

ORIGINAL RESEARCH

Comparison of the analgesic efficacy of ultrasound-guided transversus abdominis plane (tap) block versus local infiltration during laparoscopic surgeries in paediatric patients

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Abstract

Introduction: Regional anaesthesia has proved to be an essential aspect of modern paediatric anaesthesia which issues support for the superior and long-lasting analgesia without the risk of respiratory depression. The transversus abdominis plane (TAP) block is a type of regional anaesthetic technique which was first elaborated in the literature as an anatomical landmark technique in the year 2001 by Rafi. Hence this study is aimed to research whether USG guided TAP block was superior to local infiltration for intra and postoperative analgesia for paediatric laparoscopic surgeries.

Materials and Methodology: 100 children in the age group of 3–12 years, posted for elective laparoscopic hernia repair, orchidopexy, appendicectomy or cholecystectomy were enrolled in the study. All the study participants were basically divided into two groups like Group – T receiving TAP block and Group – L receiving local infiltration.

Results: The postoperative pain scores were reported to be significantly lower in Group T at 10 and 30 min, 1 and 2 hours than in Group L as tabulated in table 2. After 2 h, the pain scores were similar in the two groups. The necessity for rescue analgesia was also significantly lower in the TAP block group (10/50) when compared with the local infiltration group (37/50; $P < 0.001$). The intraoperative heart rates were significantly lower in TAP block group at port placement, 30 and 60 min compared with the local infiltration group.

Conclusion: This is to be conclude that TAP block is proven to be superior to local infiltration for intra and immediate postoperative analgesia in paediatric laparoscopic surgeries. We recommended the inclusion of TAP block as a routine in the part of multimodal analgesia for these surgeries in paediatric patients.

Keywords: post-operative analgesia, transverse abdominis, regional anesthesia

Introduction

With the advancement in the field of anaesthesia, the newer technique which is the transversus abdominis plane (TAP) block is a type of regional anaesthetic technique which

was first elaborated in the literature as an anatomical landmark technique in the year 2001 by *Rafi* and later it was advanced to be assisted with ultrasound guidance by *Hebbard et al.*⁴. There are few studies which elaborated about the strategies in using ultrasound guided TAP block in paediatrics which effectively permit the local anaesthetic to be directly injected between the internal oblique and transversus abdominis muscle layers without the need for an anatomical landmark for reference. As we all know that the abdominal wall has three muscle layers: external and internal obliques and transversus abdominis. This muscular wall comprises of the T7-12 intercostal nerves, the ilioinguinal and ilio-hypogastric nerves and the lateral cutaneous branches of the dorsal rami of L1-3 segments. The above nerves are usually run in a neurovascular plane between the internal oblique and transverses abdominis muscles and might indicate the 'target' of local anaesthetics.⁵ The various ways for blocking these sensory nerve supply to the anterior abdominal wall has been documented to provide effective postoperative analgesia following both open appendectomy and laparoscopic cholecystectomy.⁶

Regional anaesthesia has proved to be an essential aspect of modern paediatric anaesthesia which issues support for the superior and long-lasting analgesia without the risk of respiratory depression. Though the abdominal laparoscopic surgery is known for minimal pain when compared with that of laparotomy, many patients might still complain about the considerability of experiencing postoperative pain. Pain after laparoscopic surgeries is reported to be due the incision and visceroperitoneal pain due to peritoneal stretch and inflammation.⁴ A promising approach to the provision of postoperative analgesia after abdominal surgery is by block the sensory nerve supply to the anterior abdominal wall by injecting a local anaesthetic in the transversus abdominis plane (TAP). The TAP block was frequently used by *McDonnell et al.* in the year 2004,⁵ and a ultrasonography (USG)-guided technique was further described by *Hebbard et al.*¹ USG-guided TAP block enables excellent pain relief in lower abdominal surgeries.⁴ Hence this study is aimed to research whether USG guided TAP block was superior to local infiltration for intra and postoperative analgesia for paediatric laparoscopic surgeries.

