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Research Article

Surgically performed rectus sheath block – Effect of morphine added to bupivacaine versus bupivacaine only: A prospective randomized controlled double blinded trial

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KEYWORDS

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Abstract *Background:* Extended abdominal midline incision in laparotomies is associated with severe postoperative pain that is impacted badly on all body systems; proper management of this pain is essential for patient comfort and to minimize these bad impacts. Bilateral rectus sheath block (BRSB) is an option to achieve this.
Methods: 50 Adult patients classified ASA1 and ASA2 submitted to extended abdominal midline incision were included. Bilateral rectus sheath catheters (BRSCs) were placed surgically during abdominal closure for BRSB. Patients were randomly assigned into 2 groups: in group 1(morphine group); a mixture of bupivacaine and morphine was used for BRSB, while in group 2 (bupivacaine group), only bupivacaine was used for BRSB.
Results: There was a significant reduction in visual analogue scale (VAS) at rest and mobilization in the morphine group compared to bupivacaine group during 6th, 12th and 18th postoperative hours with *P values*: 0.001, 0.007, 0.04 and 0.003, 0.006, 0.036 during the same periods, respectively.
Conclusion: Addition of morphine to local bupivacaine for BRSB was effective and safe technique to achieve good quality of postoperative analgesia in patients submitted to extended midline abdominal incision.

1. Introduction

Extended midline incision used in laparotomies and other abdominal surgeries is associated with severe postoperative splinting pain, typically associated with a neuro-endocrine stress response that cannot be tolerated in certain types of patients particularly cardiac ones. The increasing work of breath-

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ing and the limited tidal volumes following this incision is another major problem of those having compromised pulmonary functions [1]. Many interventions has been tried to reduce such severe pain; including epidural analgesia, IV patient-controlled analgesia (IVPCA), transverse abdominis plane block (TAP block), local wound infiltration, peripheral nerve blocks, in addition to use of systemic administration opioids, or non-steroidal anti-inflammatory drugs (NSAIDs) [2–4].

In this study, BRSB using surgically inserted catheters was performed in 50 patients. Patients allocated into one of two groups ($n = 25$). Group 1 (morphine group) in which a mixture of both bupivacaine and morphine was injected through the catheters and group 2 (or bupivacaine group) in which only bupivacaine was used.

Our hypothesis was that addition of morphine to bupivacaine in BRSB could minimize this severe form of acute postoperative pain. Primary outcome was postoperative pain measured by VAS, while the secondary outcome was the postoperative IV requirements of morphine in milligrams (mgs) used as rescue analgesic for breakthrough pain in the two groups.

2. Patients and methods

This prospective randomized controlled double blinded study was conducted between June 2011 and August 2012 in a Teaching Hospital after approval by the Local Ethics Committee and obtaining a written informed consent from all patients.

50 Adult patients (ASA I or II) submitted to abdominal surgeries with midline incisions were enrolled into the study. At the end of the operative procedure and before closure of the wound, the operating surgeon placed epidural catheters under direct vision through a surgical snap opening bilaterally into the potential space between posterior rectus sheath and the rectus abdominus muscle. The space was created 3 cm lateral to the edge of the posterior rectus sheath using an artery forceps. The epidural catheter (Smiths-Medical 16-G-epidural mini-pack) was positioned in place for a distance of 6 cm by grasping the tip of the catheter in a retrograde fashion and bringing out the artery forceps through the skin ~3 cm above and lateral to the upper end of the midline incision. The opened snap was closed tightly during abdominal closure to prevent any fluid leakage, which was confirmed by the absence of leakage after injection of five millilitres of normal saline. The catheter was fixed on the skin with 4 o nylon. The procedure was repeated on the contralateral side using the same technique. The two catheters were connected to the epidural bacterial filter.

