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Comparing Effect of 0.25% Bupivacaine and 0.5% Ropivacaine in Transversus Abdominis Plane Block for Postoperative Analgesia in Lower Abdominal Surgeries

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Abstract

Introduction: Wall of abdomen is a source of pain after abdominal surgeries. Even an operation such as inguinal herniorrhaphymay lead to chronic pain in patients. Lower abdominal surgeries are common surgical procedure with a rare postoperative morbidity. However, chronic pain and continuous neuralgia have been accepted as complications after lower abdominal surgeries. *Aims:* To compare Effect of 0.25% Bupivacaine and 0.5% Ropivacaine in Transversus abdominis plane block for postoperative analgesia in lower abdominal surgeries. *Materials and Methods:* This is was a prospective study conducted at during the period from June 2017 to May 2018. Sixty patients with ASA Grade I and II of 20 to 60 years age, undergoing inguinal hernia surgeries under spinal anesthesia were randomly alocated into Two Groups of 30 each, Group B - Bupivacaine 0.25% and Group R- Ropivacaine 0.5%. *Results:* Thus, the effect of Bupivacaine and Ropivacaine was comparable to each other suggesting that Bupivacaine and Ropivacaine have hemodynamic stability in TAP block. The duration of postoperative analgesia was for more than 24 hrs in Ropivacaine Group comparative to Bupivacaine has a postoperative analgesia for 8 hrs. *Conclusion:* TAP bock performed by landmark technique in patients undergoing lower abdominal surgeries with 0.5% ropivacainesingle injection of 0.5% ropivacaine gives prolonged postoperative analgesia, Reduces the doses of rescue analgesics in postoperative period.

Keywords: Abdomen; Ropivacaine; Bupivacaine; Inguinal hernia.

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Introduction

The wall of abdomen is a main source of pain after abdominal surgery. Even an operation such as inguinal herniorrhaphy may lead to chronic pain in patients, with clinically significant effects on daily tasks if postoperative pain is not taken care of. The pain perceived by patients after abdominal surgery is derived from the anterior abdominal wall incision. The anterior abdominal wall is innervated by nerve afferents that course through the transverses abdominis neurovascular fascial plane.

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Lower abdominal surgeries are common surgical procedure with a rare postoperative morbidity. However, chronic pain and continuous neuralgia have been accepted as complications after lower abdominal surgeries. The prominent factors linked with chronic pain that develop after inguinal hernia repair are asearly postoperative severe pain, repeated hernia operations and surgical technique.[1,2] The most important issue of interest among chronic pain developing mechanisms after lower abdominal surgeriesas a consequence of all these factors is damaged sensory nerves at the surgical site. Therefore, chronic pain originates after lower abdominal surgeries were accepted to be neuropathic. Pain after surgeries is more pronounced in the first two postoperative days pain is aggravated during mobilization or coughing, than during rest.

Many analgesic modalities are recommended to relieve the postoperative pain. The usual trend is to prescribe an opioid or a Nonsteroids Antiinflammatory Drugs (NSAID) for postoperative analgesia. Nonsteroid ant inflammatory drugs also have certain side effects like hemostasis alteration, renal dysfunction, gastrointestinal hemorrhage etc. Intravenous Opioids although provide satisfactory analgesia, but are associated with unwanted side-effects like respiratory depression, postoperative nausea and vomiting, prolonged sedation and immobilization. Epidural analgesia is generally used regional technique to alleviate pain but it need added care has it's own complications like total spinal anesthesia, intravascular injections, epidural hematoma and epidural abcess. The physiological side effects include hypotension, motor blockade, and urinary retention. It can also result in delayed mobilization and might be contraindicated in certain situations like coagulopathy, infection at the site of injection and raised intracranial pressure.[3] However, in regional analgesic technique, drugs have peripheral site of action, hence minimum systemic side effects.

