Original Research Article

Comparison of postoperative analgesic efficacy of intrathecal buprenorphine vs transversus abdominis plane block with buprenorphine in inguinal hernia surgeries

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Abstract

Background: The major goal in the management of post operative pain is minimizing dose of medications to lessen side effects while still providing adequate analgesia. This study was conducted to compare the analgesic efficacy of intrathecal buprenorphine (ITB) with buprenorphine in TAP block (TAB) for inguinal hernia surgeries. **Methodology:** A prospective randomized double blinded experimental study of ninety four American Society of Anesthesiologists physical status I and II patients posted for elective unilateral open hernia surgeries were divided into two groups of forty seven each as ITB group and TAB group, after satisfying the inclusion criteria. **Results:** In the present study, demographic data were comparable between both the groups. The duration of analgesia was longer in TAB group (10.68±2.10 hours) compared to ITB group (5.52±1.07 hours) and was statistically significant, $p<0.05$. The mean number of doses of rescue analgesia given in first 24 h was higher in ITB group (2.51 doses) as compared to the TAB group (1.42 doses) and was statistically significant, $p<0.05$. The intensity of analgesia in ITB group was superior to TAB group in first 4 h of study period where as the intensity of analgesia in TAB group was superior to ITB group at 8 h of study period, since mean VAS score at 4 h in ITB group (0.83±0.42) was lower than TAB group (1.01±0.89) and mean VAS score at 8 h in TAB group (2.68±2.01) was lower than ITB group (5.49±1.21). There were increased side effects in ITB group compared to TAB block group. **Conclusion:** This study concludes that patients receiving buprenorphine in TAP block has prolonged duration of analgesia, lower pain scores, lower total analgesic consumption during first 24 h and lower side effects compared to patients receiving intrathecal buprenorphine. **Key Words:** Buprenorphine, Transversus Abdominis Plane block, inguinal hernia.

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INTRODUCTION

Postoperative pain is more severe during first 48 hours after surgery and gradually diminishes thereafter. Inadequate pain control in immediate postoperative period can lead to poor recovery, prolonged hospital stay and chronic pain syndromes with reported frequency of 0% to 54%[1,2]. The major goal in the management of post operative pain is minimizing dose of medications to lessen side effects while still providing adequate analgesia. Open inguinal hernia surgery is one of the most common procedures performed across the world. Pain after hernia repair is either due to neuropathic etiology, resulting from nerve injury or compression and non neuropathic cause may be from scar tissue, mechanical pressure or

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meshomas[3]. Inguinal hernioplasty is associated with moderate to severe pain with its most intense pain in initial 24hr period in over 60% of cases[4]. A multimodal approach for post operative pain management after surgery involving the use of non-steroidal anti-inflammatory drugs, opioids, epidural analgesia and local anesthetic infiltration, each acting at different sites of pain pathway has been advocated as optimal combination of pain control though evidence based pain therapy remains unknown[5].Opioids are first introduced as additives to spinal anesthesia in 1979 with intrathecal morphine as first opioid to be used ever[6]. Neuraxial opioids when added to local anesthetics prolong the duration of sensory block without sympathetic blockade and also improves quality of postoperative analgesia. After confirmation of opioid receptors in peripheral nervous system in 1980s opioids are added to peripheral nerve blocks without having central effects of opiods[7]. But opioids do have its own complications like nausea, vomiting, pruritus, sedation and respiratory depression. Buprenorphine is a semisynthetic opioid and a thebaine derivative. It has a unique pharmacological profile, high-lipid solubility and strong binding with 'μ' receptor and slow offset. It is 20 to 40 times more potent than morphine with minimal opioid-related side effects and long duration of action[7]. Among the regional blocks the transversus abdominis plane block is more popularly used in past decade for inguinal hernia repair. It was first introduced by Rafi in 2001 as landmark-guided technique where local anesthetic is deposited in the neurofascial plane between internal oblique and transversus abdominis muscles via the lumbar triangle of Petit to achieve a field block[9]. This block provides analgesia to parietal peritoneum as well as skin (dermatomal level of T6 to L1) and muscles of anterior abdominal wall after lower abdominal surgeries. Peripherally administered burenorphine has limited central side effects viz pruritus, nausea, vomiting, constipation, sedation and respiratory depression as compared to intrathecal buprenorphine[10]. Moreover perineurally administered buprenorphine has prolonged analgesic effect compared to intrathecally administered buprenorphine[11,12].To date there is no study comparing analgesic efficacy of intrathecal buprenorphine with buprenorphine in transversus abdominis plane block. So the present study was planned to compare the postoperative analgesic efficacy of intrathecal buprenorphine and transversus abdominis plane block with buprenorphine in unilateral inguinal hernia surgeries. The primary outcome of the study was to measure the duration of analgesia with intrathecal buprenorphine and transversus abdominis plane block with buprenorphine. The secondary outcome includes total amount of analgesic requirement for 24 hours following surgery. Patients are monitored for side effects such as sedation, respiratory depression, pruritus and post operative nausea and vomiting.

