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Study on Comparing the Postoperative Analgesic Efficacy of Ultrasound Guided Tansverse Abdominis Plane Block with 0.25% Bupivacaine and 0.375% Ropivacaine in Laparoscopic Surgeries

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Abstract

Introduction: Improvements in surgical training, as well as developments of instruments, imaging, and surgical techniques, have made laparoscopic surgery safe and feasible across different medical fields. It has its own advantages as it is minimally invasive with less postoperative pain, more rapid recovery, shorter hospital stay and earlier return to normal activity. *Aims:* The objective of the present study is to compare the efficacy of a single shot ultrasound guided Transversus Abdominis plane block with 0.375% Ropivacaine and 0.25% bupivacaine in providing post operative analgesia upto 24 hours for laparoscopic surgeries. *Materials and Methods:* It is a prospective, randomized, double blinded study in 60 adult patients including both males and females belonging to American Society of Anesthesiologist (ASA) I & II were included in the current study. *Results:* Bupivacaine and ropivacaine provided equally effective analgesia with TAP block till 24 hours after the block. There is also no significant difference in hemodynamics and sedation scores in between the groups. In both the groups the mean, duration of time taken for the pain score to be >4 (moderate pain) by numerical rating scale was around 15 hours after the block. Only seven patients (23.3%) in bupivacaine group and nine patients (30.0%) in ropivacaine group received the rescue analgesic once. Regarding the duration of analgesia both the drugs provided equally effective analgesia till the end of observation period i.e., 24 hours post operatively. *Conclusion:* Bupivacaine and Ropivacaine in laparoscopic surgeries showed that both (0.25%) bupivacaine and (0.375%) ropivacaine provided equally effective postoperative analgesia, better pain scores and required less doses of rescue analgesics in the first 24 hours duration after the block.

Keywords: Postoperative Analgesic; Tansverse Abdominis Plane; Bupivacaine; Ropivacaine.

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Introduction

Laparoscopic surgery has existed since the development of diagnostic laparoscopy and it has since become a frequently applied technique for a wide field of indications. The procedure has become the gold standard for many organ systems. Significant improvements in surgical training, as

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well as developments of instruments, imaging, and surgical techniques, have made laparoscopic surgery safe and feasible across different medical fields. It has its own advantages as it is minimally invasive with less post-operative pain, more rapid recovery, shorter hospital stay and earlier return to normal activity. However, patients undergoing laparoscopic abdominal surgery experience moderate or even severe pain in the early post-operative period. This pain is caused by a number of mechanisms, including incision the anterior abdominal wall, pneumo peritoneum causing stretching of anterior abdominal wall.

The most traditional approach to postoperative pain relief is multimodal using nonsteroidal anti-inflammatory drugs (NSAIDs) and opioids. Nonetheless, there are severe restrictions on the availability of opioids and other essential medications which are used to reduce nausea, vomiting, constipation, urinary retention, respiratory depression and sedation, used for the management of pain.[2] Therefore, the use of non-opioid analgesic techniques can lead to an improved quality of recovery for surgical patients. Poorly controlled acute pain after abdominal surgery is associated with a variety of unwanted postoperative consequences, including patient suffering, distress, respiratory complications, delirium, myocardial ischaemia, prolonged hospital stay and an increased likelihood of chronic pain. A number of modalities have been tried over the years to reduce the postoperative pain after laparoscopic cholecystectomy, including systemic analgesia with non- steroidal anti-inflammatory drugs (NSAIDs) and opioids, port-site local anesthetic infiltration", intravenous patient controlled analgesia, patient controlled thoracic epidural analgesia. Trans versus abdominis plane block, intraperitoneal lavage of local anesthetic agents and low pressure pneumoperitoneum".

Introduced 10 years ago in Ireland, where there was a lack of facilities and staff for acute postoperative pain treatment, it became increasingly popular worldwide because of its relative simplicity and efficacy. TAP block significantly reduces pain associated with lower abdominal surgery, regardless of whether it is used as the primary anaesthetic or for pain control after general or spinal anesthesia. With the advent of Ultrasound imaging and the promise of improved localization and efficacy, TAP blocks have once again been brought to the forefront and have gained importance as an analgesic modality. In the past few years, there have been increasing numbers of reports describing the use of TAP blocks for pain relief for adult and paediatric abdominal surgical procedures. Furthermore, the extent of morbidity arising from complications remains unknown. Any new intervention should include an assessment of the degree of patient satisfaction with tolerability of the procedure. TAP blocks are believed to provide improved postoperative analgesia and reduced requirements for medications for pain relief and a systematic review on this topic is timely. With most of the studies concentrating on the analgesic modality as such, we decided to compare the analgesic efficacy of two local anesthetics viz. Bupivacaine and Ropivacaine for lower abdominal laparoscopic surgeries.