Patients were randomly allocated to one of two equal groups (25 in each group) using a computer generated randomized table; allocation was done by a sealed opaque envelope which contain the selected random number and opened by a nurse staff not involved in the study. One day before surgery, study protocol was discussed with all Patients who agreed to give informed consent. Intravenous patient-controlled analgesia (IVPCA) using morphine sulphate was used as rescue analgesia in case of breakthrough pain. They were instructed by an anaesthetist how to use PCA device, and how to describe their level of postoperative pain on a 100-mm visual analogue scale (VAS) with 0 point reflecting "no pain" and 100 pint reflecting "worst imaginable pain. These instructions were confirmed in the recovery room whenever patients became oriented.

In group 1 (morphine group): the BRSB was activated at the end of abdominal closure using a volume of 20 ml of 0.25% isobaric bupivacaine mixed with 2 mg of morphine sulphate and injected through the epidural bacterial filter on each side, the dose was repeated 6 h (maximum bupivacaine dose was 2 mg/kg/every 6 h) until removal of the catheters on the fifth morning postoperative day by a surgeon. In group 2 (control group): 20 ml of 0.25% isobaric bupivacaine was injected similarly. Nurses were oriented about the technique; negative aspiration was confirmed before each injection to exclude inadvertent intravascular injection.

Anaesthetic management was standardized for all patients; 3.75 mg oral midazolam (half tablet) was given 30 min before induction as a premedication. On arrival to the operating room, standard intra-operative monitoring, including ECG, pulse oximetry, automatic non-invasive blood pressure (NIBP) and end-tidal carbon dioxide tension (after intubation) were connected. Anaesthesia was induced with remifentanil 0.75 μ/kg given slowly plus propofol 2 mg/kg. Tracheal intubation was facilitated with cisatracurium 0.15 mg/kg. Lungs were mechanically ventilated with volume control mode to maintain an EtCO2 ~35 mmHg using O_2/air. Anaesthesia was maintained using sevoflurane and remifentanil infusion at a rate 0.1 μg/kg/min. Increments of cisatracurium were given to maintain a satisfactory level of muscle relaxation; at the end of surgery, muscle relaxant was reversed and all patients were extubated.

All patients were transferred into the post-anaesthesia care unit (PACU) for continuation of the standard monitoring for half an hour. Patients were discharged from PACU according to our local protocol and shifted to high dependency beds where same monitoring level was extended for the next 24 h before shifting them to normal beds.

To achieve blindness, the managing nurse staff and a surgeon involved in data collection were not aware of group assignment. The following data were recorded: patient demographics, VAS at rest and during mobilization from the supine to the sitting position 6 h in the first 48 h. Total amount of morphine consumed in mgs through IVPCA in the first postoperative 24 h were recorded. To assess the ability to ambulate, patients were asked for walking independently for 5 m in both day 1 and day 2 postoperatively. The percentage (%) of ambulated patients and duration of postoperative hospital stay in days were recorded within each group. Complications such as hypotension, hypoxaemia, nausea, or vomiting, and any signs or symptoms of local anaesthetic toxicity were recorded. The surgical wound was inspected everyday by the surgeon for any sign of infection; also any difficulty in removal of catheters was recorded. The duration of this study extended to the day of discharge (cut-point) of our patients.

3. Statistical analysis

Based on a pilot study comprised of eight patients submitted to laparotomies with a midline incision and given a 20 ml bupivacaine 0.25% administered bilaterally six hourly through surgically inserted rectus sheath catheters. The incidence of patients who required boluses of IV morphine in the first 6 h postoperatively was 40%; to detect 25% reduction on the incidence of postoperative pain at a two-sided significance level of 0.050% and 80% power, it was calculated that a minimum of

24 patients were required for each group. Using SPSS version 17, continuous variables were compared with repeated measures analysis of variance or Student's *t*-test, as appropriate. Categorical data were analysed with χ^2 tests. Levels of significance were *P* value < 0.050.

