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Effect of Adding Dexmedetomidine to Ropivacaine for Transversus Abdominis Plane Block: A Prospective Randomised Controlled Trial

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Abstract

We conducted this trial to study the effects of adding dexmedetomidine to ropivacaine for transversus abdominis plane (TAP) block. Sixty patients scheduled to undergo elective hernia repair with spinal anaesthesia as primary anaesthetic technique were divided into 2 groups. Group R (n=30) received 20 ml of 0.5% ropivacaine and 2 ml normal saline while Group RD (n=30) received additional 0.5µg/kg dexmedetomidine. Group RD had significantly less postoperative visual analogue score, longer duration of analgesia and needed less analgesics. We conclude that adding dexmedetomidine to ropivacaine for TAP block improves the duration of postoperative analgesia and reduces the postoperative pain and analgesic requirements when compared to ropivacaine alone. However, more studies are needed to study the side effects of dexmedetomidine when used as an adjuvant drug in TAP block.

Keywords-TAP block, Transversus abdominis plane block, Dexmedetomidine, Ropivacaine, Hernia repair, Ultrasound

Introduction

Transversus abdominis plane (TAP) block is a commonly used regional anaesthesia technique in

which a local anaesthetic is injected between internal oblique and transversus abdominis muscles through the lumbar triangle of Petit to

anaesthetize the nerves supplying anterior abdominal wall.^[1-3] TAP block significantly reduces the post-operative pain and reduces analgesic requirements in patients undergoing abdominal surgery. It has proven to be an effective analgesic technique in various abdominal surgeries such as large bowel resection, open appendectomy, nephrectomy, prostatectomy, hernia repair, laparoscopic cholecystectomy, plastic surgery, paediatric surgery and caesarean section.^[2, 4-14]

However the duration of analgesia offered by this block is limited by duration of action of the local anaesthetic used for the block. Duration of analgesia of peripheral nerve block can be prolonged by adding various adjuvants to the local anaesthetic. Dexmedetomidine is a relatively selective α_2 agonist which prolongs the duration of analgesia provided by bupivacaine based TAP block in patients undergoing abdominal hysterectomy.^[15]

We devised this trial to study the effects of adding dexmedetomidine to ropivacaine for TAP block on post-operative analgesia in patients undergoing inguinal hernia repair.

Materials and Methods

This prospective, randomised, controlled, double blind study was carried out after obtaining approval of institutional ethical committee. Patients scheduled for elective repair of unilateral inguinal hernia with spinal anaesthesia as primary anaesthesia technique, belonging to ASA physical status I or II and 18 to 60 years of age were included in this study. Exclusion criteria were-

refusal to give consent, allergy to study medications, valvular heart disease, coagulopathy, renal or hepatic disease and local infection of drug injection site.

Patients were randomly divided into two groups using sealed envelope technique. Patients in Group R received TAP block with a drug solution containing 20 ml of 0.5% ropivacaine and 2 ml of normal saline. Patients in Group RD received TAP block with a drug solution containing 20 ml of 0.5% ropivacaine and 0.5 $\mu\text{g}/\text{kg}$ dexmedetomidine to which normal saline was added to achieve a final drug volume of 22 ml. The drug solution was prepared by an anaesthesia technician in identical syringes who did not take part in any other aspects of study. The patients, the anaesthesiologist performing the TAP block and the anaesthesiologist recording the data and managing the patient were unaware of the group allocation of the patients.

Written informed consent was taken and patients were explained about visual analogue scale (VAS) and TAP block preoperatively. After arrival of patients in the operation theatre, monitors (pulse oximeter, automated non-invasive blood pressure, and electrocardiogram) were applied, intravenous access was secured and patients were given intravenous 0.03 mg/kg of midazolam. Patients were preloaded with 15 ml/kg of Lactated Ringer's solution over 15 minutes.