Materials and Methods

The study was approved by the hospital ethics committee of hospital and informed consent was obtained from the study groups.

It is a prospective, randomized, double blinded study.

A total of 60 adult patients including both males and females belonging to American Society of Anesthesiologist (ASA) I & II were included in the current study.

Inclusion Criteria: ASA physical status I/II patients in Laparoscopic surgeries as Laparoscopic appendicectomy, laparoscopic myomectomy, Laparoscopic assisted vaginal hysterectomy.

Laparoscopic sterilization, Laparoscopic ovarian cystectomy, Laparoscopic sleeve gastrectomy, Baraitric surgeries. Diagnostic laparoscopy and Hysterolaparoscopy.

Exclusion Criteria: Known hypersensitivity for study drugs, Surgeries where epidural analgesia is used for postoperative pain relief.

Patients were allocated randomly to the two groups, Group-1 (bupivacaine) and Group-2 (ropivacaine) using a computer generated random numbers table when they were received in the preoperative area. An anesthesiologist not involved in the study prepared the syringes containing either bupivacaine or ropivacaine.

Group-l (n=30): received 20 ml Inj.Bupivacaine 0.25% on each side of the abdomen.

Group-2 (n=30): received 20 ml Inj.Ropivacaine 0.375% on each side of the abdomen.

After randomization, Group l received 20 ml 0.25% bupivacaine (10 ml of 0.5% bupivacaine+ 110 ml of sterile water) and Group 2 received 20 ml

0.375% ropivacaine (10 ml of 0.75% ropivacaine + l0 ml of sterile water) on each side.

The following monitoring methods were used are Six channel ECG connected- Leads II & V5 were monitored, Non invasive blood pressure monitor, Pulse oximetry and base-line heart rate, mean blood pressures, and oxygen saturation were recorded.

Technique of Tranversus abdominis plane (tap) block.

All surgeones were performed under general anesthesia, endotracheal intubation and controlled ventilation. Anesthesia was induced with inj. Propofol 2 mg/kg iv, Inj.Fentanyl 1-2 mcg/kg, lnj. Midazolam 1 mg iv, endotracheal intubation was facilitated with lnj.Vecuronium 0.1 mg/kg iv and maintained with oxygen and nitrous oxide (50:50) sevoflurane one MAC and intermittent doses of vecuronium. lnj.ketorolac 30 mg IM is given twice daily first dose being 30 mins prior to performing the block.

- At the end of the surgical procedure and before extubation the TAP block is performed under ultrasound guidance. The anaesthesiologist performing the block was blinded from the local anaesthetic drug that was being used. After skin preparation with the antiseptic, the USG probe (Sonosite, Bothell, WA) transducer with a frequency of 5-10 mHz is covered with a sterile sleeve.

The transducer probe placed in the anterior axillary line between the iliac crest below and the costal margin above, the following structures can be seen from superficial to deep-skin, subcutaneous tissue, the external oblique muscle, internal oblique muscle, the transverses abdominis muscle, peritoneum and bowel loops. Once the transversus abdominis plane is identified between the internal oblique and transversus muscles; a 23G spinal needle is inserted, the needle tip was visualised using the ultrasound probe and 20 ml of the study drug is injected after negative aspiration of blood while looking for the local spread of the drug in the plane between internal oblique and transversus muscle using USG. Block is repeated on the opposite side. After the block, neuromuscular blockade is adequately reversed with lnj.Neostigmine and Inj. glycopyrolate and the patient is extubated and shifted to post anesthesia care unit (PACU).

Parameters observed. The heart rate mean arterial pressure and oxygen saturation, pain score using numerical rating scale and sedation score using Ramsay sedation score were monitored at every fifteen minute interval for the first hour and at the end of second hour in the post anesthesia care unit.

For the first 24 hour period in the ward the pain scores and sedation scores were noted at 4th hour, 8th hour, 12th and 24th hour. The time of Requirement of rescue analgesia and the number of rescue analgesic doses were also recorded.

Pain score is assessed using numerical rating scale (Fig. 1).