4. Results

Patients' demographic data, basal mean ABP, HR, SPO2 showed no significant difference between the 2 groups (Table 1); Table 2 demonstrate the operative procedures done in each group. The mean VAS on mobilization in the morphine group during 6th, 12th hours and 18th hours were 2.9 ± 1.1, 3.1 ± 1.4 and 1.6 ± 0.9, respectively, compared with 4.8 ± 2.1, 4.5 ± 1.9 and 2.4 ± 1.1 in the control group with statistical significance and *P values* 0.001, 0.007 and 0.04, respectively (Fig. 1). The Mean values of VAS at rest in patients who received morphine during the 6th, 12th and 18th hours were 2 ± 1.1, 2.1 ± 1.2 and 1.1 ± 0.7, respectively, compared with 4.2 ± 1.8, 4.5 ± 1.9 and 2.4 ± 1.1 in the control group with *P values* 0.003, 0.006 and 0.036, respectively (Fig. 2). Similarly, mean morphine consumption in mgs via IVPCA showed a significant reduction in the morphine group .8 ± 1.8, .2 ± 0.8 and 0 ± 0, respectively, compared with 3.8 ± 4.7, 1.9 ± 2.5 and .5 ± 1.1 in the control group with *P values* amount used in mgs compared with the control one during the first, second and third 6 h periods postoperatively with *P* value < 0.010, 0.003 and 0.038, respectively (Fig. 3). The mean total morphine consumption per patient during the first 24 h for the morphine group was .7 ± 2 reflected significant reduction compared to control one 6.3 ± 8.3 *p* value was 0.002 (Fig. 3).

64% of patients in the morphine group were able to walk for 5 m distance independently on postoperative day 1 compared with 36% in the control group, while on postoperative day 2, 100% of patients within the morphine group walked same distance independently compared with 80% in the control group (Table 3). Patients in the morphine group went home earlier than those in the control group (Table 3) although the difference was not significant with *p value* 0.065. Five patients within the control group got vomiting compared with 2 patients in the study group; there was neither incidence of hypoxaemia, hypotension, nor local anaesthetic toxicity. Removal of catheter was easy and there was no wound infection in the 2 groups.

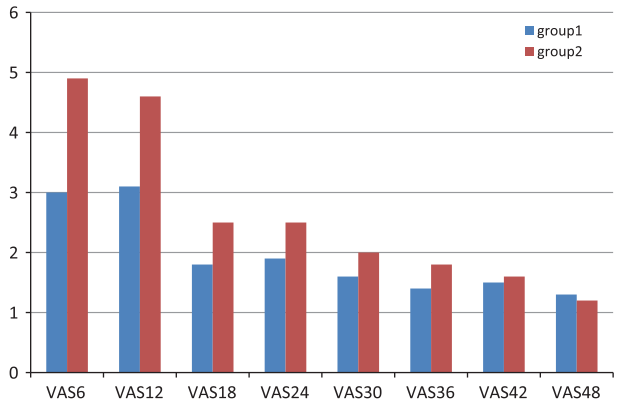

Figure 1 Show the difference between the mean VAS on mobilization in group 1 (morphine group) and group 2 (control group) VAS = visual analogue score at 6th, 12th, 18th, 24th, 30th, 36th, 42nd and 48th hours postoperatively.

5. Discussion

The current study displayed that addition of morphine to bupivacaine injected for bilateral rectus sheath block (BRSB)

Table 1 Represents demographic data, operative time, basal haemodynamic parameters and basal SPO2 operative time in both group 1 and group 2. Values for age, weight, operative time, basal MAP, basal HR, basal SPO2 are mean (SD) while for sex, values are represented by absolute number of cases.

Parameters	Groups	
	Group 1 (morphine group *n* = 25)	Group 2 (control group *n* = 25)
Age (years)	53.6 (10.7)	52.5 (9.9)
Weight (kg)	74.3 (11.7)	76.1 (8.8)
Sex (number)	18M 7F	17M 8F
Operative time (minutes)	191.2 (49.4)	202.9 (45.9)
Basal MAP(mmHg)	81.1 (6.5)	79.5 (9.8)
Basal HR (b/m)	77.8 (9.8)	78.2 (13.2)
Basal SPO2 (%)	6 (1.5)	96 (1.7)

b/m = Beats per minute.