METHODOLOGY

Ninety four American Society of Anesthesiologists (ASA) physical status I and II patients aged 18 – 60 years undergoing elective unilateral inguinal hernia surgery under spinal anesthesia were recruited for the study. After obtaining approval from institutional human ethics committee the study was conducted. Patients who has ASA >III, BMI >35, coagulation abnormalities, local skin infection, patient refusal, patients allergic to any of study medications and patients with any history of long term opioid intake were excluded from the study. Patients were randomly assigned into two groups (ITB and TAB) of forty seven each using sealed envelope method. These groups received the drugs as following:

- GROUP ITB: Intrathecally- 2.8mL of 0.5% bupivacaine (H) and 0.2mL of 60μg Buprenorphine, TAP block- 20mL saline is given.
- GROUP TAB: Intrathecally- 2.8mL of 0.5% Bupivacaine (H) and 0.2mL saline, TAP block- 10mL of 0.5% Bupivacaine with 0.5mL of 150μg Buprenorphine and 9.5mL of saline

On the day of surgery, after establishing intravenous access and placing standard monitoring (ECG, NIBP and pulse oximeter), baseline vitals (heart rate, respiratory rate, SpO_2, BP) were recorded prior to anaesthesia. Under strict sterile precautions spinal anaesthesia was performed with above drugs using 25G Quincke Babcock spinal needle at L3-L4 interspace with patient in left lateral position. Immediately after administering spinal anesthesia patient was placed in supine position and TAP block was given using landmark guided technique. Petit triangle was located by palpating iliac crest anterior to posterior until latissimus dorsi muscle was appreciated (Petit triangle is just anterior to latissimus dorsi muscle). Under sterile precautions block was performed by introducing 23G Quincke Babcock spinal needle in Petit triangle (midpoint between subcostal margin and highest point of iliac crest) perpendicular to skin in coronal plane with double pop technique and after checking for negative aspiration of blood the prepared drug was deposited in increments while observing for signs of local anesthetic toxicity. Each group were given their respective drug as described above in space between internal oblique muscle and transversus abdominis muscle plane. Duration of analgesia was monitored from '0' hour which was the time of spinal anesthesia for both the groups. Patients were monitored at intervals of 15 min, 30 min, 45 min, 1 h, 4 h, 8 h, 12 h and 24 h from administration of spinal anesthesia. The pain was quantified on a 10cm visual analog scale (VAS). Time

from spinal anesthesia administration to time for first request of analgesia was taken as duration of analgesia. At first request for analgesia or when VAS score was more than 4, patient was given Inj.Paracetamol 1gm every 6 hours for 24 hrs. Patients were also monitored for side effects of opioids viz., sedation (evaluated using modified Wilson sedation scale 1-oriented 2-drowsy 3-arousable 4-not arousable), Respiratory depression, nausea, vomiting and pruritus was recorded and it was treated. Patients were also monitored for TAP block related complications.

