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Original Research Article

Efficacy of Spinal Anaesthesia for Laparoscopic Ventral Hernia Repair

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Abstract

Aim and Objective: Aim of the present study was to evaluate efficacy of spinal anaesthesia in terms of onset, duration and quality of sensory& motor blockade, hemodynamic stability and perioperative complications.
Methods: The study enrolled 30 patients of either sex of ASA grade I and II posted for elective laparoscopic hernia repair. In all the patient spinal anaesthesia was performed using 3 ml 0.5% bupivacaine with 25 mcg fentanyl in L3-L4 inter space. After induction, we studied the various parameters of subarachnoid block.
Result: Mean time required for onset of sensory and motor block was 2.46 ± 0.43 (2-3) and 6.93 ± 1.48 (5–9) minutes respectively. The mean time for reappearance of pain sensation at surgical site (duration of sensory block) was 294.00 ± 62.24 minutes as well as mean time for reappearance of flexion at hip (duration of motor block) was 220.0 ± 46.04 (100 – 300) minutes. Quality of analgesia and quality of motor block was grade 3 in 20 patients (66.67%) and grade 2 in 10 patients (33.33%). None of the patients had grade 0 and grade 1quality.
Conclusion: Spinal anaesthesia with 0.5% bupivacaine (3 ml) and fentanyl (25 mcg) for elective laparoscopic ventral hernia repair was efficacious and has preserved ventilation and hemodynamic changes within physiological limits during pneumoperitoneum with minimal treatable side effects.
Keywords: Spinal anaesthesia, Laparoscopic ventral hernia repair, Subarachnoid block, Bupivacaine, Fentanyl. Pneumoperitoneum

1. Introduction

The goal of anaesthetic management with spinal anaesthesia includes managing the change in hemodynamic, achieving satisfactory level of sensory blockade and motor relaxation, management of shoulder tip pain, presence of adequate postoperative pain relief adequate to prevent worsening of respiratory mechanics, and mobilization as in the early hours. Various techniques like low pressure pneumoperitoneum[1], acupuncture[2], analgesics[3], opioids[4], alpha 2 agonist, or in combinations in various modes i.e. oral, intra-muscular, intra-venous, epidural, intrathecal are used so as to reduce the above mentioned complications in combination with regional anaesthesia. However regional anaesthesia like spinal and epidural have a long history of safe use for variety of surgical procedure. Subarachnoid block is one of the most versatile popular regional blocks available today. It has emerged as a variable alternative to general anaesthesia and use for variety of surgeries e.g. infraumbilical, perineal and lower limb surgeries.

Several local anaesthetics like Lidocaine, Bupivacaine, Procaine, Tetracaine and Levobupivacaine etc are used for local anaesthesia. Bupivacaine is an amide local anesthetic that has a prolonged duration of action and lower incidence of transient radicular symptoms [5]. In order to maximize duration of anesthesia and postoperative analgesia, a number of adjuvant were added to local anaesthetic such as opioids (morphine, fentanyl), vasoconstrictors (adrenaline), ketamine, midazolam, clonidine etc [6].

Ventral hernia, both primary and incisional, represents a frequent clinical problem with both open and laparoscopic techniques being used for its repair. Traditionally, the open repair is considered, and not unfairly, as a rather challenging procedure associated with significant morbidity [7,8]. On top of that, studies raise the incidence of recurrence after “simple” repair up to 49%, a figure that however seems to be limited (under 10%) when a prosthetic mesh is used [9,10]. Laparoscopic ventral hernia repair (LVHR) aimed to offer the advantages of minimally invasive surgery in a patient population by definition prone to postoperative complications [11,12].

Laparoscopic ventral hernia repair is minimal invasive surgery therefore it has got advantage over open

hernia repair in terms of minimal surgical trauma, lesser postoperative pain, cosmetically better scar and quicker return to normalcy.

So we have conducted case series of 30 patients to evaluate efficacy of spinal anaesthesia in terms of characteristics of subarachnoid blockade, hemodynamic stability and side effects for laparoscopic ventral hernia repair.