Table 2 Distribution of operative procedures done in group 1 and group 2.

Name of operative procedure	Number done in each group	
	Group 1 (*n* = 25)	Group 2 (*n* = 25)
Paraumbilical hernia repair	4	5
Intestinal obstruction	8	6
Intra-abdominal tumour resection	13	14

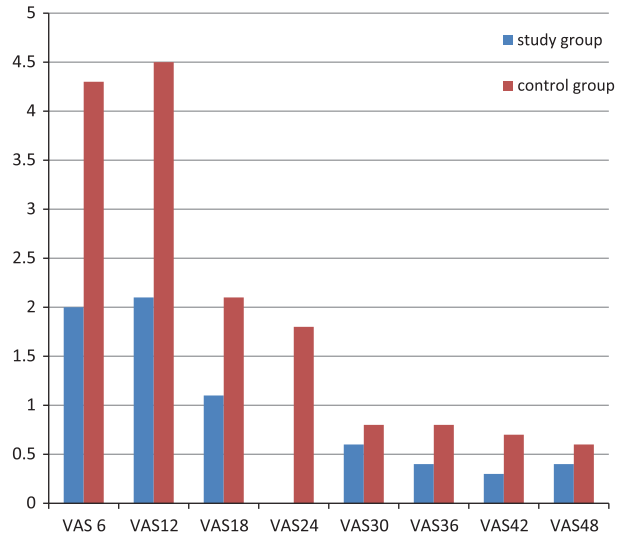

Figure 2 Show the difference between the mean VAS at rest in morphine group (study group) and group 2 (control group). VAS = visual analogue scale at 6th, 12th, 18th, 24th, 30th, 36th, 42nd and 48th hours postoperatively.

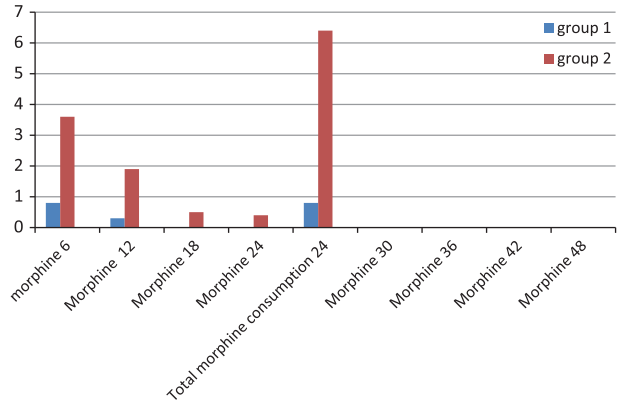

Figure 3 Amount of morphine consumed per patient postoperatively in group 1 (morphine group) and group 2 (control group) during the first 48 h categorized 6 h, including total morphine consumption per patient in each group during first 24 h. The number following morphine (e.g. 6, 12, 18, etc.) equal timing by hours.

was associated with significant reduction in both static and dynamic postoperative pain as evidenced by VAS concomitant with significant reduction in the total postoperative IV morphine consumption administered through PCA. Early ambulation (64% versus 36%) and reduction of duration of hospital stay (nearly two days earlier) in the morphine group was another advantage of mixing morphine to bupivacaine in BRSB.

BRSB could be more advantageous than an epidural block that is commonly used for such a type of extended midline abdominal incision; it can be used in situations considered as absolute contraindications to epidurals like coagulopathy and sepsis. The haemodynamic stability associated with BRSB makes it a suitable option for analgesia hypovolaemic patients and those with cardiovascular compromise. The catastrophic complications occurring with epidural analgesia like epidural haemotoma, abscess or spinal cord injury are absent in RSB which is another major advantage.

Compared with transverse abdominis plane block, (TAP block) which is one of the hot topics in the abdominal wall regional anaesthesia, BRSB is more effective in midline and paramedian abdominal incisions above the umbilicus than TAP block, which is mainly useful for transverse or pfennensteil incisions below the umbilicus. In TAP block, single injection is enough for several days while frequent dosage is required in case of BRSB hence, insertion of rectus sheath catheters is essential [5,6].