STATISTICAL METHODS

The data collected were analyzed using Statistical Package for Social Sciences (SPSS), version -21.0. Within group heart rate, respiratory rate, systolic and diastolic BP were analysed using paired sample 't' test. Between two groups quantitative variables were analysed using unpaired sample 't' test. When qualitative variables like level of block and side effects were analysed chi-square test of association was used

RESULTS

The demographic factors and operative factors were comparable between the two groups (Table 1) and were not statistically significant.

Table 1: Demographic factors

Variables	ITB group	TAB group	'p' value
Age (years)	45.96±8.82	47.21±12.56	0.576
BMI (kg/m²)	27.57±1.78	27.74±1.46	0.607
ASA status I (%)	51.1%	59.6%	
ASA status II(%)	48.9%	40.4%	0.172
Duration of surgery(min)	99.42±13.95	98.42±13.16	0.722

BMI – Body Mass Index, ASA-American Society of Anesthesiologist

Figure 1: Bar diagram showing comparison of duration of analgesia in both the groups;

The hemodynamic parameters – HR, RR, SPO2, SBP, side effects were reported more in intrathecal buprenorphine group (Fig 3). The incidence of nausea and vomiting was 27.7% in ITB group and 5.31% in TAB group, 'p' value was significant (p=0.047). The incidence of sedation was 90.5% in ITB group and 9.5% in TAB group, 'p' value was significant (p=0.001). Incidence of pruritus was 25.5% in ITB group and 8.5% in TAB group, 'p' value was significant (p=0.028) (Table 3).

The mean duration of analgesia was longer in TAB group (10.68±2.10 h) compared to ITB group (5.52±1.07 h) and was statistically significant, 'p' value =0.001 (Table 2) (Fig.1). Total consumption of number of inj.paracetamol doses in first 24h was significantly higher in ITB group. The mean dose of inj.paracetamol consumed in ITB group was 2.57 gm and in TAB group it was 1.42gm and was statistically significant, 'p' value = 0.001 (Table 2). The mean VAS scores assessed at 4 h was higher in TAB group and at 8 h was higher in ITB group, 'p' value was significant (p=0.001). The mean VAS scores at 12 h and 24 h were comparable and 'p' value was not significant (p>0.05) (Table 2, Fig 2).

Table 2: Duration of analgesia, total consumption of analgesics in 24h and VAS scores

Variables	ITB group	TAB group	p value
Duration of analgesia (hours)	5.52±1.07	10.68±2.10	0.001
Mean analgesic consumption in 24 h (gm)	2.57	1.42	0.001
VAS scores at			
4h	0.83±0.42	1.01±0.89	0.001
8h	5.49±1.21	2.68±2.01	0.001
12h	4.59±1.38	4.08±1.74	0.115
24h	3.66±0.96	3.79±1.19	0.571

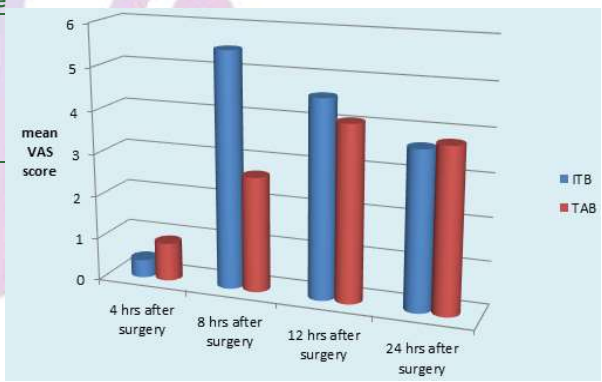

Figure 2: Bar diagram showing comparison of VAS scores between two groups at various intervals during study period

Table 3: Adverse effects

variables	ITB group	TAB group	'p' value
Nausea and vomiting	13(27.7%)	5(5.32%)	0.047
Sedation	38(90.5%)	4(9.5%)	0.001
Pruritus	12(25.5%)	4(8.5%)	0.028