2. Materials and Methods

This was a prospective study conducted in the department of anaesthesiology in tertiary care hospital during period of October 2013 to November 2015, after approval from the Institutional Ethics Committee. Study included total 30 patients of either sex belonging to ASA grade I & II with the age, weight and height between 20 to 70 years, 50 to 90 kg and 148 to 175 cm respectively. A written informed consent was obtained from all the patients after explaining the procedure posted for elective laparoscopic hernia repair under spinal anaesthesia. Patients with neurological disease, absolute and relative contraindication to spinal anaesthesia e.g. local infection, bleeding disorders, vertebral column malformation, ASA grade III and IV, uncontrolled hypo or hypertension of any cause, Patients were having history of hypersensivity to amide type local anaesthetics, non co-operative patient were excluded from study. A detailed pre-anaesthetic evaluation including relevant laboratory investigations was done for all the patients.

On operation table, standard monitoring devices were applied to the patient and baseline parameters like pulse rate, blood pressure, respiratory rate, oxygen saturation and ETCO2 were recorded. All patients were premedicated with intravenous ranitidine 50 mg, ondansetron 4 mg and metoclopramide 10 mg. Intravenous lines was secured with wide bore 18G cannula and patient was preloaded with 10-15 ml/kg of Ringer lactate solution before giving subarachnoid block. After preloading the patient was put on right or left lateral position and lumbar puncture was performed at L3-L4 level with pin prick by 24G spinal needles and the injection 0.5% bupivacaine 3 ml with 25 mcg fentanyl was given and achieved highest level of sensory block T4-T5. Patients were breathing spontaneously with oxygen supplementation at rate 5liter/min. Nasogastric tube was inserted on surgeons demand. Pneumoperitoneum was established with CO2 of 10 mmHg, at flow rate 1 liter/min after 20 minutes of subarachnoid block. Intra operatively patient was monitored for pulse rate, blood pressure `respiratory, and ETCO2. These parameters were recorded at 5 min interval for first 30 minutes then at 15 minutes interval. Data regarding the onset, duration and quality of sensory and motor block, cardiovascular changes and incidence of side effects were noted.

In our study, pulse rate < 60/min was taken as bradycardia and was treated with atropine when required. Fall in blood pressure by 30% or < 90 mmHg was taken as clinically significant hypotension and was treated accordingly with intravenous fluids, 100% oxygen and incremental doses of mephentaramine 6mg as and when required. Respiratory insufficiency was defined as- respiratory rate below 8 breath/minute, pulse oximetry value of less than 94% at any given time and/ or subjective breathing difficulty not relieved by reassurance. Other side effects like nausea, vomiting, shivering, anxiety and shoulder pain was noted and treated whenever necessary. Intraoperative supplementation for sedation by midazolam 0.01-0.03 mg/kg or sedation with analgesia by pentazocine 0.5 mg/kg with or without ketamine 0.5 mg/kg or conversion to general anaesthesia if required was noted.

After completion of surgery the patients were shifted to the recovery room. They were observed for regression of block. Postoperatively when patient complained of pain at surgical site, that time was noted and IV diclofenac 1.5 mg/kg was administered. After that patients were shifted to ward and followed up till discharge from hospital.

2.1 Statistical analysis

Continuous variable (age, height, weight, onset and duration of sensory and motor block, mean operative time, pneumoperitoneum time, pulse rate, systolic blood pressure, respiratory rate) were presented as Mean ± SD. Categorical variables (sex, grades of sensory and motor block, complications) were expressed in actual numbers and percentage, Variation in hemodynamic parameters were assessed at different time point by performing one way repeated measure ANOVA, Post hoc comparison was performed by bonferroni test. Categorical variables were compared by performing chi-square test. $P<0.05$ was considered as statistical significance. Statistical software STATA version 13.1 was used for statistical analysis.

3. Observations and Results

A total of 30 patients who underwent elective laparoscopic hernia repair were enrolled for the study. Table 1 show the demographic profiles of the patients and mean duration of surgical procedures. Regarding the type of the hernia, eight (26.67%) patients had primary umbilical and four (13.33%) patients had para-umbilical hernia, eight (26.67%) had epigastric hernia and maximum patients had incisional hernia repair (33.33%).

Subarachnoid block was found successful in majority of the patients (90%) but 3 (10%) patient required general anaesthesia for surgery due to severe shoulder pain. The results regarding characteristics of subarachnoid (sensory and motor) blockade were depicted in Table 2. The mean time of onset of sensory and motor block was found to be 2.46 ± 0.43 (2-3) and 6.93 ± 1.48 (5-9) minutes respectively. Quality of analgesia and quality of motor block was grade 3 in 20 patients (66.67%) and grade 2 in 10 patients (33.33%). None of the patients had grade 0 and grade 1quality, (Table 3).