Hence, regional analgesic technique has gained widespread acceptance as paramount component of postoperative analgesia regimen. Transversus Abdominis Plane Plock (TAPB) is gaining demand as one of such regional blocks. The Transversus Abdominis Plane (TAP) block is a regional anesthesia technique that lend analgesia to the parietal peritoneum as well as the skin and muscles of the anterior abdominal wall. It has been shown to be a safe and potent postoperative adjunct analgesia method in a variety of surgical procedures and it is proposed as part of the multimodal anesthetic approach to promote recovery after lower abdominal surgeries.[4]

Transversus Abdominis Plane Block (TAPB) can be performed through the lumbar triangle of Petit formed by external oblique muscle anteriorly, latissimus dorsi muscle posterior, iliac crest inferiorly and is usually identified as a defect 1 cm above the iliac crest in midaxillary line. The technique involves injection of local anesthetic towards the plane between the Transverses Abdominis Muscle (TAM) and internal oblique muscles. It allows sensory blockade of plexus of nerves supplying lower abdominal wall, muscles and skin *via* local anesthetic drug deposition above the TAM. The present study is to compare the duration of postoperative analgesia dealthby 0.25% bupivacaine and 0.5% ropivacaine used in TAPB for lower abdominal surgeries.

Materials and Methods

This prospective study was conducted during the period from June 2017 to May 2018. A total number of 60 patients undergoing elective lower abdominal surgeries (Unilateral inguinal hernia and open appendectomy) were studied.

Inclusion Criteria

Age between 20–60 years of either gender, American Society of Anesthesiologist (ASA) Grade I and II Patients posted for elective lower abdominal surgeries (Unilateral inguinal hernia and open appendectomy)under spinal anesthesia.

Exclusion Criteria

ASA Grade III and above, allergy to study drugs, history of abdominal surgeries, hematological disorders and emergency surgeries. All the patients were randomly allocated into Two Groups of 30 each using computer generated random numbers by simple randomization technique. In each Group of 25 members were posted for elective unilateral inguinal hernia surgeries and 5 members were posted for elective appendicectomy surgeries. Patient will be observed for 48 hours postoperatively. After the institutional ethics committee approval and written informed consent sixty ASA one or two patients aged between 20 and 60 years scheduled to undergo lower abdominal surgeries (Unilateral inguinal hernia and open appendectomy surgeries). Following a comprehensive preanesthetic evaluation all patients were told about visual analogue scale for pain (0-no pain,10-worst imaginable pain) in their own local language.

All patients were kept nil by mouth from midnight before surgery and tablet alprazolam (0.01 mg/kg) was administered at bed time, the day before surgery. All the patients were reexamined, reassessed and weighed preoperatively on the day of surgery. Intravenous access was established with a 18G intravenous cannula and preloading was done with 15 ml/kg lactated ringer's solution 30 minutes before procedure. Anesthesia machine and accessory anesthetic equipments were checked and drugs, including emergency drugs were kept ready. A multi parameter monitor for monitoring Heart Rate (HR), Noninvasive Blood Pressure (NIBP), Electro Cardiogram (ECG) and oxygen saturation (SpO_2) were attached to each patient on arrival to the operating room and baseline parameters were recorded.

All the patients were randomly divided into Two Groups of 30 each using computer generated random numbers by simple randomization approach. In Each Group 25 members were posted for elective unilateral inguinal hernia surgeries and 5 members were posted for elective appendicectomy surgeries–

Group B : Bupivacaine 0.25%;

Group R : Ropivacaine 0.5%.

Under strict aseptic conditions, with the patient in the lateral position, a lumbar puncture was performed at L3-L4 intervertebral space through midline approach using a 25-gauge Quincke spinal needle. After ensuring free flow of CSF, 0.5% heavy bupivacaine 3 ml was administered intrathecally in both the groups, the spinal injection rate of bupivacaine 0.5% was 1 ml in 3–4 seconds in all patients. Without any additive in lateral position without any table tilt.

At the end of the surgery Petit's triangle will be identified on the side of surgery as a defect of 1 cm above the iliac crest in midaxillary line between the fibers of external oblique and latissimus dorsi muscles. Under all aseptic precautions the block will be given through Petit' triangle with 23G spinal needle attached to a 20 ml syringe containing the drug as per the group allocation.

Needle will be introduced perpendicular to skin and advanced until two "POPS" or "give way" were felt. Then the drug will be injected in the fascial plane after aspiration.

Assessment of block was done by pinprick. Target height was T6. Patients were monitored intraoperatively. Hypotension was taken as fall in systolic blood pressure > 20% of baseline and was treated with incremental doses of Ephedrine 6 mg and bolus of 200 ml of Ringer Lactate. Bradycardia was taken as heart rate < 60 beats per minute and treated accordingly with intravenous glycopyrolate 0.2 mg. No analgesic or sedation was given to any patient intraoperatively. The anesthesiologist who observed the patients in postoperative ward was blinded to the drug injected in TAPB. Patient was monitored every 5 minutes for half an hour, then every 15 minutes till 2 hours and then at 4, 6, 12, 24, 48 hours postoperatively for heart rate, systolic blood pressure, diastolic blood pressure, pain and complications if any. Pain was assessed according to visual analog score from 0 to 10.