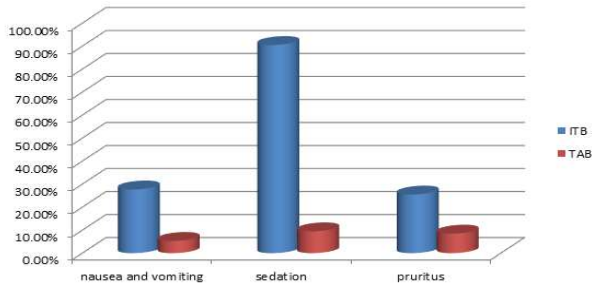

Figure 3: Bar chart showing comparison between occurrence of side effects between ITB and TAB groups

DISCUSSION

Intrathecal opioids are effective in treating both somatic and visceral pain[8]. Neuraxial opioids mediate selective spinal analgesia by binding to opioid receptor in substantia gelatinosa of dorsal horn of spinal cord near the site of injection. Buprenorphine has high affinity for 'μ' opioid receptors and they slowly dissociate from receptors which explains longer duration of action[13] and faster onset of block[8]. Buprenorphine when compared to morphine has lesser side effects because of limited rostral spread of drug in CSF, this is due to high molecular weight of lipophilic buprenorphine which on intrathecal administration is rapidly absorbed from CSF into spinal venous plexus[8,14]. Buprenorphine when given in peripheral nerve blocks acts via two mechanisms: 1) μ opioid receptors of C-fibers 2) has local anesthetic action on nerve fibers[11]. Since buprenorphine has above advantages over other opioids[7,10,15,16] we have chosen buprenorphine as adjuvant in present study. TAP block is the safe and effective modality for postoperative analgesia as a part of multimodal approach to analgesia for variety of surgical procedures[11,12,17,18,19]. A single shot TAP block technique can produce prolonged analgesia due to poor vascularization of transversus abdominis plane[20]. Though intrathecally administered buprenorphine has reduced side effects on comparing other opioids it has more side effects when compared to buprenorphine in TAP block[12].

Duration of analgesia: In studies where 60μg was used intrathecally the duration of analgesia varied from 6.48 h to 12.3 hours[8,12,14,21]. In a study where 45μg was used intrathecally the duration of analgesia was 7 h[22,23]. These studies indicates the dose dependent action of buprenorphine when given intrathecally.

The mean duration of analgesia was found to be 319±115.2 min for TAP block with 0.25% bupivacaine for inguinal hernia surgeries in a study conducted by Kamal K and coworkers[5], where as duration for bilateral transversus abdominis plane block was found to be 669.17±140.65 min in a study conducted by Marappa P and co-workers[12].Seervi SN and colleagues[11] conducted a study to compare the analgesic efficacy with addition of buprenorphine to TAP block with that of dexamethasone in TAP block. The duration of analgesia was 688±36.11 min for buprenorphine group, 601.45 ± 39.85 min for dexamethasone group and 383.06 ± 36.21 min for control group, which was comparable to the result of present study group TAB (duration of analgesia in TAB group was 10.68±2.10 h which was longer than ITB group 5.52±1.07 h).

Visual Analog Scale score: Many studies showed that patients with intrathecal buprenorphine had lower VAS scores compared to control groups[14]. In a study conducted by Seervi SN and co-workers[11] the analgesic efficacy of buprenorphine and dexamethasone in TAP block were compared. Patients with NRS >4 at end of 10 hours after surgery was highest in dexamethasone group (81%) than buprenorphine group(36%). This was similar to present study, where VAS scores were lower in TAB group throughout the study period. In present study the mean VAS score at 4h in ITB group was lower than TAB group whereas the mean VAS score at 8 h in TAB group was lower than ITB group. This proves that the intensity of analgesia provided by intrathecal buprenorphine is superior to buprenorphine in TAP block since intrathecal buprenorphine covers both visceral pain and somatic pain whereas TAP block covers only the somatic pain[8]. But the duration of analgesia provided by intrathecal buprenorphine is limited.

