new regional anaesthesia technique described for postoperative pain management with a potential utility as a sole anaesthetic for increasing number of surgical procedures. TAP block improves postoperative pain management, decreases postoperative visual analog scale score, opioid demand and time to first administration of rescue analgesic in patients undergoing lower abdominal surgeries.

Aims and objectives: In our study, we have used TAP block as a sole anaesthetic technique in elective patients undergoing unilateral inguinal hernia repair and compared two different local anaesthetics, 0.5% Bupivacaine and 0.75% Ropivacaine for their duration of anaesthesia/ analgesia and cardiovascular stability.

Materials and Methods: A prospective randomized clinical study was conducted on 60 ASA I and II patients aged between 30 and 80 years coming for inguinal hernia repair fulfilling inclusion and exclusion criteria. They were divided into two groups of 30 each. Group B received injection 0.5% bupivacaine, group R received injection 0.75% ropivacaine, not exceeding 2.5 mg/kg body weight.

Results and Conclusion: We have found that both the drugs give excellent anaesthesia for inguinal hernia repair with hemodynamic stability. 0.75% Ropivacaine with significant delay in onset of anaesthesia (13.46+/- 3.2 min.) compared to 0.5% bupivacaine (7.86 +/- 2.47 min.) (P value <0.001), gives prolonged postoperative analgesia, (675.54 +/-30.31 vs 573+/- 45.72 minutes with P value <0.001). Transversus abdominis plane block can be used as a sole anaesthetic for inguinal hernia repair.

Key words: TAP block, Landmark technique, 0.5% Bupivacaine, 0.75% Ropivacaine, Inguinal hernia repair.

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Introduction

Inguinal hernia repair is the most commonly performed surgery in male patients of all age groups, more commonly in the elderly patients with weak abdominal wall and lax inguinal canal. It is performed under many anaesthetic techniques including spinal anaesthesia, inguinal field block, local infiltration and general anaesthesia. Postoperative analgesia in these patients is short lived requiring additional postoperative analgesics, like opioids, NSAIDs, acetaminophen etc. To overcome this short lived postoperative analgesia, various techniques have been tried like adding adjuvants to local anaesthetic used in spinal, field block. Recently TAP block has been tried in patients undergoing emergency lower abdominal surgery as well as in patients with multiple co-morbidities undergoing inguinal hernia repair and found it to be an alternative technique.

Transversus Abdominis Plane (TAP) is formed by the subcostal margin, from 9th to 12th costal cartilage continued into the border of the latissimus dorsi superiorly, inguinal ligament, iliac crest below and linea semilunaris anteriorly. TAP block is one of the new regional anaesthesia technique where the local anaesthetic is deposited in the potential space between the internal oblique and transversus abdominis muscle in the abdominal wall.

The sensory and motor nerves supplying the abdominal wall: intercostal nerves (T_7-T_{11}) subcostal nerve (T_{12}) and the iliohypogastric and ilioinguinal nerves (L_1) enter the TAP at various levels and course through this plane to supply different parts of the abdominal wall including the skin over the upper gluteal region and upper medial part of thigh[1,2]. TAP block as described by Karim Mukhtar, in the journal of New York school of Regional Anaesthesia, provides anaesthesia to parietal peritoneum as well as skin and muscles of anterior abdominal wall by blocking these nerves[3].

Mc Donnell et al, have performed the TAP block through LTOP[4] (Lumbar Triangle Of Petit), bounded posteriorly by the lateral border of latissimus dorsi, anteriorly by external border of external oblique and the

base by the iliac crest. Carney JJ et al, and Tran TMN et al used ultrasound guided technique for TAP block and demonstrated the definitive spread of local anaesthetic in the TAP from the superior margin of the iliac crest to the level of costal margins, using MRI (magnetic Radio Imaging), and showed it reduces the postoperative morphine requirement in 24-48 hours of postoperative period[4-6].