Patient was given rescue analgesia in the form of intramuscular diclofenac 75 mg at a visual analog pain score of ≥ 4 (i.e. minimal pain). The duration of analgesia in TAPB was treated to be from the time of recession of sensory level below T10 on the nonoperated side to pain score of 447 (i.e. minimal pain). Patient was also observed for any other postoperative complications like hematoma, flank fullness, etc.

Statistical Analysis

The mean of a collection of numbers is their arithmetic average, derived by adding them up and dividing by number of samples. The standard deviation is the root mean square deviation of the values from their arithmetic mean. In the present study, we used student's unpaired *t*-test for statistical analysis. It was used because two sets of population were compared which were independent and identically distributed. '*p*'-Value: It indicates the probability of error and a value less than 0.05 is considered statistically significant.

Results

Following were the observations and results of present study.

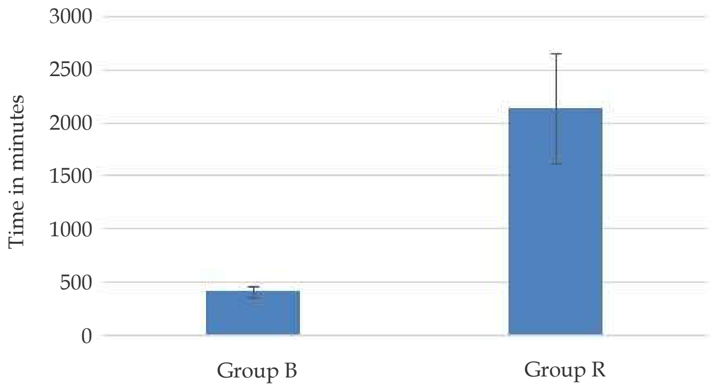
Age wise, weight wise, height distribution is similar in both the groups, Mean age, weight and height is comparable between both the groups (Table 1).

Duration of postoperative analgesia in Group B is 419 ± 49.95 minutes where as in Group R it is 2140 ± 511. 12 minutes which is highly significant compared to Group B. Difference in duration of postoperative analgesia between Two Groups is significant. (*p*–Value <0.0001). Duration of analgesia

Table 1: Demographic distribution in present study

Age in year	Group B (n = 30)	Group R (n = 30)
20–30	2 (6.67%)	3 (10.00%)
31–40	5 (16.67%)	4 (13.33%)
41–50	7 (23.33%)	8 (26.67%)
51–60	16 (53.33%)	15 (50.00%)
Mean age in years	51 + 9.6	50 + 9.4
p-Value	>0.05	
Weight in Kilograms		
40–50	10 (33.33%)	9 (30%)
51–60	10 (33.33%)	10 (33.33%)
61–70	5 (16.67%)	6 (20%)
71–80	5 (16.67%)	5 (16.67%)
Mean weight in years	56.6 + 8.98	57 + 8.9
p-Value	>0.05	
Height wise distribution in cms		
155–160	12 (40%)	14 (46.67%)
161–165	18 (60%)	16 (53.33%)
Mean weight in years	159.2 ± 3.16	159.5 ± 3.01
p–Value	>0.05	

p-value <0.05 is taken as significant.



p-value <0.05 is taken as significant.

Fig. 1: Comparison of duration of analgesia (mean±sd) in both.

is prolonged in Group R (ropivacaine) (Fig. 1).

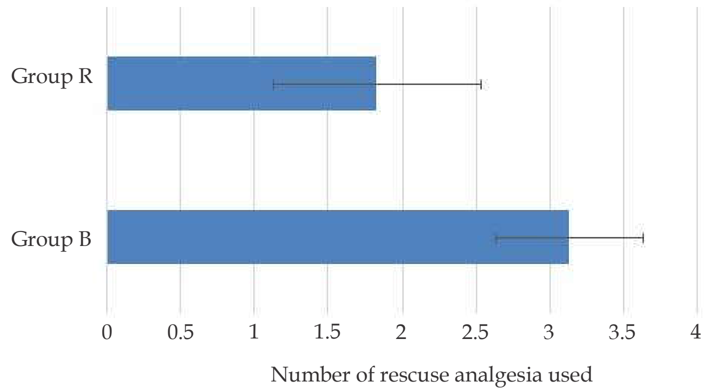
The patient were assessed for postoperative analgesia by visual analog scale. At visual analog pain score of 4 (i.e. minimal pain) patient received rescue analgesic in the form of intramuscular diclofenac 75 mg. Patients in Group B had pain relief for minimum period of 8 hrs postoperatively. Patients in Group R had postoperative analgesia for more than 24 hours (Table 2).