Total analgesic consumption: In present study- mean paracetamol consumption in 24h in ITB group was (2.57gm) higher than TAB group (1.42gm) and it was statistically significant (p=0.001). In a study conducted by Ravindran R and colleagues[14] the mean number of rescue analgesic doses were 2.2 in control group, 1.03 with 60μg of intrathecal buprenorphine group and 1.43 in 45μg intrathecal buprenorphine group. With increase in intrathecal dose of buprenorphine there was increase in duration of analgesia and hence lower consumption of rescue analgesic doses. It was similar to present study group ITB. In a study conducted by Marappa P and colleagues[12] the mean paracetamol consumption in 24hrs for TAP block group is 3.5g and 1.13g in intrathecal buprenorphine group. Seervi SN and colleagues[11] had shown in their study that in patients undergoing the TAP block with buprenorphine as an adjuvant had a reduced 24 h tramadol consumption than those who received dexamethasone as an adjuvant and the control group (158.06 ± 50.16 mg, 177.41 ± 71.69 mg, and 274.19 ± 44.48 mg, respectively. The difference was statistically significant. In our study mean paracetamol consumption is 2.57gm in ITB group and 1.42gm in TAB group. The perineural buprenorphine has reduced the consumption of analgesics. Buprenorphine when added intrathecally or when added to TAP block as adjuvant post operative total

analgesic consumption is decreased. The decrease was more in TAB group compared to ITB group in present study.

Adverse effects: In our study both the groups had been reported to have adverse effects. 13(27.7%) patients in ITB group and 5(5.319%) patients in TAB group had nausea and vomiting, 38(90.5%) patients in ITB group and 4(9.5%) patients in TAB group had sedation and 12(25.5%) patients in ITB group and 4(8.5%) patients in TAB group had pruritus. ITB group had been reported to have more incidence of nausea, vomiting, sedation and pruritus than TAB group. This is because of direct action of buprenorphine directly on chemoreceptor trigger zone and many studies support the increase in adverse effects with intrathecal buprenorphine[8,14,21,22,24]. Increase in intrathecal dose of buprenorphine increases incidence of side effects. In a meta-analysis done by Schnabel A and colleagues[25] on comparing perineural buprenorphine with local anaesthetics versus local anaesthetic alone demonstrated that the risk of PONV was five times higher in patients with 150mcg to 300mcg perineural buprenorphine. On comparing perineural buprenorphine combined with local anaesthetics versus systemic buprenorphine combined with local anaesthetics they demonstrated that there was no evidence for a difference in risk of PONV in both the groups.In present study there was fall in respiratory rate in intrathecal buprenorphine (ITB) group compared to TAP block with buprenorphine group (TAB) but clinically this fall in respiratory rate was not significant (RR<10/min). Buprenorphine has a ceiling effect on respiratory depression but not on analgesic effect[26]. In study conducted by Marappa P and colleagues[12] where intrathecal buprenorphine was compared with TAP block with bupivacaine showed 23.3% incidence of nausea in both the groups but incidence of vomiting and drowsiness was 13.3% and 26.7% respectively in intrathecal buprenorphine group which was statistically significant. This supports present study and TAP block with local anesthetic alone usually has lower incidence of nausea and vomiting. Seervi SN and colleagues[11] demonstrated that group with buprenorphine had 13% incidence of nausea and 3% incidence of vomiting whereas group with dexamethasone had only 6% incidence of nausea. Whereas the control group had 16% incidence of nausea and 6% incidence of vomiting. From above study the incidence of nausea and vomiting between group with buprenorphine in TAP block and control group were comparable. This study supports the present study stating that buprenorphine when added to TAP block had lower incidence of side effects similar to TAB group. Hemodynamic stability was maintained throughout the study.

LIMITATIONS OF THE STUDY

- Ultrasound was not used to give TAP block instead well experienced senior anaesthetists administered landmark guided TAP block.
- VAS scores were not determined with accordance to movement.

CONCLUSION

This study concluded that patients receiving buprenorphine in TAP block for inguinal hernia surgeries reported longer duration of analgesia, lower pain scores, lower analgesic consumption during the first 24 h and lower side effects compared to patients receiving intrathecal buprenorphine. However intensity of analgesia in intrathecal buprenorphine till 4h was superior to buprenorphine in TAP block. In this era of ultrasound-guided peripheral nerve blocks, buprenorphine is recommended as adjuvant which can provide longer duration of analgesia without centrally mediated side effects.

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