However, the overall quality of anaesthesia was excellent in 60% of the patients, good in 10% patients and fair in 20% patients, (Table 3). But in only 10% patient anaesthesia was not satisfactory to carry out surgery in spinal anaesthesia. The mean duration of sensory and motor block was 294.00 ± 62.24 and 220.0 ± 46.04 minutes respectively.

We found statistically significant change in pulse rate and blood pressure at various time intervals during intra and postoperative period (p - < 0.001), (Figure 1 and 2). Table 4 show the peri - operative complications of the patients. Hypotension was observed in 4 patients (13%) and bradycardia in 6 patients (20%), while 5 patients (16.6%) required sedation for anxiety intraoperatively. Postoperatively nausea was observed in 3 patients (10%). Because of prior antiemetic prophylaxis with metoclopramide and ondansetrone less patients experienced nausea whereas vomiting not observed in any patient. As such intraoperative and postoperative complications was insignificant except for anxiety (p= 0.052) and shoulder pain (p=0.001) and which were easily treated with anxiolytics and sedative analgesics. The incidence of postoperative mortality and morbidity was almost nil in present study with privilege of postoperative analgesia.

Table 1: Demographic data and duration of surgery

Variables	Range	Mean±SD
Age (years)	28-69	49.36 ± 11.29
Height (cm)	148-175	159.8±8.77
Weight (kg)	53-89	66.2 ± 8.56
Duration of surgery (min)	70 – 125	102.16 ±13.87

Table 2: Summary of results regarding characteristics of subarachnoid (spinal) blockade

Characteristics	Range (Min)	Mean ±SD
Onset of sensory block	2 – 3	2.46 ± 0.43
Onset of motor block	5 – 9	6.93 ± 1.48
TT4 of sensory block	5 – 17	9.86 ± 3.63
TR2 of sensory block	110 – 170	135.0 ± 18.70
Duration of sensory blockade	120 – 350	294.66 ± 62.24
Grades of motor block in bromage scale	2 -3	2.66 ± 0.48
Duration of motor block	100 – 300	220.0 ± 46.04
Pneumoperitonium time	60 – 115	91.16 ± 13.68

Data are Mean and ±SD.

Table 3: Quality of analgesia and quality of motor block

Grades	No. of patients	Percent
0	-	-
1	-	-
2	10	33.33
3	20	66.67
Total	30	100
Overall - quality of analgesia		
Quality of analgesia	**No. of patients**	**Percent**
Excellent	18	60
Fair	6	20
Good	3	10
poor	3	10
Total	30	100

Table 4: Peri - operative complications

Complications	Intra-operative	Post operative	p-value
Anxiety	5	0	0.052,NS
Shoulder pain	10	0	0.001,HS
Bradycardia	6	0	0.024,S
Hypotension	4	0	0.246,NS
General Anesthesia	3	0	0.237,NS
Nausea	0	3	0.119,NS

Figure 1: Graphical presentation of variation in mean pulse rate

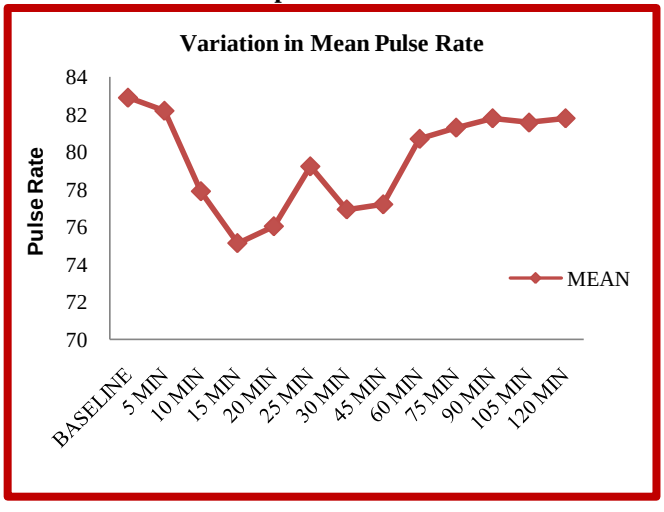
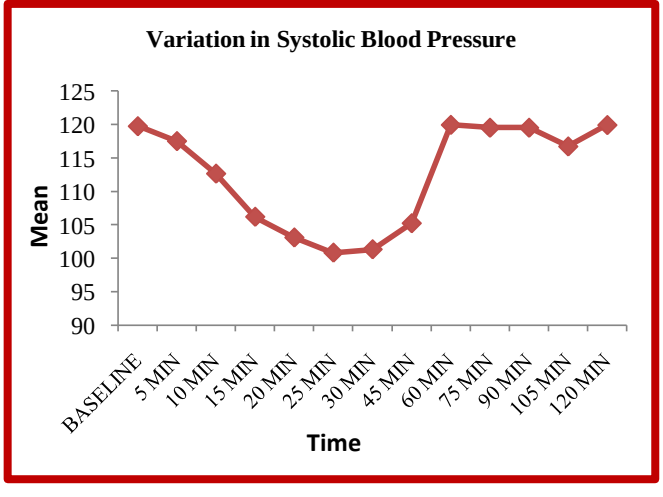