Table 2: Comparsion of VAS pain scores in Two Groups

Time	Group B Mean + SD	Group R Mean + SD	*p*-Value
0 min	0 ± 00	0 ± 00	.000
15 min	0 ± 00	0 ± 00	.000
30 min	0 ± 00	0 ± 00	.000
1 hr	0 ± 00	0 ± 00	.000
2 hr	0 ± 00	0 ± 00	.000
4 hr	0 ± 00	0 ± 00	.000

Time	Group B Mean + SD	Group R Mean + SD	*p*-Value
8 hr	3.4 ± 0.67	0 ± 00	.000
16 hr	4.33 ± 0.54	0 ± 00	.000
24 hrs	5.06 ± 0.63	2.76 ± 0.77	0.107
48 hr	6.26 ± 1.14	6.6 ± 0.89	0.213

p-value <0.05 is taken as significant.



p-value <0.05 is taken as significant.

Fig. 2: Comparision of number of rescue analgesics used (Mean ± SD) in Two Groups in 48 hours.

Patients in Group B required more rescue analgesics compared to Group R (Fig. 2).

Mean heart rates, systolic blood pressures and diastolic blood pressures are comparable between both the groups. They are not significant in between Groups (Table 3).

Table 3: Comparison of heart rate (Mean ± SD) in both groups

Time	Group B Mean+SD	Group R Mean + SD	*p*-Value
0 mins	77.86 ± 9.12	81.63 ± 1.63	.134
15 min	78.53 ± 9.13	82.33 ± 2.33	.113
30 min	78.86 ± 9.15	82.23 ± 2.23	.172
1 hr	81.13 ± 9.60	83.18 ± 3.10	.413
2 hr	79.86 ± 7.42	82.13 ± 2.13	.239
4 hr	79.33 ± 7.05	82.46 ± 2.46	.113
8 hr	81.4 ± 6.54	83.66 ± 3.66	.181
16 hr	79.33 ± 9.33	81.66 ± 1.66	.290
24 hr	79.26 ± 9.26	81.58 ± 1.50	.342
48 hr	78.47 ± 8.40	81.56 ± 1.56	.108
Systolic blood pressures			
0 mins	126.66 ± 10.07	125.93 ± 9.12	.770
15 min	127.33 ± 9.17	126.13 ± 9.13	.636
30 min	127.53 ± 9.67	125.86 ± 9.15	.535
1 hr	126.8 ± 8.82	124.86 ± 9.60	.453
2 hr	124.06 ± 7.33	123.33 ± 7.42	.649
4 hr	125.6 ± 8.01	125.53 ± 7.05	.821
8 hr	128 ± 6.43	127.06 ± 6.54	.615
16 hr	129.7 ± 7.80	128.8 ± 9.05	.592
24 hr	130.6 ± 8.37	129.6 ± 9.62	.610
48 hr	130.13 ± 7.44	128.46 ± 7.58	.521

Time	Group B Mean+SD	Group R Mean + SD	*p*-Value
Diastolic blood pressure			
0 mins	81.63 ± 10.07	77.86 ± 9.12	.134
15 min	82.33 ± 9.17	78.53 ± 9.13	.113
30 min	82.23 ± 9.67	78.86 ± 9.15	.172
1 hr	83.1 ± 8.82	81.13 ± 9.60	.413
2 hr	82.13 ± 7.33	79.86 ± 7.42	.239
4 hr	82.46 ± 8.01	79.33 ± 7.05	.113
8 hr	83.66 ± 6.43	81.4 ± 6.54	.181
16 hr	81.66 ± 7.80	79.33 ± 9.05	.290
24 hr	81.50 ± 8.37	79.26 ± 9.62	.342
48 hr	81.50 ± 8.37	79.26 ± 9.62	.521

p-value <0.05 is taken as significant.