On extensive search of literature, we have found that TAP block has been used by many authors as a component of multimodal postoperative analgesia for lower abdominal surgeries, in emergency situations and in patients with multiple co-morbidities for inguinal hernia repair[7,8], but very few articles in the literature are found where TAP block has been used as sole anaesthetic for elective inguinal hernia repair[9-11]. Hence in our study we have tried to explore the possibility of TAP block in inguinal hernia repair, and compare the efficacy of 0.5% bupivacaine and 0.75% ropivacaine, given through Lumbar Triangle of Petit (LTOP), in their duration of anaesthesia/analgesia, cardiovascular stability along with post-operative analgesia and perioperative complications.

Both bupivacaine and ropivacaine belong to amide group of local anesthetics. Derived from parent molecule propivacaine, bupivacaine is a mixture of S(-) and R(+) isomer with relatively more cardio-toxic than ropivacaine which is a pure S(-) enantiomer. Ropivacaine is less lipophilic than Bupivacaine. Because of this less lipid solubility, the dose of ropivacaine required for peripheral nerve blocks are higher than bupivacaine (equipotency). Both the drugs have been used for local infiltration, peripheral nerve blocks, epidural anesthesia, labor analgesia and intrathecal administration.

Material and Methods

A prospective randomized single blind study was conducted on 60 ASA grade I and II patients undergoing elective inguinal hernia repair in our Institute, after obtaining approval by institutional ethical committee. The patients were divided into two groups with 30 patients in each group. Group (B) received 30ml of 0.5% bupivacaine and group(R) received 30ml of 0.75% ropivacaine. TAP block was given via lumbar triangle of Petit (blind landmark technique) using Tuohy's needle.

Methods

Patients who refused to give consent, patients with ASA grade III and above, uncontrolled hypertension, arrhythmias, recent myocardial infarction (< 6 months old), patients with recent CABG, patients with heart block on pacemaker, irreducible/obstructed scrotal hernia, coagulopathy, liver disease, renal disease, localized infection over injection point/ surgical point, local anaesthetic allergy were excluded from the study.

Patients giving informed written consent, patients belonging to ASA I and ASA II grade, aged between 30 and 80 years, and body mass index (BMI) <30 were included for the study.

Based on literature survey for outcome variable of the present study, with 90% statistical power, 5% type I error, the sample size of 60 (30 in each group) patients was obtained.

Patients who were scheduled for elective inguinal hernia repair fulfilling the inclusion criteria were enrolled for the study after explaining the procedure. Written informed consent was obtained from all the participating patients.

Randomization was done by thick envelope method. Two anaesthetists performed the technique. One anaesthesiologist loaded and kept the drug as per the information in the envelope. The other anaesthesiologist was blinded to the loaded drug and performed the technique and assessed the patients for the required parameters.

Electrocardiography, pulse oxymetry and non-invasive blood pressure monitors were connected. Intravenous line with 18G cannula was secured and ringer-lactate (RL) infusion started for all patients at the rate of 10ml/kg/hour.

Patient was pre-medicated with injection midazolam 0.02 mg/kg body weight.

All emergency resuscitation equipments were kept ready. TAP was accessed by landmark technique as described by Mc Donnell and others via the lumbar triangle of petit. Tuohy's needle18 gauge was used to identify the transverus abdominis plane (TAP). The needle was inserted perpendicular to the skin just above the highest point of iliac crest, in the posterior axillary line where a depression was felt in the LTOP. Needle was gently advanced until a "pop" was felt- indicating the needle piercing the external oblique fascia. The needle was further advanced until a second 'pop' was felt- indicating the needle piercing the internal oblique fascia and entering the transversus abdominis plane. After aspiration to exclude any vascular injury and malposition of the needle tip, 2.5 mg/kg of bupivacaine or 3.0mg/kg. of ropivacaine, amounting to a maximum of 30ml was injected into TAP. Time taken for onset of sensory block is taken as the time gap between the end of injecting local anaesthetic to loss of sensation above the injected site and time for complete sensory and motor blockade ($T_{10} – L_1$) was recorded.