Initially, RSB was performed blindly, recently it has been used under the guidance of ultrasound [7,8]; surgical insertion of rectus sheath catheters intraoperatively was described in 2007 [9] which, according to our experience, is easy, safe and non-time-consuming.

The secret of success of any regional block is the appropriate dose and correct location of the local anaesthetic agents. Using our surgical technique allows 100% proper placement of the epidural catheters under direct vision through a snap opening bilaterally into the potential space between posterior rectus sheath and the rectus abdominus muscle. This maximized its safety through avoidance of placing the catheter in the superior or inferior epigastric vessels which run in the posterior rectus sheath, thereby increasing the efficacy and safety of our technique in both groups as evidenced by the absence of any signs or symptoms of local anaesthetic toxicity in both groups.

Padmanabhan et al. [10] studied the efficacy of bupivacaine administration in RSB and found that there was no statistically significant difference in postoperative opioids requirements and postoperative pain score between bupivacaine and normal saline groups. The difference between this study and the current study might be related to; first we used bupivacaine every 6 h not 8 h as they used, second the surgical technique we used for insertion of the catheter in our study.

Up to our knowledge, no further studies evaluated the effect of morphine administration into the rectus sheath space. The role of opioid receptors located in the peripheral nervous system in inflammatory pain type of surgical wound is well established as reported by Whiteside et al. [11] who concluded that administration of the peripheral mu agonist like morphine resulted in 75% anti-hyperalgesia and reduced postoperative

Table 3 Number (percentage) of ambulated patients in day 1 and 2 postoperatively and duration of hospital stay represented by means (SD).

	Study group (n = 25)	Control group (n = 25)
Patients ambulated postoperative day 1	16 (64%)	9 (36)
Patients ambulated postoperative day 2	25 (100%)	9 (36)
Duration of hospital stay (days)	8.6 (4.7)	10.6 (3.6)

systemic opioid requirements, which is concomitant with our results.

In the current study, the sum of doses of morphine administrated for BRSB was 16 mg (2×2 mg every 6 h/24 h) giving in mind the fact that rectus sheath is a well perfused anatomic region having an absorption rate which should not be neglected. Shah et al. [12] investigated the efficacy of ultrasound modified RSB compared with wound infiltration using levobupivacaine 0.25% in hysterectomy and myomectomy with a lower transverse abdominal incision; they found no significant difference in postoperative morphine consumption in both groups.

In this study [12], postoperative morphine consumption in modified RSB group was 12 ± 18 which is very high and non-comparable with morphine consumption in the morphine group of the current study 0.7 ± 2, and the double morphine consumption of the bupivacaine group is 6.3 ± 8.3. These differences could be explained by the effective role of morphine when injected into the rectus sheath as well as by nearly 100% appropriate placement of rectus sheath catheters under direct vision using our own surgical technique compared with Ultrasound technique, in addition to the different type of incision midline, versus lower transverse ones.

However, this does not solve the question, whether the above positive results in the morphine group was related to peripheral nerve action or through systemic absorption? which deserves more attention and is a limitation of this study. Measurement of plasma level of morphine could help in differentiation. The frequency and dosage of morphine used in this study were determined according to our daily practice and experience with rectus sheath block in abdominal surgeries with extended midline incisions. However, other prospective trials comparing different dosages of morphine mixed with bupivacaine injected into the rectus sheath could help obtaining the most suitable morphine dose to be used in BRSB.

In conclusion, the addition of morphine sulphate to bupivacaine injected in bilaterally surgically inserted rectus sheath catheters was an effective method in reducing postoperative pain. Morphine injection into the rectus sheath led to reduction in IVPCA morphine consumption in patients submitted to abdominal surgeries with midline incisions. Lastly, our own surgical technique for insertion of rectus sheath catheters was easy and safe.

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