Discussion

The gain of enough postoperative analgesia are clear and comprise a reduction in the postoperative stress response, postoperative morbidity and in certain types of surgery, bettered surgical outcome. Effective pain control also facilitates rehabilitation and hasten recovery from surgery. Other advantages of competent regional analgesic techniques include reduced pain intensity, reduced incidence of side effects from analgesics and improved patient comfort.

Dr. Reid renders two points, first refers to anatomy of the triangle of Petit. Dr. Rafi, an early collaborator with the first author (JMcD) in establish this block, was incorrect in stating that the floor of the triangle is set by the internal oblique muscle.[4,5] As stated the floor of the triangle of Petit is composed of fascial extensions of the external and internal oblique muscles.[5] The needle does not extend the external oblique muscle, but rather the fascial extensions of this muscle and the internal oblique. It is these fascial layers which present the "pop" sensation described when achieving the block. The needle then lies just lateral to the transversus abdominis, which is the correct position for the performance of the block.

The second point concerns the performance of the block in obese patients. We acknowledge that the triangle of Petit can be more difficult to locate in these patients. However, we have a high success rate with the block even in this group. However, we do recommend initially performing this block in patients with a normal body habitus, in order to gain experience with the block prior to moving onto patients that one might find more challenging. A number of maneuvers may aid palpation of the triangle in these patients. There is usually tenting of the adipose tissue at the pelvic rim, so that, this adipose fold can be "displaced" superiorly. Palpation can be further aided by having the patient lift their head off the bed which tenses the abdominal wall and makes the triangle easier to palpate. It is also worth remembering that palpation of the triangle of Petit can cause some discomfort, which can be used to confirm the location of the triangle. We are presently characterizing the utility of ultrasound, which may assist in locating the triangle, particularly in obese patients.

We agree with Dr. Tornero-Campello that the clinical utility of the transversus abdominis plane block can usefully be compared to epidural analgesia.[7] There is directly no reason to contend that the transversus abdominis plane block would provide superior analgesia to epidural blockade. There are number of patients undergoing abdominal surgery for epidural blockade is not adopted, due to contraindications such as sepsis or coagulopathy or to logistical issues such the lack of availability of the required postoperative monitoring. Therefore, epidural analgesia cannot be considered "standard care," but rather is the 'gold standard' for provision of postoperative analgesia. Furthermore, the transversus abdominis plane block can provide unilateral analgesia, an advantage in patients undergoing nonmidline abdominal incisions. In our study, we demonstrated that the transversus abdominis plane block substantially improves patient comfort when compared to patients who receive opioid-based postoperative analgesia. Therefore, at present we would recommend the transversus abdominis plane block for patients in whom epidural analgesia is not feasible for the reasons discussed earlier.

Using local anesthetic agents in Transverses Abdominis Plane Block (TAPB) is a simple and competent analgesic technique, applicable for surgical procedures where parietal pain is a significant component of postoperative pain. The ease of the procedure can also provide an advantage for clinical use.

In this study local anesthetic agents like 0.5% ropivacaine and 0.25% bupivacaine used in TAPB produced effecient and prolonged postoperative analgesia. The finding that a single-shot TAP technique using drugs like ropivacaine can produce effective analgesia for up to 48 h. The reasons for the prolonged duration of analgesic effect after TAP blockade are not entirely elucidated. However, this may relate to the fact that the TAP is relatively poorly vascularized, and therefore drug clearance may be slowed.[6]

Over the past 3 yrs, a series of studies have highlighted the value of efficacy of various local anesthetic agents in Transverses Abdominis Plane (TAP) block, after the initial description of the technique by Dr. Rafi.[5] TAP Block as described by Dr. Rafi involves identifying the neurovascular plane of the abdominal musculature and injecting a local anesthetic agent there in. He performed abdominal field block *via* the lumbar triangle without any untoward sequelae.