Materials and methodology

After obtaining approval from the Institutional ethical committee, informed consent from parents and consent from children older than 7 years, 100 children in the age group of 3–12 years, posted for elective laparoscopic hernia repair, orchidopexy, appendectomy or cholecystectomy were enrolled in the study. The exclusion criteria that were followed in this study is that any contraindication to TAP block such as surgical scar or distorted anatomy at the site of injection, known allergy to local anaesthetics and children with known cardiovascular, respiratory, hepatic or renal disease.

All the study participants were basically divided into two groups like Group – T receiving TAP block and Group – L receiving local infiltration. The study participants and the investigator enrolling in the patients were blinded in the intervention. The concealment was done using sequentially numbered opaque sealed envelopes (SNOSE technique). The study was undertaken in paediatric surgery operation theatre of a tertiary care hospital and the postoperative data were collected in the surgical ward.

In Group L, the study participants were received port site infiltration with 0.4 mL/kg of 0.25% bupivacaine by the surgeon at the time of port placement and at the end of surgery. In Group T, bilateral TAP block was conducted under ultrasonographic guidance with a Logiq E7 GE portable ultrasound unit (GE Healthcare, Milwaukee, WI, USA) and a linear 5–10MHz probe.

Statistical analysis of the demographic data like age and weight were done using Student's t-test while that data on sex and type of surgery were analysed with the help of Chi-square test.

The continuous outcomes were measured using Student's t-test or Mann-Whitney U-test. P value less than 0.05 was considered as statistically significant.

Results

The study was proposed to be conducted over a period of 6 months. Data from 100 patients was studied in this study. There was no significant difference in the demographic profile of the two groups with regards to age, sex and the average duration of surgeries as given in table-1. The number of patients undergoing laparoscopic hernia repair (27 vs 23), orchidopexy (15 vs 12), appendicectomy (8 vs 12) or cholecystectomy (5 vs 4) was also comparable between Group L and Group T (P = 0.71). The postoperative pain scores were reported to be significantly lower in Group T at 10 and 30 min, 1 and 2 hours than in Group L as tabulated in table 2. After 2 h, the pain scores were similar in the two groups. The necessity for rescue analgesia was also significantly lower in the TAP block group (10/50) when compared with the local infiltration group (37/50; P < 0.001) as listed in table - 3. Half of the patients who had undergone cholecystectomy in the TAP group (two of four) required postoperative analgesia.

The intraoperative heart rates were significantly lower in TAP block group at port placement, 30 and 60 min compared with the local infiltration group as given in table - 4. The requirement for intraoperative opioids was also considerably minimised in the TAP block group as shown in table - 3. No adverse events such as nausea, vomiting or sedation were enlisted in both the groups.

Table 1: Demographic characteristics of the two groups

Parameters	Group T	Group L	P – value
Age (mean ± SD)	6.5 ± 3.9	5.7±3.1	0.301
Sex (M/F)	35/15	38/12	0.789
Weight (mean ± SD)	18.9±1.5	17.1±2.3	0.362
Duration (min)	101.8 ± 7.9	99.8 ± 8.3	0.259

Table 2: Pain scores in the two groups

Time	Group L	Group T	P - value
10 min	3 (2-4)	3 (0-2.7)	0.014
30 min	3 (2-6)	1.8 (0-2.5)	<0.001
1 h	2 (1-3)	2.2 (0-3)	<0.001
2 h	3 (1.7-2.7)	2 (0-2)	0.013
3 h	2 (0-2)	2 (0-2)	0.358
4 h	3 (0-2)	0	0.272
6 h	1 (1-2)	0	0.511

Table 3: Need for intraoperative opioids and postoperative rescue analgesia in the two groups

Groups	Group L	Group T	P - value
Intra-operative opioids	42	7	<0.001
Post-operative analgesia	37	10	<0.001