The Ramsay sedation score is used to monitor sedation

Ramsay Sedation Score[3]

1 = anxious and agitated

2 = cooperative and tranquil

3 = drowsy but responsive to command

4 = asleep but responsive to a glabellar tap

5 = asleep with a sluggish response to tactile Stimulation

6 = asleep and no response

Excessive sedation was defined as a score greater than 4/6. When the Pain score >4 as per numerical rating scale rescue analgesic Inj. Tramadol 50 mg iv was given to a maximum of three doses in 24 hours.

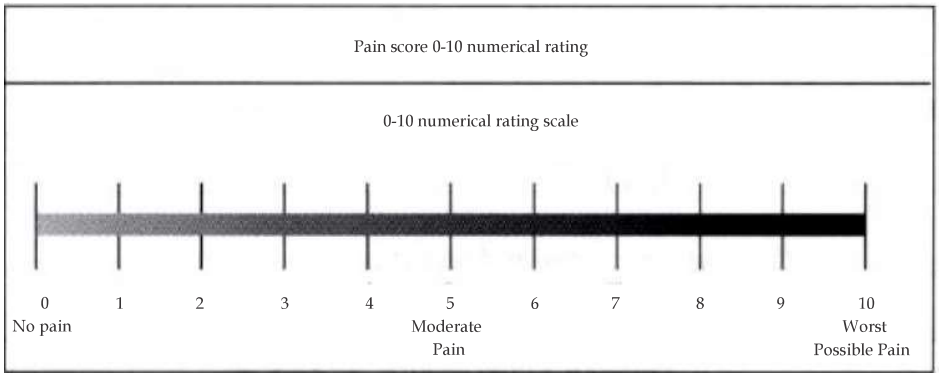

Fig. 1: Numerical rating scale

Statistical Analysis

Statistical analysis was done using statistical package for the social sciences (SPSS) 1.5 software. Data were expressed as mean standard deviation or numbers and percentages. P value less than 0.05 was considered significant. The categorical variables were compared using chi square test. The physiological parameters were compared using independent samples test. The pain scores and sedation scores were compared using Mann whitney test and chi square test respectively. The duration of analgesia was analysed with independent samples test. The total number of rescue analgesics used was analysed using chi square test.

Results

All the sixty patients included in the study were randomly divided into 30 patients in each group.

Table 1: Demographic data in study

Varibles	Group-1 (n=30) Mean (SD)	Group-2 (n=30) Mean (SD)	p-value
Age (years)	42.4 (8.1)	41.8 (8.2)	0.93
Weight (kgs) (kg/sqmetre)	59.27 (11.16)	60.73 (13.54)	0.64
Male	3 (10.0%)	8 (26.7%)	0.09
Female	27 (90%)	22 (73.3%)	