Spinal anaesthesia was administered with patients in sitting position with a 25 G pencil point spinal needle. Taking aseptic precautions, midline spinal puncture was done at L₃-L₄ vertebral interspace (at L₂-L₃ interspace, if not possible at L₃-L₄) and

12.5 mg hyperbaric 0.5% bupivacaine was injected in the intrathecal space. Patients were immediately positioned in supine position after completion of intrathecal drug injection. Surgery was allowed to start after achieving T₁₀ sensory level block. After completion of surgery, all TAP blocks were administered using Sonosite Micromaxx (Bothell, WA, USA) ultrasound machine and linear 6-13 MHz ultrasound transducer by same anaesthesiologist taking aseptic precautions. With patients in supine position, ultrasound transducer was initially placed on patient's anterior abdominal wall with medial end of the transducer just lateral to umbilicus which enabled visualization of rectus abdominis muscle. Then, the transducer was slid laterally between patient's iliac crest and subcostal margin. The transducer was further manipulated to obtain a clear image of external oblique, internal oblique and transversus abdominis muscles. A 22G, 100 mm block needle (SonoPlex Stim, Pajunk, Geisingen, Germany) was inserted in anterior to posterior direction in plane with the ultrasound transducer till needle tip was between internal oblique and transversus abdominis muscles. After desired position of needle tip was achieved, the drug solution was injected with intermittent aspiration while visualizing the correct spread of drug solution between the two muscle layers.

Patients were assessed for intensity of pain using VAS at 2, 4, 6, 8, 12, 18 and 24 hours after administration of TAP block. Intravenous paracetamol (1 gram) was given when demanded by the patients. If a patient demanded another

dose of analgesic before 6 hours had elapsed since the last paracetamol dose, intravenous tramadol (1 mg/kg) was given as rescue analgesic. Duration of analgesia was defined as duration between completion of drug injection for TAP block and demand of first analgesic dose. Side effects like bradycardia (pulse rate < 50 beats per minute), hypotension (systolic blood pressure < 90 mm Hg), post-operative nausea and vomiting, and excessive sedation (Ramsay sedation score > 3) for first 24 hours were recorded.^[16] Any other side effects were also recorded.

For type I error of 0.05 and power of 0.8, 28 patients per group were required for detecting a difference of 30 minutes in duration of analgesia with standard deviation of 40 minutes. We included 30 patients in each group to minimize any effect of data loss. This sample size was also able to detect a difference of 1 cm with a standard deviation of 1.3 cm in VAS. Normally distributed numerical data were analysed using Student's t-test. Skewed data were analysed using Mann-Whitney U-test. Categorical data were compared using χ^2 test. P value < 0.05 was considered significant with two-sided tests used for all experimental outcomes. Data is being expressed as mean \pm standard deviation (SD), median (range) or number (percentage) as appropriate. Statistical analysis was performed using SPSS software for Windows (version 22, IBM Corp, New York).

Results

A total of 60 patients were recruited in the study with 30 patients in each group. No patient was

excluded after entry in the study and data from all the patients were analysed. Demographic characteristics and duration of surgery were comparable in both the groups (Table 1). Only male patients could be included in this study as only male patients were scheduled for surgery during the study period. Post-operative VAS was significantly less in Group RD as compared to Group R at all the time points except at 2 hours (Table 2). Duration of analgesia was statistically greater in Group RD as compared to Group R ($p < 0.001$). Total analgesic consumption was significantly less in Group RD as compared to Group R (Table 3). No patient in either group needed tramadol.

Patients experienced bradycardia, postoperative nausea and vomiting and sedation only as their side effects. Incidence of these side effects were statistically similar in both the groups (Table 4).

Discussion

In this study we added dexmedetomidine to ropivacaine for TAP block and studied its effects on duration and quality of analgesia in patients undergoing inguinal hernia repair. We observed that dexmedetomidine prolonged the duration of analgesia, reduced postoperative pain scores and reduced postoperative analgesic consumption. There was no difference in side effects between the two groups.

Control of post-operative pain is an essential component of perioperative patient management and failure to achieve adequate pain relief can result in a number of negative implications ranging from patient dissatisfaction, respiratory

and cardiovascular compromise, delay in patient mobilization and discharge from hospital, venous thromboembolism, progression to chronic pain.^[6,15] TAP block is particularly effective in reducing post-operative pain in patients undergoing lower abdominal surgery. Its main advantages are relative simplicity, opioid sparing effect, hemodynamic stability and low risk of complications. Its duration and analgesic efficacy can be prolonged by adding adjuvant drugs like adrenaline, ketamine or α_2 agonists like clonidine and dexmedetomidine.^[1,6,15]

