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RESEARCH ARTICLE
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EFFECT OF DEXAMETHASONE AS AN ADJUVANT ON THE DURATION OF POSTOPERATIVE ANALGESIA FOLLOWING ULTRASOUND GUIDED BILATERAL ERECTOR SPINAE PLANE BLOCK USING BUPIVACAINE IN PATIENTS UNDERGOING LAPAROSCOPIC SURGERIES UNDER GENERAL ANAESTHESIA

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Abstract

Background: Laparoscopic surgeries are associated with acute pain in the postoperative period, which maybe: somatic, visceral and referred thereby delaying postoperative recovery. Erector spinae plane block (ESPB) acts by blocking the dorsal and ventral rami of nerves supplying the anterior abdominal wall. Dexamethasone is an adjuvant that prolongs duration of action of local anesthetics (LA) by reducing inflammatory response. We studied the effect of dexamethasone used as an adjuvant to Bupivacaine on the duration of analgesia when used for USG guided ESPB during Laparoscopic surgeries.

Methods: After obtaining IEC clearance and CTRI registration, a prospective randomized double blinded study was conducted in 2 groups of 50 patients each, aged ≥ 18 years belonging to ASA 1 and 2 undergoing laparoscopic surgeries. Group B patients received USG guided B/L ESPB with Bupivacaine 0.25% 20 mL+ NS 1 mL each side. Group D patients received USG guided B/L ESPB with Bupivacaine 0.25% 20 mL+ Dexamethasone 1mL(4mg) each side. The duration of analgesia in the postoperative period was assessed using VAS score at 2nd hourly intervals up to 24 hours postoperatively. Complications if any were noted.

Results: The mean total duration of analgesia in Group B was 445±42.3 minutes and in Group D was 668±39.8 minutes. Mean difference in total duration of analgesia was 223± 55.13 min (95% CI 207, 239 Range 120, 360 min) ($p<0.001$) which is statistically significant. Median total dose of paracetamol (PCT) needed 24 hours in Group B 2[2, 2] and Group D was 1[1,1] with, ($p<0.001$) which is statistically significant. There were no complications in either group.
Conclusion: USG guided B/L ESPB with Dexamethasone as an adjuvant to Bupivacaine 0.25% 20 mL was found to significantly prolong the duration of analgesia with significant reduction in paracetamol (PCT) dose requirement postoperatively. There was minimal incidence of post operative nausea and vomiting (PONV).

Keywords: Erector spinae Plane Block, Dexamethasone, Laparoscopic surgeries, postoperative analgesia, Paracetamol, PONV, Bupivacaine

INTRODUCTION

Laparoscopic surgeries are commonly performed minimally invasive procedure.[1] Pain after laparoscopic surgeries arise from somatic pain by port site incision in the anterior abdominal wall. The visceral pain is caused by gallbladder resection, abdominal insufflation, including peritoneal distention and damage, which manifests as shoulder pain.[2,3]Anterior abdominal wall receives sensory supply from nerve fibers running between internal oblique and transverse abdominis muscle.[2]Regional analgesic techniques have been used to reduce opioid consumption for post operative analgesia.[4] Various analgesic techniques used for post operative pain relief include: Thoracic epidural analgesia, subcostal transverse abdominal plane block, paravertebral blocks and others.[4,5,6] These analgesic techniques are efficacious for somatic pain.

Erector spinae plane block (ESPB) is an analgesic technique first described for Thoracic Neuropathic pain in 2016[6]. Subsequently it has been used for acute pain control after surgeries.[7] It acts by blocking the ventral rami of spinal nerves including sympathetic nerve fibers.[8] Various adjuvants are used to prolong the duration of local anaesthetic action in regional anaesthetic techniques.[9] Dexamethasone is presumed to act by having anti-inflammatory action and inhibiting potassium channel mediated release of C fibers.[10]

However, studies comparing the effect of dexamethasone as an adjuvant to local anaesthetics in erector spinae plane block are minimal. Based on this information, a prospective double blinded randomized control trial was conducted to study the effect of dexamethasone as an adjuvant to bupivacaine in prolonging postoperative analgesia in patients undergoing laparoscopic surgeries.

The primary objective was to assess the duration of postoperative analgesia produced by pre-emptive USG guided B/L ESPB using bupivacaine alone compared with bupivacaine and dexamethasone in patients undergoing laparoscopic surgeries under general anaesthesia. The secondary objectives were to compare the total need of rescue analgesia in first 24 hours and incidence of postoperative nausea and vomiting. We hypothesized that addition of dexamethasone as an adjuvant to bupivacaine in erector spinae plane block for laparoscopic surgeries prolongs the duration of postoperative analgesia.