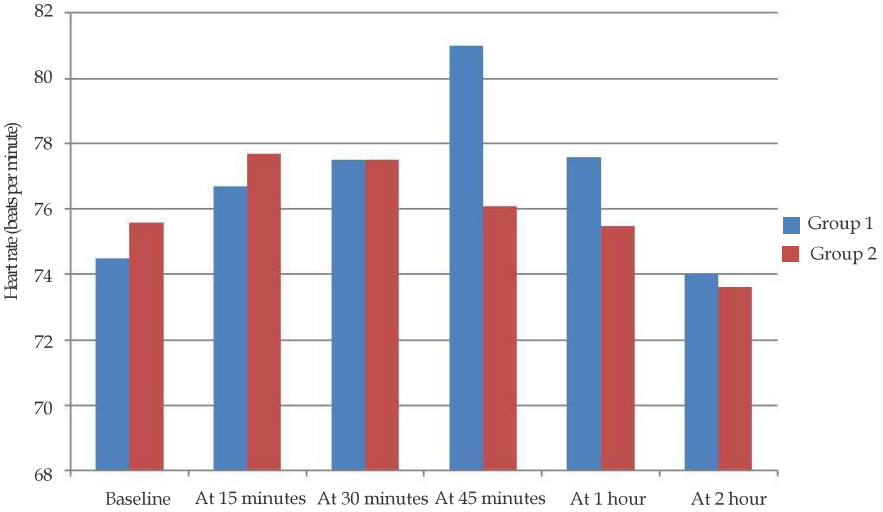

Fig. 2: Comparison of mean heart rate among both the groups at various intervals

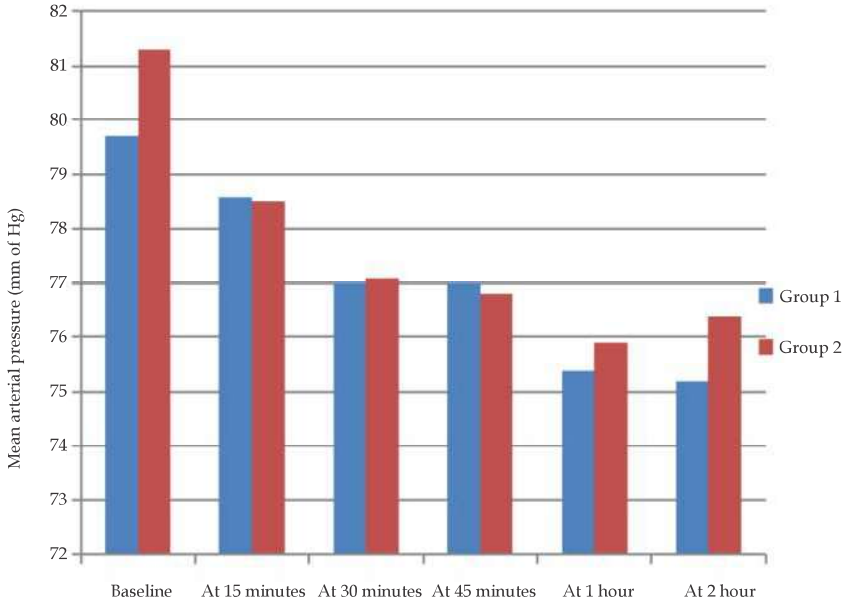

Fig. 3: Comparison of Mean arterial pressure among both the groups at various intervals

There were no significant differences between the two groups with respect to age, weight and gender (Table 1).

There was no significant differences in observed physiological variables of heart rate, mean blood pressure and percentage oxygen saturation in between the groups at various time intervals (Fig. 2).

There was no significance observed in pain scores or sedation scores monitored at different time intervals in between the groups (Fig. 5).

There was no significance observed in total duration of analgesia time for pain score >4 (Fig. 7).

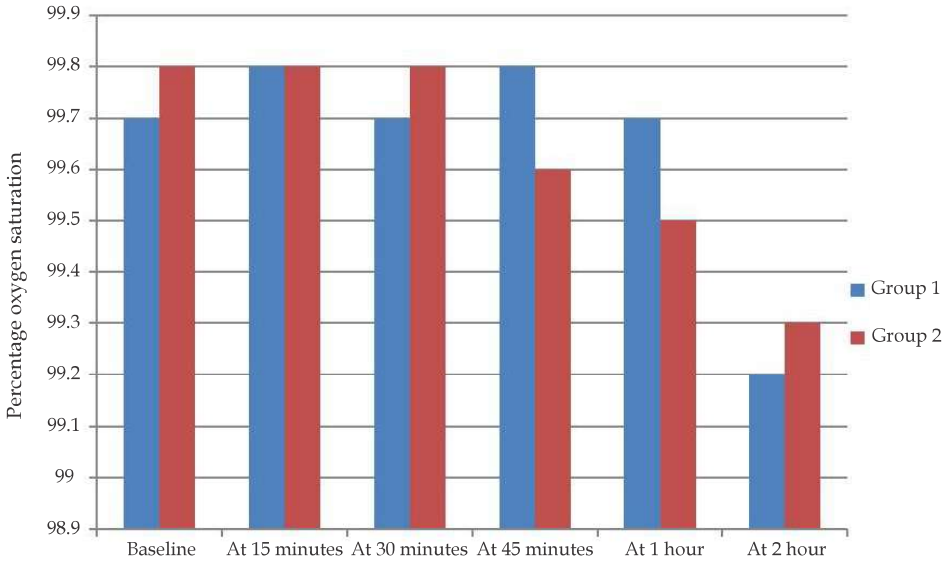

Fig. 4: Comparison of Mean Percentage oxygen saturation among both the groups at various intervals