Hemodynamic parameters were recorded preoperatively (basal reading) and every 15 minutes intra-operatively. Post-operative readings were taken every 2nd hourly, until the patient asked for first rescue analgesia. VAS (Visual analogue scale) score was also recorded at the time of rescue analgesia.

All the patients were kept awake throughout the procedure. Postoperatively, injection tramadol 1 mg/ kg was used as rescue analgesic when the patients asked for analgesia.

All the recorded parameters were compared with respect to the study drugs and their efficacy with regard to time taken for sensory blockade and complete motor blockade, hemodynamic stability and duration of analgesia.

Observations and Results

Descriptive and inferential statistical analysis has been carried out in our study.

All the recorded parameters were analysed using statistical software: SAS 9.2, SPSS 15.0, Stata 10.1, MedCal 9.0.1, Systat 12.0 and R environment.Ver.2.11.1.

Results on continuous measurements are presented on mean±SD (Min-Max) and results on categorical measurements are presented in number (%).

Student t test has been used to find the significance of study parameters on continuous scale between two groups. Chi-square/Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups.

Significance of the data:

+Suggestive significance (P value: $0.05 < P \leq 0.10$)

*Moderately significant (P value: $0.01 < P \leq 0.05$)

* * Strongly significant ($P \leq 0.01$)

Both the groups were comparable with respect to demographic variables like age, sex and weight. The mean age in group (B) was 57.90 yrs (SD 8.59 yrs). In group (R) the mean age was 60.00yrs (SD of 9.30yrs). (Table 1) The mean weight in group (B) was 63.97 kg (SD of 5.92 kg). In group (R) the mean weight was 65.07 kg (SD of 4.94kg). In both the groups only male patients were anesthetized. (Table 1)

There was no significant difference in the duration of surgery. In group (B) mean duration of surgery was 90.56mins with SD of 6.70 mins. In group (R) mean duration of surgery was 91.15min with SD of 8.64 mins. (p 0.779) (Table 2)

There was strong statistically significant ($p<0.001$) prolongation in the time to onset of block and time taken for complete block in group(R). In group (B) mean time taken for onset of block was 7.86, mean time taken for complete block was 44.00 mins. In group(R) mean time taken for onset of block was 13.46mins, and mean time taken for complete block was 56.15mins (Table 2).

Patients in both the groups were hemodynamically stable throughout the procedure with no significant change in heart rate, systolic and diastolic blood pressure within the group. There was no significant intra group differences in hemodynamic parameters postoperatively also. (Table 4, 5, 6).

Analgesia was prolonged in group R which was statistically highly significant ($p<0.001$). In group (B) the mean duration of analgesia was 573.00mins. In group (R) the mean duration was 675.54mins (Table 3). No significant difference in VAS score was observed between the groups with VAS score of 2 in 10 number of patients in group B and 16 number in group R, VAS score 3 in 17 patients in group B, 10 patients in group R with a p value 0f 0.074. No intra and postoperative complications were observed in both the groups (Table 7).

Three cases in group B and four cases in group R were excluded from statistical analysis because of inadequate anaesthesia.

Table 1: Demographic Data

Description		Group B	Group R
Number of Observations		30	30
Gender	Male	30	30
	Female	0	0
Age	Mean	57.9	60
	Standard Deviation	8.59	9.3
Weight (in Kilograms)	Mean	63.97	65.07
	Standard Deviation	5.92	4.94

Table 2: Time taken for onset of complete Analgesia & duration of Surgery

Description	Group B	Group R	P value
Time taken for Onset of block (mins) (Avg±Std Dev)	7.86±2.47	13.46±3.20	<0.001**
Time taken for complete Block (mins) (Avg±Std Dev)	44.00±5.08	56.15±5.88	<0.001**
Duration of surgery (mins) (Avg±Std Dev)	90.56±6.70	91.15±8.64	0.779