MATERIALS AND METHODS

After obtaining institutional ethics committee clearance (reference No. EC-325) and CTRI registration (CTRI/2023/06/053872), the study was conducted from June 2023 to September 2023 in Dr B. R. Ambedkar Medical College and Hospital. Informed written consent was taken from all the patients participating in the study.

As per a previous study [3], considering power at 80%, alpha error of 0.05, a sample size of 38 patients per group was obtained. In order to compensate for the possible dropouts and study errors a sample size of 50 patients in each group was deemed adequate. Patients posted for Laparoscopic Surgeries, aged ≥ 18 years belonging to American Society of Anaesthesiologists (ASA) class I and II were included in the study. Patients who are known case of diabetes mellitus, having infection at the site

of injection, alcoholics, drug abusers, having psychological or other emotional problems were excluded from the study. We included patients undergoing Laparoscopic Cholecystectomy(LC), Laparoscopic appendicectomy, Intraperitoneal Onlay Mesh repair, Totally extraperitoneal mesh repair, Total laparoscopic hysterectomy, transabdominal preperitoneal mesh repair, Laparoscopic myomectomy, Laparoscopic nephrectomy, Laparoscopic abscess drainage in our study.

All patients underwent pre-anaesthetic evaluation and optimization before surgery. They were explained about the study protocol, visual analogue scale (VAS, 0 = no pain to 10 = worst imaginable pain) for assessment of post operative pain. On the day before surgery, patients were premedicated with T. Alprazolam 0.25 mg.

Patients were randomized by computer generated random numbers and group assignment was done by sealed envelope technique. The envelopes were opened just before the procedure by the principal investigator and patients were divided into two groups: Group B- Bupivacaine group and Group D- Bupivacaine+ Dexamethasone group. The patient, the anaesthetist performing the block and the investigator assessing post operative VAS score were blinded to group allocation.

On the day of surgery after confirming the nil per oral status of the patient an 18 G intravenous cannula was secured after taking necessary aseptic precautions in the preoperative room. Baseline Heart rate (HR), Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP), Saturation (SPO2) were recorded in both the groups of patients.

After taking necessary aseptic precautions a high frequency linear array Sonosite 13-6 MHz transducer probe was positioned longitudinally at T7 vertebra level in parasagittal orientation. The tip of the transverse process of T7 vertebra along with underlying pleura was visualized. The tip of the needle was advanced using in-plane technique in craniocaudal direction to contact the transverse process. Confirmation of the plane was obtained by hydrodissection technique. In both the groups the test drug was injected deep to Erector spinae muscle bilaterally. Group B (BUPIVACAINE) patients received 20 mL of 0.25% Bupivacaine+ 1mL normal Saline on each side. In Group D(BUPIVACAINE+DEXAMETHASONE), patients received 20 mL of 0.25% Bupivacaine+ Dexamethasone 1mL(4mg) on either side. After the block, patients in both groups HR, SBP, DBP, MAP, SPO2 were monitored at 5 minutes interval for 30 minutes before shifting to the operation theatre.

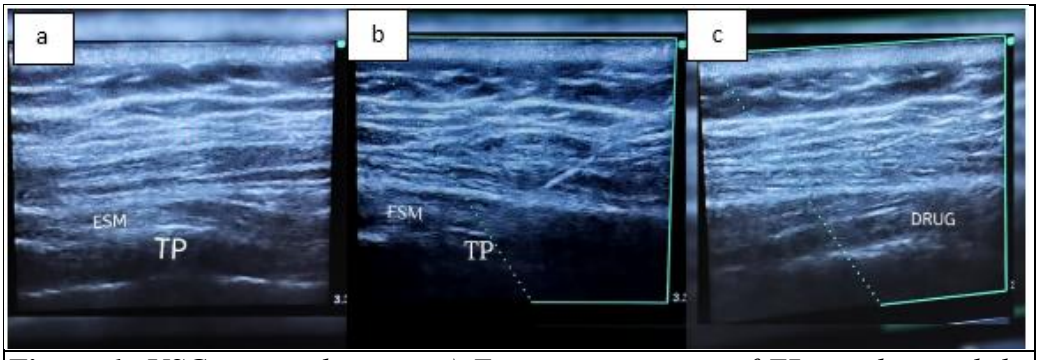

Figure 1: *USG image showing a.) Transverse process of T7 vertebra and the overlying Erector spinae muscle (ESM) b.) Needle at the transverse process of T7 vertebra c.) Spread of drug deep to ESM at T7 transverse process*