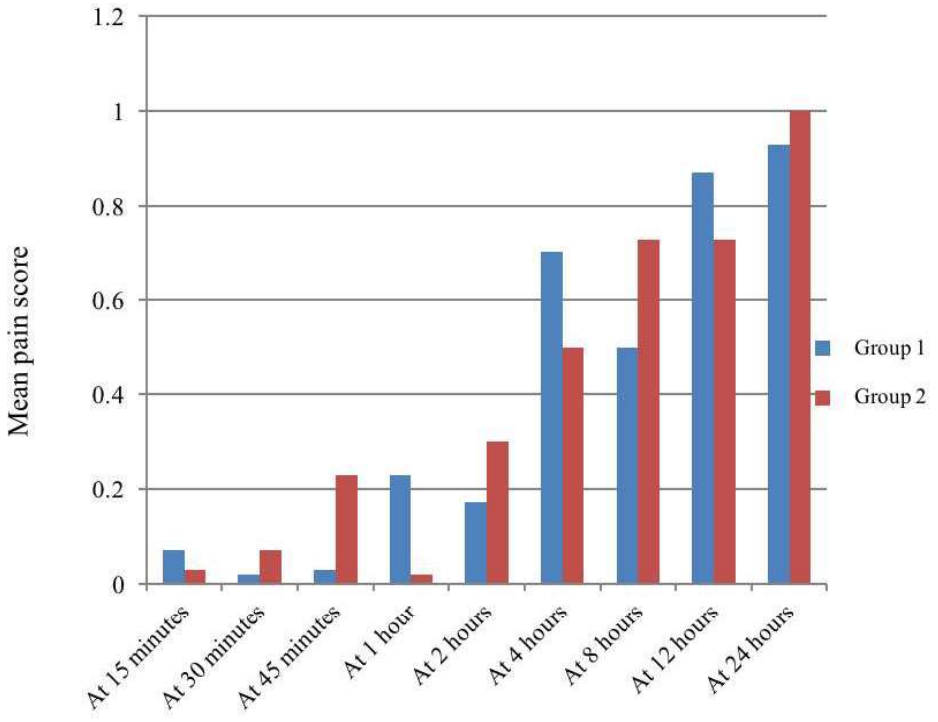

Fig. 5: Pain score and sedation score

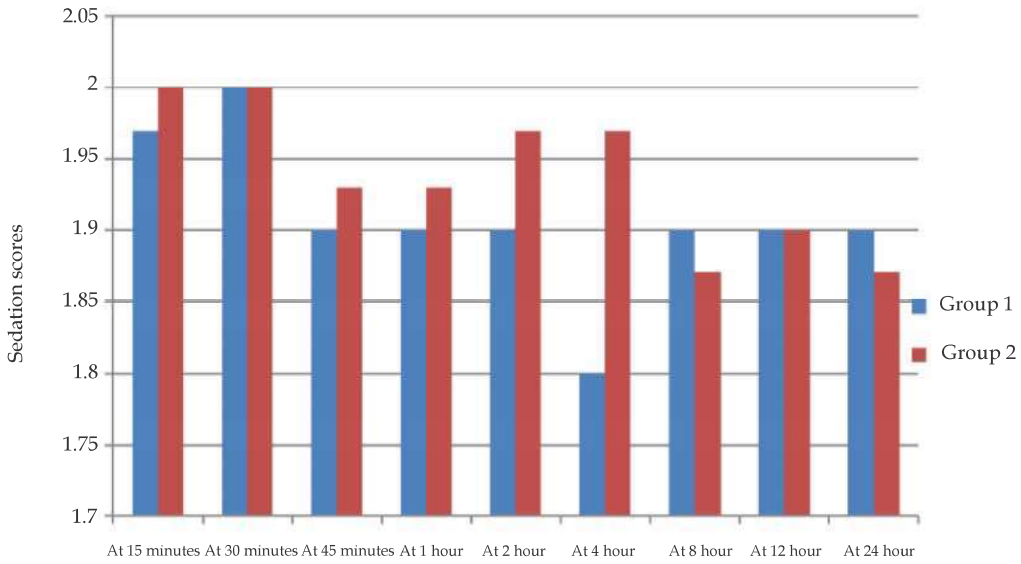

Fig. 6: Comparison of Mean Sedation scores among both the groups at various intervals