With the procedure of ultrasound guided nerve blockade gaining popularity, this technique was also practiced to injection of bupivacaine and ropivacaine in the TAP block.[6] However, injection *via*Petit's triangle using double POP technique resulted in reliable deposition into the transverses abdominis plane.[6] Moreover, it may not always be possible to use ultrasound guided techniques for administering TAPB where such facilities are not available. The landmark-based technique for the TAP block, have been performed without difficulty in the children. Alternative procedures to the TAP block using ultrasound guidance have newly been described in series of case in children undergoing inguinal hernia repair.[8] There are new variety of techniques for the TAP block and the analgesic merit of each will beclarified in ongoing studies. Although it is possible to ultrasonically visualize the three muscle layers of the abdominal wall, there variance in these muscle layers that can impede the use of ultrasound over the triangle of Petit.[9]

As a result, the point of insertion of needle as described in the ultrasound studies, which is dependent on the adequate identification of the 3 muscle layers, can vary. This will vary the location of the injectate as will the angle of the insertion of needle to skin, which deviate to the landmark approach's description. Although there is an ever-increasing access to ultrasound, it is far from universal and there is a continuing interest in marker techniques.[10]

Epidural ropivacaine was found to be significantly less effective than bupivacaine by a factor of 0.4, ropivacaine was 60% as potent as bupivacaine when used for epidural pain relief in labor analgesia. The analgesic potency of ropivacaine was 0.6 relative to bupivacaine.[11] So, the present study used 20 ml of either 0.25% bupivacaine or 0.5% ropivacaine drugs under study for use in unilateral TAPB considering ropivacaine to be approximately half as potent as bupivacaine (Table 2).

In the present study, mean age in the bupivacaine and ropivacaine groups was 51±9.6 and 50±9.4 years respectively. Mean age among the groups was comparable (Table 1). The mean age of patients in bupivacaine and ropivacaine groups of the present study is in accordance with those of Neha Fuladi 201434 (44.28 ± 16.04 and 47.56 ± 15.48) and Venkatesh Murthi et al. 201636 (57 ± 8.9 and 60 ± 9.3).[12,13]

In the present study, mean weight in the bupivacaine and ropivacaine groups was 56.6 ± 8.98 and 57.27 ± 8.94 kilograms respectively. Mean weight among the groups was comparable.

The mean weight of the patients in bupivacaine and ropivacaine groups of present study is in accordance with those Neha Fuladi 201434 (52.04±10.65 and 52.56 ± 6.87), Shradha et al. 201635 (54.15 ± 7.64 and 55.25 ± 6.45).[12]In the present study, mean height in the bupivacaine and ropivacaine groups was 159.2 ± 3.16 and 159.5 ± 3.01 centimeters respectively. Mean height among the groups was comparable (Table 1).

Mean height of patients in bupivacaine and ropivacaine groups of present study is in accordance with the studies of Shradha et al. 201635 (156 ± 7.64 and 155 ± 6.45).[12]

In present study, mean duration of analgesia in bupivacaine and ropivacaine groups was 419 ± 49.95 and 2140 ± 511.12 minutes respectively and it is prolonged in Ropivacaine group which is statistically significant (p<0.05) (Figure 1). The mean duration of analgesia in present study is in accordance with Neha Fuladi et al. 201434 (420.06 ± 14.1 and 2187 ± 1011.09).[12] Thus, it is seen that mean duration of analgesia is prolonged in Ropivacaine group as compared to control group.

The difference between the mean heart rate, mean systolic and diastolic blood pressure were found to be statistically nonsignificant between Group B and Group R at all periods of time (Table 3). Thus, the effect of bupivacaine and ropivacaine was found to be comparable suggesting that bupivacaine and ropivacaine have comparable hemodynamic stability in TAP block (Figure 2).

The findings of present study are in accordance to the study conducted by, Belavi et al. (2009), Neha fuladi (2014) and Venkatesh Murthi et al. (2016) stated that hemodynamic parameters were comparable and statistically in significant (p>0.05) in all the groups at any point of time with no statistical variation.[14,12,13]

The reasons for the prolonged duration of analgesia and hemodynamic stability after TAP blockade are not entirely elucidated. However, this may relate to the fact that the TAP is relatively poorly vascularized, and therefore, drug clearance may be slowed. In present study, no complications such as LA toxicity, liver trauma, local infection or hematoma were seen in any of the Two Groups. Present study with accordance to Neha fuladi (2014) and Shradhasinha et al. (2016) who also did not encounter any complications in their study.[12,15]

Conclusion

From the present study, we conclude that TAP bock performed by landmark technique in patients undergoing lower abdominal surgeries (unilateral inguinal hernia and open appendicectomy surgeries) with 0.5% ropivacaine has following advantages than 0.25% bupivacaine:

Single injection of 0.5% ropivacaine gives prolonged postoperative analgesia. Reduces the doses of rescue analgesics in postoperative period. Both the groups were hemodynamically stable. No complications were seen.

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