Table 4: Difference in the intraoperative heart rate between the two groups

Time (min)	Group L	Group T	P - value
5	105.2 ± 14.2	102.3 ± 16.3	0.392
15	111.5 ± 14.4	103.6 ± 14.9	0.014
30	111.4 ± 14.4	101.7 ± 13.8	0.001
45	107.2 ± 15.5	100.8 ± 15.9	0.062
60	107.9 ± 14.7	100.0 ± 15.9	0.027

Discussion

With the advancement in surgical technique and anaesthesia, the scope for the limited access surgeries has been broadly widened. Conventionally, laparoscopic surgeries are known to cause minimal postoperative pain and rapid recovery. Therefore, pain after laparoscopic surgeries could be attributed to incision, visceroperitoneal pain due to stretch and inflammation and shoulder pain due to diaphragmatic irritation by the residual insufflated carbon dioxide gas.⁴ Hence, it is possible that we institute a multimodal approach of analgesia rather than just rely on one modality. TAP block is a regional anaesthetic technique that blocks neural afferents of the anterolateral abdominal wall. We observed that the pain scores were considerably lower in the TAP block group when compared with the local infiltration group in the initial 2 h. Although the significant difference in the pain scores was relatively small, it was statistically and clinically significant when considering the number of patients receiving postoperative analgesia. The intraoperative requirement of fentanyl was also considerably less in the TAP block group, as evidenced by decreased haemodynamic response particularly at port placement.

This research study generally included four types of commonly performed laparoscopic surgeries, inguinal hernia repair, orchidopexy, appendectomy and cholecystectomy. The patients who had undergone cholecystectomy had a relatively higher necessity for the requirement of analgesia in the postoperative period even in the TAP group. The pain due to peritoneal stretch and shoulder pain is relatively higher in these patients when compared with other types of surgeries. The TAP block provides somatic pain relief only at a standard dose of up to 0.4–0.5 mL/kg of bupivacaine or ropivacaine. Therefore, the transverses abdominis plane is a relatively continuous with the paravertebral space and a significantly larger dose of 1–2 mL/kg could possibly lead to some visceral pain relief particularly in neonates and infants.⁶

There are only a few studies elaborating the efficacy of TAP block in paediatric laparoscopic surgeries.^{7,8} The results obtained from these studies are still vague and unclear. In a study conducted at a children's hospital in the year 2009, 93 patients undergoing laparoscopic appendectomy received either a TAP block or port site infiltration. The authors concluded that TAP blocks increased the anaesthesia time by about 14 min but showed no clinical merit in terms of analgesia as supported by similar morphine requirements postoperatively.⁷ Therefore, in a study performed at a children's hospital in patients undergoing laparoscopic orchidopexy, the children who had received TAP block needed less intraoperative and post-operative analgesia, with preserved haemodynamic stability and a good degree of parental satisfaction.⁸ *Albokrinov* et al in their study compared TAP block to oral analgesia for laparoscopy and reported minimised pain scores and morphine consumption in TAP block.¹⁰ A systematic review of TAP and rectus sheath block documented in the year 2015 did not find strong evidence for determining the efficiency of TAP blocks in children due to the paucity and heterogeneity of randomised trials.¹⁰

One of the positives about this study is that we had used various approaches of TAP block for effectively performing cholecystectomy and lower abdominal procedures to enhance the efficacy of the block. This is due to the fact the results of a trial done in patients undergoing laparoscopic hernia repair could not be extrapolated to patients undergoing a more painful and extensive surgeries such as cholecystectomy. Moreover, we compared TAP blocks to port site infiltration which is assumed as the standard procedure in most of the centres and not to morphine or opioid based patient-controlled analgesia postoperatively is used less frequently.

Conclusion

This is to be conclude that TAP block is proven to be superior to local infiltration for intraand immediate postoperative analgesia in paediatric laparoscopic surgeries. We recommended the inclusion of TAP block as a routine in the part of multimodal analgesia for these surgeries in paediatric patients.

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