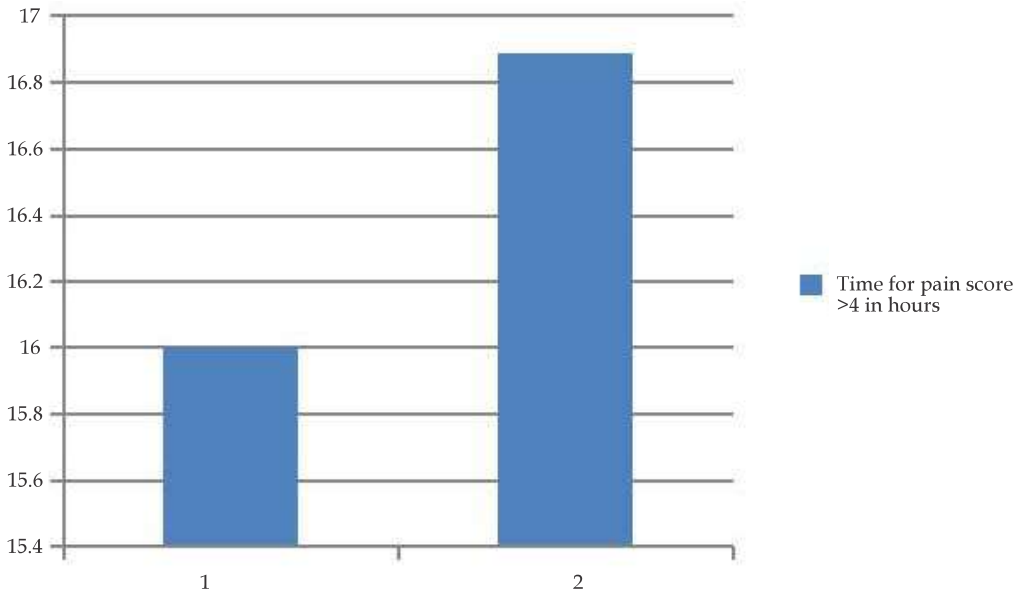

Fig. 7: Comparison of Mean Time for pain score >4 (in hours) among both the groups

Table 2: Comparison of total number of rescue analgesics in number of patients in both the groups

	Group 1	Group 2	p value
Number of rescue analgesics used in number of patients (%)	23(76.7)	21(70.0)	0.25
Rescue analgesics used once in number of patients (%)	7(23.3)	9(30.0)	0.68

There was no significance observed in number of rescue analgesics required in between the groups (Table 2).

Discussion

A substantial component of pain is experienced by patients after abdominal surgery which is derived from abdominal wall incision. The abdominal wall consists of three muscle layers the external oblique, the internal oblique and the transverses abdominis and their associated fascial sheaths. The central abdominal wall also includes the rectus abdominis and its associated facial sheath. This muscular wall

is innervated by nerve afferents that coarse through the transverses abdominis neuro fascial plane.

Table 3: shows various studies in correlation

Study	Local anaesthetic Solution	Duration of analgesia by TAPB
McDonnell (2007)[4]	Levobupivacaine 3.75 mg/ml (20 ml) bilaterally	24 hrs
McDonnell (2008)[5]	Ropivacaine 7.5 mg/ml (15-20 ml) bilaterally	6-12 hrs
Carney (2008)[6]	Ropivacaine 7.5 mg/ml (15-20 ml) bilaterally	48 hrs
El-Dawlatly (2009)[7]	Bupivacaine 5 mg/ml (15 ml) bilaterally	24 hrs
Niraj (2009)[8]	Bupivacaine 5 mg/ml (20 ml)	24 hrs
Belavy (2009)[9]	Ropivacaine 5 mg/ml (20 ml) bilaterally	24 hrs

Compared to regional analgesia, the advantages of the TAP block are absence of sympathetic and motor block and avoidance of possibility of damage to spinal cord structures. The transversus abdominis plane is the fascial plane between the internal oblique and the transversus abdominis muscles. The deposition of local anaesthetic in this plane has shown to reliably produce block that extends from T 10 dermatome to L 1 dermatome and therefore is suitable for lower abdominal surgery. When we directly visualise all anatomical structures, the needle, and the spread of local anaesthetic by ultrasound guidance, it may be associated with an increased margin of safety and optimal block qualities. Also, obese patients, post lower abdominal surgeries are often put on deep vein thrombosis (DVT) prophylaxis, and epidural catheter if present, needs removal after timing with the DVT prophylactic dose. The provision of TAP block avoids all these problems and also leads to improved patient comfort. Adequate pain relief after abdominal surgery encourages the patient to have optimum respiratory function (by doing manoeuvres like incentive spirometry), avoiding complications like basal lung atelectasis.[10]

In many studies which were conducted in recent times, TAP blocks have been described as an effective component of multimodal postoperative analgesia for a wide variety of abdominal procedures including large bowel resection, open/ laparoscopic appendectomy, cesarean section, total abdominal hysterectomy, abdominal wall hernia, open gastrectomy, laparoscopic cholecystectomy, open prostatectomy, renal transplant surgery, abdominoplasty with/without flank liposuction, and iliac crest bone graft.[11] Most reports demonstrate the efficacy of TAP blocks by highlighting some combination of reduced postoperative opioid requirement, lower pain scores, and/or reduction in opioid-related side effects.