Table 3: Total duration of the analgesia (in Minutes)

Minutes	Group B		Group R	
	Number	%	Number	%
<550	5	16.7	0	0
550-650	22	73.3	8	26.7
>650	0	0	18	60
NA	3	10	4	13.3

Total	30	100	30	100
Mean ± SD	573.00±45.72		675.54±30.31	
P<0.001**, Significant, Student t test				

Table 4: Heart Rate Variable during and after surgery

Heart Rate (beats/min)	Group B	Group R	P value
Intra op			
Pre-op	79.67±9.05	79.88±9.21	0.931
Initial	82.52±8.00	80.85±9.40	0.488
15 min	83.11±8.05	81.23±9.18	0.431
30 min	81.19±8.18	80.19±9.40	0.683
45 min	80.74±7.32	79.23±8.35	0.487
60 min	79.48±5.89	78.38±8.33	0.581
75 min	80.26±7.28	77.50±8.36	0.205
90 min	81.93±7.26	78.92±8.69	0.178
105 min	82.67±6.15	78.54±8.61	0.049
Post op			
Initial	83.93±6.53	81.04±8.89	0.183
2 hours	82.00±6.79	80.04±8.60	0.36
4 hours	81.96±6.03	79.31±7.31	0.155
6 hours	81.41±5.26	79.73±7.31	0.341
8 hours	83.48±6.48	79.73±8.37	0.073
10 hours	84.81±5.82	82.23±8.16	0.189
12 hours	81.22±6.74	81.69±7.00	0.804

Table 5: Systolic blood pressure variables

SBP (mm Hg)	Group B	Group R	P value
Intra op			
Pre-op	118.96±25.65	123.69±8.03	0.373
Initial	124.56±7.73	126.04±7.56	0.484
15 min	126.07±7.68	127.00±6.98	0.648
30 min	125.00±4.92	126.00±7.35	0.562
45 min	124.81±5.69	126.46±6.65	0.337
60 min	125.85±5.38	126.00±5.74	0.923
75 min	126.59±4.33	125.77±5.52	0.548
90 min	125.33±4.71	126.35±5.82	0.488
105 min	126.67±5.11	126.69±6.20	0.987
Post op			
Initial	129.70±5.78	129.15±6.15	0.739
2 hours	128.22±5.21	127.46±5.56	0.609
4 hours	127.19±5.30	126.23±5.41	0.519
6 hours	127.11±4.72	127.31±6.09	0.896
8 hours	127.96±4.61	127.85±5.85	0.936
10 hours	129.30±3.70	129.54±4.47	0.83
12 hours	124.07±4.06	127.12±6.78	0.052+

Table 6: Diastolic Blood Pressure variables

DBP (mm Hg)	Group B	Group R	P value
Intra op			
Pre-op	81.00±8.42	76.62±8.21	0.061+
Initial	80.37±6.47	79.04±7.10	0.478
15 min	78.89±7.00	78.08±7.08	0.676
30 min	79.26±4.27	77.85±5.79	0.315
45 min	79.70±5.31	77.92±4.54	0.196
60 min	80.15±4.30	77.69±4.76	0.054+
75 min	81.52±3.74	77.23±5.12	0.001**

90 min	81.11±4.48	78.00±5.06	0.022*
105 min	81.63±4.84	79.00±5.19	0.062+
Post op			
Initial	84.00±6.23	80.62±5.08	0.035*
2 hours	81.48±4.79	79.00±5.10	0.074+
4 hours	80.81±4.52	78.50±5.59	0.103
6 hours	81.04±4.31	79.15±4.64	0.132
8 hours	81.11±4.68	80.50±4.86	0.643
10 hours	82.63±3.91	81.85±4.00	0.474
12 hours	80.15±4.30	80.92±6.21	0.599

Table 7: VAS Score at first rescue analgesia

VAS Score	Group B		Group R	
	Number	%	Number	%
2	10	33.3	16	53.3
3	17	56.7	10	33.3
NA	3	10	4	13.3
Total	30	100	30	100
P=0.074+, Significant, Chi-Square test				

Discussion

Inguinal hernia repair is the most common surgical procedure in elderly persons, who may have other co-morbidities and need extended postoperative analgesia to help in early ambulation, thereby limiting many complications including deep vein thrombosis.