Figure 2: Graphical presentation of variation in systolic blood pressure



4. Discussion

Many researchers have observed that laparoscopic ventral hernia repair performed under regional anaesthesia is advantageous due to reduction of surgical stress response. Avoidance of airway instrumentation and lower incidence of deep vein thrombosis are other few advantages [13]. Low intra-abdominal pressure with low insufflations flow rate contributes only few hemodynamic changes [14]. However, there are several disadvantages of the regional technique due to sympathetic denervation of high regional block which might lead to bradycardia, hypotension and decreased cardiac output. The vigilant monitoring is essential for prevention and

treatment. Assessment of any anaesthetic technique includes consideration of technical factors, anaesthetic agent toxicity, incidence of critical intraoperative and postoperative events, provision for postoperative pain relief as well as patient's and surgeon's satisfaction. In present research, we evaluate efficacy of spinal anaesthesia in a case series of thirty patients posted for elective laparoscopic ventral hernia repair.

From literature review [15-17] we selected bupivacaine and fentanyl for spinal anaesthesia, because bupivacaine 0.5% produced more intense and longer duration of motor block. Subarachnoid administration of the bupivacaine with fentanyl has been shown to accelerate the onset of sensory and motor blocks without significant fentanyl related side effects [18]. Fentanyl due to its high lipid solubility easily crosses the lumbar dura and contributing to rapid onset of action, when added with bupivacaine. Bupivacaine when used alone has disadvantage like delayed onset of action and cardio toxicity when used in large doses, so we used combination of bupivacaine and fentanyl in our study.

We had taken onset of sensory block from injection of drug into subarachnoid space to complete loss of pinprick sensation at L1 level. Mean time required for onset of analgesia was 2.46 ± 0.43 (2 - 3) minutes. Maximum patients required 2 minutes for onset of analgesia. This result was comparable with study of Chavan *et al* [19]. Time to achieve sensory block at T4 level was defined as time required achieving loss of pinprick sensation at T4 level from 0 hour. The mean sensory block at T4 level was 9.86 ± 3.63 (15 – 26) minutes. The median highest level of sensory blockade achieved was at T4-T5. Similar observation was found in study done by Imbelloni *et al* [20] and Lau *et al* [22]. Time to regress sensory block by 2 segments was observed that mean time required to regress sensory level by two segments from maximum achieved cephalic level was 135 ± 18.70 (110-170) minutes. Chavan *et al* [19] had same result. Duration of sensory block was 294.66 ± 62.24(120 – 350) minutes. Maximum patients (46.6%) demanded analgesia between 300 – 330 minutes, postoperatively. It shows, intrathecal addition of fentanyl with bupivacaine, in our study, significantly prolong duration of analgesia. Imbelloni *et al* [20] observed mean duration of sensory blocked was 4hr and 18 min that is comparable to our study.

Onset, duration and quality of motor block were assessed by Bromage scale. Mean time required for onset of motor block was 6.93 ± 1.48 minutes. It was observed that mean time for reappearance of flexion at hip joint was 220.0 ± 46.04 (100 – 300) minutes. Imbelloni *et al* [20] reported the mean duration of motor blocked was 3 hr. In their study, the duration of the motor blocked was significantly shorter than duration of sensory blocked that is similar to our study. It was observed that quality of sensory and motor block was grade 3 in 66.6% (20/30) of the patients and did not complain of pain or discomfort while operating, 33.3% (10/30) of the patients complained of mild discomfort (grade 2) which was symptomatically managed. None of the patient belonged in grade 0 and grade 1. Similar result found in study of Imbrelloni *et al* [20] and Gupta *et al* [13]. Overall quality of analgesia was excellent in 60% of the patients, good in 10% patients and fair in 20% patients. In only 10% patients anesthesia was poor i.e. not satisfactory to carry out surgery. Reason for supplementation of sedation and analgesic was anxiety and shoulder pain.