Petersen *et al.*[12] reviewed 7 randomized, double-blinded, clinical trials of both landmark-based (n = 3) and ultrasound-guided (n = 4) TAP blocks for managing postoperative pain after abdominal surgery with incisions below the level of the umbilicus. All 7 studies compared pain-related outcomes with TAP blocks as part of a multi-modal postoperative analgesic regimen. Morphine PCA ± acetaminophen ± nonsteroidal anti-inflammatory drugs was most commonly used to complement TAP blocks. In one study, intrathecal morphine was also part of the analgesic regimen. A meta-analysis of these 7 studies (180 cases and 184 controls) demonstrated an average reduction in 24 hour morphine consumption of 22 mg (95% confidence interval: −31 mg to −13 mg) in favor of TAP block patients compared with standard management. Furthermore, TAP blocks were associated with reduced early postoperative visual analog scores (VAS) both at rest and during mobilization in 4 of the 7 studies (1 study did not record VAS scores). Postoperative sedation, as well as postoperative nausea and vomiting (PONV), was marginally reduced in patients with TAP blocks.

In a separate meta-analysis using 4 of the 7 studies reviewed by Petersen et al[12]., Siddiqui *et al.*[13] also demonstrated a morphine-sparing effect of TAP blocks in the first 24 hours after surgery. Similarly, another meta-analysis by Charlton *et al.*, which reviewed 236 participants from 5 studies (including landmark- and ultrasound-guided TAP blocks), demonstrated a significant reduction in 24 hour morphine requirements (average −22 mg, 95% confidence interval −38 mg to −6 mg) in TAP block patients compared to controls.

It has also been found that the analgesic effect of TAP block persists for atleast 24 h postoperatively and the block could be considered an integral part of multimodal analgesic strategy to control residual pain.

The TAP block will also reduce the use of morphine and its complications like nausea, vomiting, sedation, and especially respiratory depression, in obese. Hence, it also ensures that the patient can be shifted to the ward from the postoperative intensive care unit much earlier, since the complications due to opioid consumption is avoided.

Different techniques have been described in the

performance of transverses abdominis plane (TAP) block. In current study we used the ultrasound guided approach, the needle was inserted in the lumbar triangle of Petit to reach the transverses abdominis plane. Although we did not encounter any complications during TAP blocks procedure, the true incidence of complications such as systemic toxicity, vascular or visceral injury were still unknown. It is conceivable that the needle visualization might reduce the incidence or potential for complications, but studies confirming this statement is lacking.

In current study we compared the analgesic efficacy of Bupivacaine 0.25% (total dose 100 mg) with Ropivacaine 0.375% (total dose of 150 mg) in TAP block for patients undergoing laparoscopic surgeries. In our study both. Bupivacaine and ropivacaine provided equally effective analgesia with TAP block till 24 hours after the block. There is also no significant difference in hemodynamics and sedation scores in between the groups. In both the groups the mean, duration of time taken for the pain score to be >4 (moderate pain) by numerical rating scale was around 15 hours after the block. Only seven patients (23.3%) in bupivacaine group and nine patients (30.0%) in ropivacaine group received the rescue analgesic once. Regarding the duration of analgesia both the drugs provided equally effective analgesia till the end of observation period i.e 24 hours post operatively.

In a study by McDonnell Gerald *et al.* compared ropivacaine 0. 75% with saline in TAP block for caesarean delivery they found that patients who have undergone TAP block with ropivacaine had reduced 8 hour morphine requirement and a longer time to first patient controlled analgesia-morphine request. This study supports the current study since analgesia from TAP block is superior to saline group.[4]

Rafi described the use of 20 mL of "a local anaesthetic agent" for each side requiring analgesia.[14] Subsequently, McDonnell *et al.* reported the use of 20 mL of 0.5% lidocaine for each side in healthy volunteers.[4]

Over the past 3 year, a series of studies have highlighted the value of efficacy of various local anaesthetic agents in Transversus Abdominis Plane (TAP) Block, after the initial description of the technique by Rafi.[14] Transversus Abdominis Plane Block as described by Rafi involves identifying the neurovascular plane of the abdominal musculature and injecting a local anaesthetic agent therein. He performed abdominal field block via the lumbar triangle without any untoward sequelae.

With the technique of ultrasound guided nerve blockade gaining popularity, this technique was also applied to injection of bupivacaine and ropivacaine in the TAP block. However injection via Petit's triangle using double POP technique resulted in reliable deposition into the transversus abdominis plane. Moreover it may not always be possible to use ultrasound guided techniques for administering TAP Block where such facilities are not available.