Studies have shown that perineural administration of dexmedetomidine potentiates the neural block produced by local anaesthetics.^[15,17] Exact mechanism by which dexmedetomidine and other α_2 agonists potentiate local anaesthetics is not well understood. The effect of α_2 agonists may be due to spinal, supraspinal or peripheral mechanisms. At spinal level, α_2 agonists inhibit pain by inhibiting release of substance P in the nociceptive pathway at level of the dorsal root neurons.^[17,18] At supraspinal level, α_2 agonists produce analgesia by activating α_2 -adrenoreceptors in locus coeruleus.^[19] Local vasoconstrictive effects of dexmedetomidine due to α_2 agonism may prolong the duration of analgesia by reducing systemic absorption of local anaesthetic from effect site.^[20]

Almarakbi et al studied effects of adding dexmedetomidine to bupivacaine in TAP block for pain relief in patients undergoing abdominal hysterectomy using general anaesthesia as primary anaesthetic technique.^[15] The main observations of their study were prolongation of duration of

analgesia, reduction in postoperative analgesic consumption and lower pain scores in patients receiving dexmedetomidine in addition to bupivacaine. Findings of our study (prolonged duration of analgesia, reduced postoperative pain scores and reduced postoperative analgesic consumption due to dexmedetomidine) are consistent with the findings of Almarakbi et al.

However, Almarakbi et al found significantly lower heart rate without any hemodynamic instability in patients receiving dexmedetomidine. This differs from our study as we did not find any difference in incidence of bradycardia. Our study was not adequately powered to detect these differences. This is one of the limitations of our study. Other limitation is that our study consisted of only male subjects. Hence, the findings of our

study may not be extrapolated to female population.

Conclusions

We conclude that adding dexmedetomidine to ropivacaine in TAP block prolongs duration of postoperative analgesia, reduces pain intensity and reduces analgesic consumption in patients undergoing elective inguinal hernia repair. However, its widespread use may be advised after more sufficiently powered studies are conducted regarding its side effects.

Table 1: Comparison of baseline and demographic characteristics

	Group R (n=30)	Group RD (n=30)	p-value
Age (Years)	38.93±12.30	39.90±12.17	0.761
Weight (Kg)	63.67±9.72	65.43±9.92	0.489
Height (Cm)	162.83±11.30	161.30±12.01	0.612
ASA I/II	18(60%)/12(40%)	21(70%)/9(30%)	0.417
Sex (F/M)	0(0%)/30(100%)	0(0%)/30(100%)	NA
Duration of surgery (minutes)	67.33±15.83	61.50±17.26	0.178

Values are expressed as mean±SD and numbers (percentage).

Table 2: Comparison of VAS at different time points

Time	Group R (n=30)	Group RD (n=30)	p-value
2 Hour	1(0-2)	1(0-2)	0.733
4 Hour	3(1-5)	2(1-4)	0.001*
6 Hour	5(2-5)	2(1-4)	<0.001*
8 Hour	5(2-5)	2(2-5)	<0.001*
12 Hour	5(2-5)	2(1-5)	<0.001*
18 Hour	5(3-5)	2(1-5)	<0.001*
24 Hour	5(2-5)	2(1-5)	<0.001*

Values are expressed as median (range), * denotes statistical significance

Table 3: Comparison of duration of analgesia and total paracetamol consumption

	Group R (n=30)	Group RD (n=30)	p-value
Duration of analgesia (Minutes)	219.00± 27.31	555.07± 120.22	<0.001*
Paracetamol consumption (mg)	1966.67± 850.29	1266.67± 449.78	<0.001*

Values are expressed as mean±SD. * denotes statistical significance

Table 4: Incidence of side effects

	Group R (n=30)	Group RD (n=30)	p-value
Sedation	2(6.67%)	1(3.33%)	0.554
Bradycardia	1(3.33%)	2(6.67%)	0.554
PONV	3(10%)	6(20%)	0.278

Values are expressed as numbers (percentage), PONV: postoperative nausea and vomiting