Though few authors have used TAP as an available technique for anaesthetizing for inguinal surgeries in emergency situations[9,10], available literature is very less to conclude and opine on effectiveness of this procedure for elective hernia repair. Hence this prospective randomized single blind study was conducted to study its feasibility as a sole anaesthetic for elective inguinal hernia repair.

In 1993 Kuppuvelumani injected local anaesthetic (0.5% Bupivacaine 20 ml on each side) into a point just above the iliac crest, bilaterally, and found it to be useful as a technique for postoperative pain management in patients undergoing cesarean section[12]. Rafi formally described and portrayed it as a new abdominal field block with a targeted single shot local anaesthetic delivery in to the TAP in 2001[13]. Since then it has undergone several modifications. Mc Donnell et al adopted the term TAP block in 2007 and demonstrated its utility in patients undergoing lower abdominal surgeries either as a primary anaesthetic or for postoperative pain management[4].

Many of the anaesthetists have used different drugs like 0.5% bupivacaine, 0.5% L-bupivacaine, 1.5% mepivacaine, 0.75% ropivacaine in their separate studies and found that TAP block can be used as an alternative technique in patients undergoing inguinal hernia repair especially with multiple co-morbidities, and found that ultrasound guided TAP block gives better results than blind technique.[8-11]

Laffey et al in their study found that the upward spread of local anaesthetic in the TAP takes longer time and estimation of upper level of the block before the complete spread of the drug is inaccurate.[14]

Individual studies by Lipi Mishra et al[7], meta-analysis and review of clinical studies conducted by many authors[15-18], revealed that TAP block is an excellent mode of postoperative pain management especially in lower abdominal surgeries and in patients with multiple co-morbidities.

In our study we have followed blind landmark technique as described by Mc Donnell and others in 2007. Only male patients who were willing to participate in the study were selected. There was no statistically significant difference in the age and weight among the participants. We have compared 0.5% bupivacaine and 0.75% ropivacaine and found that time to onset and complete block was significantly prolonged (P value<0.001). Both the drugs give good anaesthesia and analgesia for inguinal hernia repair, with better quality of anaesthesia and statistically significant prolonged duration of analgesia by 0.75% ropivacaine in comparison with the study conducted by other authors[10,17-19]. In group B the duration of analgesia was: 573.00±45.72mins, in group R it was: 675.54±30.31mins. (P value of <0.001). Both the drugs were found to maintain hemodynamic stability both intra-operatively and post-operatively without any side effects, and no significant difference in postoperative VAS score.

Conclusion

TAP block performed by landmark technique provides adequate anaesthesia and prolonged postoperative analgesia in patients undergoing inguinal hernia repair with stable hemodynamic parameters. It reduces the dose of analgesics like, opioids, NSAIDs, acetaminophen, in the postoperative period. Injection 0.75% ropivacaine gives statistically significant

prolongation (P value<0.001) of analgesia than 0.5% bupivacaine, without any perioperative side effects. TAP can be used safely for inguinal hernia repair.

Limitations of the study

Blind double pop technique was followed in our study to identify the TAP. It was performed by one of the investigator who had comparable skills as the other investigator. Accuracy of the block would have been better if it was performed under ultrasound guided technique which is an alternate technique currently practiced.

Large volume of local anaesthetics up to 30 ml have been used, but have not come across any complications related to the dose. Further studies are required to optimize the dose/volume needed for the block and also its feasibility in upper abdominal surgeries as well.

Conflict of Interest: Nil

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