The landmark-based technique for the TAP block, have been performed without difficulty in the children.[15] Alternative approaches to the TAP block using ultrasound guidance have recently been described in a case series of children undergoing inguinal hernia repair.[11] The optimal approach remains to be demonstrated. There are now a variety of techniques for the TAP block and the analgesic merit of each is being elucidated in ongoing studies. Although it is possible to ultrasonically visualize the 3 muscle layers of the abdominal wall, there is variation in these muscle layers that can restrict the use of ultrasound over the triangle of Petit.[15] As a result, the needle insertion point as described in the ultrasound studies, which is dependent on the adequate identification of the 3 muscle layers, can vary. In the current study, USG guided TAP Block is performed following the induction of general anesthesia.

This will alter the location of the injectate as will the angle of the needle insertion to skin, which contrasts 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 landmark techniques.[16] Moreover ultrasound machine may not be available at all places especially in peripheral health centers where the blind technique alone is the option for giving TAPB. 100% success rate with TAP block have been obtained using landmark technique for posterior approach of block.[14] To our knowledge till now no study has been performed to compare the efficacy of landmark versus ultrasound technique for posterior approach of TAP block.

TAP injection of local anaesthetic injection cephalad to the iliac crest likely involves T10–L1 nerve roots and implies that the technique may be limited to use in lower abdominal surgery.[17]

Sinha A *et al.* conducted a study to evaluate efficacy of Ropivacaine with dexmeditomidine versus ropivacaine with plain saline which concluded that addition of dexmeditomidine to local anaesthetics for performing TAP Block has provided adequate and longer duration of

analgesia and supported for early mobilization by providing continuous analgesia post operatively and also supports the current study.

Maitreyi Gajanan Mankikar, Shalini Pravin Sardesai, Poonam Sachin Ghodki *et al.* evaluated Sixty patients undergoing caesarean section under spinal anesthesia who were randomised to undergo TAP block with ropivacaine (n = 30) versus control group (n = 30) with normal saline, in addition to standard analgesia with intravenous paracetamol and tramadol. This study concluded that Mean requirement of tramadol in the first 24 h was reduced in US guided TAP block after caesarean section which supports the current study.[18]

In addition, a growing number of reports suggest that TAP blocks may also be a safe alternative to neuraxial blockade in patients who are anti-coagulated, coagulopathic, or in patients who would not tolerate the hemodynamic sequelae often associated with profound neuraxial sympathectomy.

The TAP block is an effective and safe adjunct to multimodal postoperative analgesia for abdominal surgery. Multiple studies have demonstrated its superiority over standard medical therapy for postoperative pain control. Limited data also suggest that in select patient populations, TAP blocks/catheters may provide comparable analgesia as well as patient satisfaction to epidural therapy. However, the data is less encouraging for patients who receive intrathecal morphine during C-section, where the addition of TAP blocks does not appear to improve postoperative pain control. Nonetheless, it may be a good alternative strategy for patients who are highly sensitive to opioids. Hence, current study was conducted using plain local anaesthetics for performing TAP Block for various surgeries.

D. Belavy, P.J. Cowlishaw, M. Howes *et al.* evaluated the analgesic efficacy of TAP block in patients undergoing caesarean delivery and concluded that the USG guided TAP block reduces morphine requirements after caesarean delivery when used as a component of a multimodal analgesic regimen which supports the current study.[9]

The benefit of adequate postoperative analgesia are clear and include a reduction in the postoperative stress response, reduction in postoperative morbidity, and in certain types of surgery, improved surgical outcome. Effective pain control also facilitates rehabilitation and accelerates recovery from surgery. Other benefits of effective regional analgesic techniques include reduced pain intensity, decreased incidence of side effects from analgesics and improved patient comfort.

In our experience, the TAP block has a fast learning curve and requires short performance time especially by an experienced anesthesiologist. However it is possible that different providers in different clinical circumstances may find obstacles to the routine implementation of a TAP block as part of a multimodal pain strategy to improve postoperative quality of recovery.

Conclusion

In our experience, the TAP block has a fast learning curve and requires short performance time especially by an experienced anesthesiologist. However it is possible that different s providers in different clinical circumstances may find obstacles to the routine implementation of a TAP block as part of a multimodal pain strategy to improve postoperative quality of recovery.

Our current study which is a prospective randomized double blinded study comparing the postoperative analgesic efficacy of ultrasound guided transverses abdominis plane block with bupivacaine and ropivacaine in laparoscopic surgeries showed that both (0.25%) bupivacaine and (0.375%) ropivacaine provided equally effective postoperative analgesia, better pain scores and required less doses of rescue analgesics in the first 24 hours duration after the block.

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