References

1. Jankovic Z. Transversus abdominis plane block: the holy grail of anaesthesia for (lower) abdominal surgery. *Periodicum Biologorum* 2009;111:203-8.
2. Bhattacharjee S, Ray M, Ghose T, Maitra S, Layek A. Analgesic efficacy of transversus abdominis plane block in providing effective perioperative analgesia in patients undergoing total abdominal hysterectomy: A randomized controlled trial. *J Anaesthesiol Clin Pharmacol* 2014;30:391-6.
3. Bonnet F, Berger J, Aveline C. Transversus abdominis plane block: what is its role in postoperative analgesia? *Br J Anaesth* 2009;103:468-70.
4. Petersen PL, Mathiesen O, Stjernholm P, Kristiansen VB, Torup H, Hansen EG, Mitchell AU, Moeller A, Rosenberg J, Dahl JB. The effect of transversus abdominis plane block or local anaesthetic infiltration in inguinal hernia repair: a randomised clinical trial. *Eur J Anaesthesiol* 2013;30:415-21.
5. Atim A, Bilgin F, Kilickaya O, Purtuloglu T, Alanbay I, Orhan ME, Kurt E. The efficacy of ultrasound-guided transversus abdominis plane block in patients undergoing hysterectomy. *Anaesth Intensive Care* 2011;39:630-4.
6. Aveline C, Le Hetet H, Le Roux A, Vautier P, Cognet F, Vinet E, et al. Comparison between ultrasound-guided transversus abdominis plane and conventional ilioinguinal/iliohypogastric nerve blocks for day-case open inguinal hernia repair. *Br J Anaesth* 2011;106:380-6.
7. El-Dawlatly AA, Turkistani A, Kettner SC, Machata AM, Delvi MB, Thallaj A, et al. Ultrasound-guided transversus abdominis plane block: Description of a new technique and comparison with conventional systemic analgesia during laparoscopic cholecystectomy. *Br J Anaesth* 2009;102:763-7.
8. Sivapurapu V, Vasudevan A, Gupta S, Badhe AS. Comparison of analgesic efficacy of transversus abdominis plane block with direct infiltration of local anesthetic into surgical incision in lower abdominal gynecological surgeries. *J Anaesthesiol Clin Pharmacol* 2013;29:71-5.
9. McDonnell JG, Curley G, Carney J, Benton A, Costello J, Maharaj CH, et al. The analgesic efficacy of transversus abdominis plane block after cesarean delivery: A randomized controlled trial. *Anesth Analg* 2008;106:186-91.
10. Araco A, Pooney J, Araco F, Gravante G. Transversus abdominis plane block reduces the analgesic requirements after abdominoplasty with flank liposuction. *Ann Plast Surg* 2010;65:385-8.
11. Carney J, Finnerty O, Rauf J, Curley G, McDonnell JG, Laffey JG. Ipsilateral transversus abdominis plane block provides effective analgesia after

- appendectomy in children: A randomized controlled trial. *Anesth Analg* 2010;111:998-1003.
12. Sahin L, Sahin M, Gul R, Saricicek V, Isikay N. Ultrasound-guided transversus abdominis plane block in children: a randomised comparison with wound infiltration. *Eur J Anaesthesiol* 2013;30:409-14.
13. McDonnell JG, O'Donnell B, Curley G, Heffernan A, Power C, Laffey JG. The analgesic efficacy of transversus abdominis plane block after abdominal surgery: A prospective randomized controlled trial. *Anesth Analg* 2007;104:193-7
14. O'Donnell BD, McDonnell JG, McShane AJ. The transversus abdominis plane (TAP) block in open retropubic prostatectomy. *Reg Anesth Pain Med* 2006;31:91
15. Almarakbi WA, Kaki AM. Addition of dexmedetomidine to bupivacaine in transversus abdominis plane block potentiates post-operative pain relief among abdominal hysterectomy patients: A prospective randomized controlled trial. *Saudi J Anaesth* 2014;8:161-6
16. Ramsay MA, Savage TM, Simpson BR, Godwin R. Controlled sedation with alphaxolone-alphadolone. *Br Med J* 1974;2:656-9
17. Marhofer D, Kettner SC, Marhofer P, Pils S, Weber M, Zeitlinger M. Dexmedetomidine as an adjuvant to ropivacaine prolongs peripheral nerve block: a volunteer study. *Br J Anaesth* 2013;110:438-42
18. Al-Metwalli RR, Mowafi HA, Ismail SA, Siddiqui AK, Al-Ghamdi AM, Shafi MA, El-Saleh AR. Effect of intra-articular dexmedetomidine on postoperative analgesia after arthroscopic knee surgery. *Br J Anaesth* 2008;101:395-9
19. Guo TZ, Jiang JY, Buttermann AE, Maze M. Dexmedetomidine injection into the locus ceruleus produces antinociception. *Anesthesiology* 1996;84:873-81
20. Kosugi T, Mizuta K, Fujita T, Nakashima M, Kumamoto E. High concentrations of dexmedetomidine inhibit compound action potentials in frog sciatic nerves without alpha(2) adrenoceptor activation. *Br J Pharmacol* 2010;160:1662-76