The mean pneumoperitoneum time and mean operative time in our study was 91.16 ± 13.68 minutes and 102.16 ± 13.87 minutes respectively. This is agreement with the study of Bejarano *et al* [15] and Yasser Ali *et al* [21]. Yasser Ali reported the mean surgical time (98.5 ± 21.4 min) and mean anesthesia time (117.7 ± 20.1 min) which was less than our study. The longer duration of operative time in our patients might be due to relative inexperience of the operating surgeon; as such type of study was carried out in our institute for the first time.

Considering the haemodynamic parameters in our study, there was statistically significant change in pulse rate and blood pressure at various time intervals during intraoperatively. The mean base line systolic blood pressure was found to be119.73 ± 6.82 mmHg. Also we found base line mean pulse rate (MPR) was 82.90 ± 7.7 0beats/min which decreased significantly after spinal anaesthesia to 75.13 ± 8.54 beats/min at 15 min. and persisted after CO_2 insufflations at a level of 76.93 ± 13.24 mmHg at 30 min. After that it increased and remained stable throughout the procedure and postoperatively without significant change. The changes in MPR were accompanied by significant decrease in mean blood pressure after spinal anaesthesia and CO_2 insufflations which increased again and remained stable throughout the procedure and post operatively without any significant change. In present study spinal anaesthesia showed a significant decrease in both heart rate and the mean arterial blood pressure. Those changes were attributed to the sympathetic block and decreased after load, which was corrected by using intravenous fluids and vasopressor drugs after starting spinal anaesthesia. This led ultimately to patient's hemodynamic stabilization secondary to the increase in ejection fraction and cardiac index, as confirmed in the results of Lau *et al* [22] who reported stable perioperative hemodynamic in patients undergoing laparoscopic hernia repair and attributed to the same factors.

Preoperatively mean base line respiratory rate was 15.037 ± 0.6 breaths/ minute and mean $ETCO_2$ was 35.01 ± 0.91 per min. After CO_2 insufflations, there was significant increase in $ETCO_2$ from a mean value and accompanied by change in respiratory rate from a mean value. Changes in $ETCO_2$ and respiratory rate disappeared after desufflation. Along with respiratory rate and $ETCO_2$ changes there was no significant change in oxygen saturation. Hence spinal anaesthesia in our study was not associated with respiratory

depression as the respiratory control mechanism remains intact to allow the patients to adjust their minute ventilation. This is agreement with the study of Raju *et al* [23] and Ciofolo *et al* [24].

One of the feared complications in abdominal surgeries under regional anaesthesia is inadequate muscle relaxation [13]. We did not encountered such problem in fact surgeons appreciated the technique because of adequate abdominal relaxation and surgical conditioning. Similarly surgeons did not have problems with relaxation of musculature, or the surgical technique in Imbrelloni *et al* [20], he study and answered that there was no difference either surgery performed under general or spinal anaesthesia. Intra operative complication i.e. severe shoulder pain occurred in 3 (10%) patients and required general anaesthesia for surgery. Although we observed bradycardia in 6(20%) patients and hypotension 3 (10%) patients, the complications were easily treatable with intravenous fluids, vasopressors, and atropine. 10(33.33%) patients experienced shoulder pain due to irritation of diaphragm by pneumoperitoneum. It was manageable with pentazocine 0.5 mg/kg ± ketamine 0.5 mg/kg. 5 patients (26.7%) required midazolam for management of anxiety whereas only 3 (10%) patients experienced nausea postoperatively. Low incidence of nausea/vomiting in our study could be attributed to antiemetic prophylaxis with metoclopramide and ondansetron. Thus the excellent analgesia, muscle relaxation, less oozing during perioperative procedure because of subarachnoid block helped to carry out the surgery easily.

In present study, spinal anaesthesia provides excellent sensory and motor blockade at the surgical site, and also diminishes the requirements of opioids and local anaesthetics. Hence the surgeons appreciated the technique because of adequate muscle relaxation and surgical condition. Majority of patients were satisfied with the technique especially because they had no postoperative pain however 10% of patients refused to have same type of anaesthesia in the future.

5. Conclusion

We concluded that, spinal anaesthesia successfully and effectively can be used for laparoscopic ventral hernia repair, eliminating the need for immediate postoperative analgesia. Co-operative patients, lesser surgical manipulation with low intra-abdominal pressure being the key for success of the technique. This procedure may be more beneficial in the patients which are at high-risk for general anaesthesia due to presence of co morbid conditions.

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