In the operation theatre after connecting the basic ASA monitors patients were preoxygenated with 100% O_2 for 3 minutes. Thereafter, anaesthesia was induced with Inj Propofol 2mg/kg, Inj. Fentanyl 2mcg/kg and Inj Succinyl Choline 1.5- 2.0 mg/ kg, Endotracheal intubation was done with appropriately sized ET tube and Inj Atracurium 0.5 mg/ kg was administered. Anaesthesia was maintained with air in O2, and isoflurane to maintain adequate depth of anaesthesia. Incremental doses of Inj Atracurium were administered as needed. The pneumoperitoneum pressures were maintained between 12-14 mm Hg in all patients. Parameters like HR, SBP, DBP, MAP, SPO2,

ETCO2 was recorded at 5 minutes interval till the end of surgery. Postoperative analgesic effect was assessed with the help was VAS score at 2nd hourly intervals up to 24 hours. If the VAS score at any point of time was ≥3, rescue analgesia was administered with Inj. Paracetamol 15 mg/kg and the patient was excluded from the study. The duration of analgesia (from the time of block to the time of receiving first rescue analgesic) was noted down. The total dose of Inj Paracetamol required in the first 24 hours was also noted down. The incidence of complications like postoperative nausea and vomiting if any were noted down and treated appropriately.

Statistical Analysis:

Data was entered in Microsoft Excel datasheet. Descriptive analysis was carried out by frequency and proportion for categorical variables. Continuous variables were presented as mean ± SD for normally distributed random variable and median (IQR) for non-normal variable. Independent t-test was used to compare mean ± SD of continuous variables between two groups and Mann-Whitney U test was used to compare Median (IQR) of non-normally distributed variable. The chi-square test was used to test the statistical significance of cross-tabulation between categorical variables. The line diagram was used to show the trend of parameters with respected two groups. Statistical analysis was done using R-Studio Desktop Version 4.3.0.(Reference: R-Studio Team (2023). R-Studio: Integrated Development for R. R-Studio, PBC, Boston, MA URL http://www.rstudio.com/.)

RESULTS

Totally 104 patients were assessed for eligibility and finally 100 patients were included in the current study (Fig 2). The demographic characteristics of both the groups were similar and details are listed in Table 1.

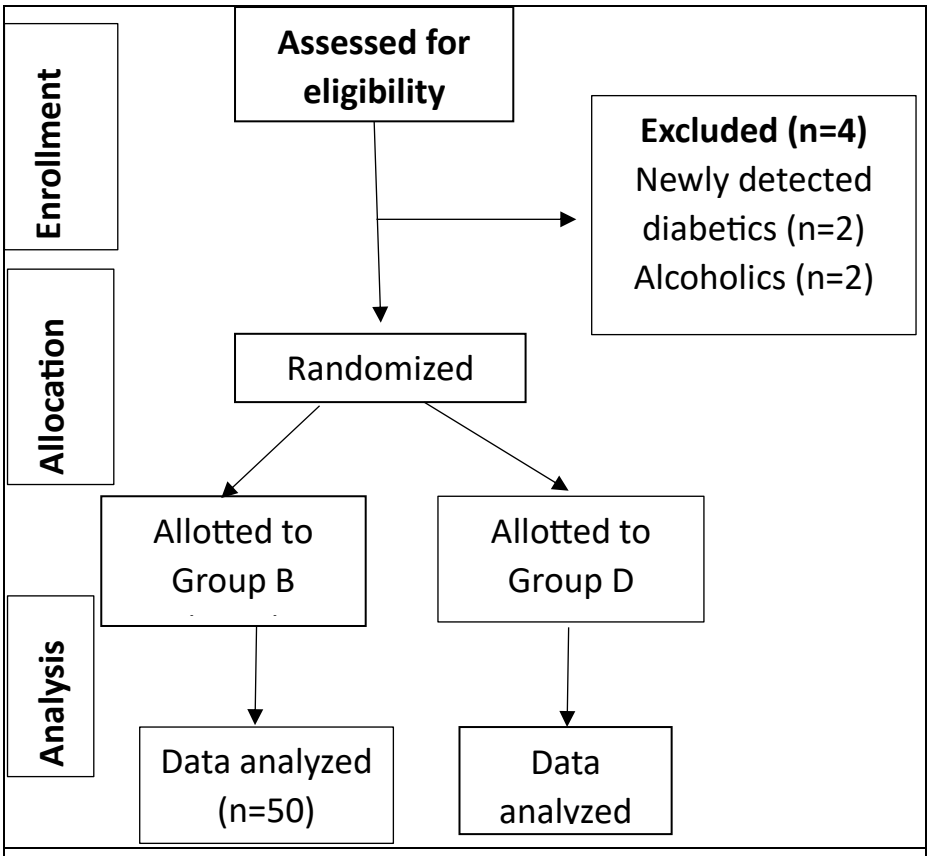

Figure 2: ***CONSORT flow diagram for enrolment, group allocation, follow-up and analysis***

Variables	**Group B (N=50)**	**Group D (N=50)**
Age, Median (IQR)	37[30.2, 47.8]	38.5[30, 49.5]
Gender		
Female	32	28
Male	18	22
ASA Class		
1	34	28
2	16	22
Smoking		
Yes	7	12
No	43	38
Table 1: ***Comparison of demographic characteristic between group (N=100)***		

There is no statistically significant difference in the mean duration of surgery and the mean pneumoperitoneum time among both the groups. In group B, the mean duration of surgery was 78±12.04 minutes and it was 76±13.09 minutes in Group D. The mean pneumoperitoneum time was 67.71±11.7 minutes in group B and 64.5±13.1 minutes in group D (Table 2)

Parameter	**Group**		**P value**
	Group B (N=50)	**Group D (N=50)**	
Pneumo time in minutes, Mean (SD)	67.71±11.7	64.5±13.1	0.126
Duration of Surgery Minutes, Mean (SD)	78±12.04	76±13.09	0.426
Table 2: Comparison of time parameters between groups			

The HR and MAP was comparable between both the groups during the period of pneumoperitoneum insufflation.

The mean total duration of analgesia in Group B was 445±42.3 minutes and in Group D was 668±39.8 minutes. Mean difference in total duration of analgesia was 223± 55.13 min (95% CI 207, 239 Range 120, 360 min) ($p<0.001$) which is statistically highly significant. (Table 3)

Total Duration of Analgesia in minutes	**Mean**	**SD**	**95% C I**		**Range Min**	**Range Max**
			Lower Bound	**Upper Bound**		
Group B	445	42.36	432.86	456.94	360	510
Group D	668.0	39.85	656.67	667.44	600	750
Table 3: Mean Total Duration of Analgesia Comparison between two groups						

The median Total Dose of PCT needed 24 hrs in Group B was 2[2, 2] and Group D was 1[1, 1] with, ($p<0.001$) which is statistically significant. (Table 4)

None of the patients had complications like postoperative nausea and vomiting in both the groups.

Duration of Analgesia in minutes	**Median**	**SD**	**Range Min**	**Range Max**
Group B	2.00	0.41	1	2
Group D	1.00	0.24	1	2
Table 4: Median Total dose of PCT required Comparison between two groups				

DISCUSSION

Pain management is an important aspect of perioperative anaesthetic and surgical care.[1] Postoperative pain delays post anaesthesia care unit and hospital stays, early ambulation, increased resource utilization and affects patient satisfaction negatively.[2] ESPB is a promising option for perioperative analgesia for abdominal surgeries when administered at the level of T7 transverse process,[1] since it blocks both supra and infraumbilical dermatomes with single level of injection.[11] Low concentration of local anaesthetic used in ESPB have positive effect than higher concentrations as they decrease the risk of systemic toxicity and systemic complications of local anaesthetic. [3]

A meta-analysis of patients undergoing LC concluded that ESPB decreased 24-hour opioid consumption and 12-hour pain scores significantly[1] and prolonged the time to first rescue analgesic and hence is an effective option in management of postoperative pain in LC. [7] A study on opioid free anasesthesia for laparoscopic surgeries concluded that integration of ESPB into postoperative analgesic regimen provides better postoperative pain relief with lower VAS scores, increased duration of analgesia and reduced opioid consumption compared to conventional opioid anaesthesia.[12] In adult undergoing heterogenous type of abdominal surgeries under GA, ESPB can be a novel and beneficial nerve block for postoperative analgesia since the time to first rescue analgesia is prolonged and the incidence of PONV are minimal.[13] Following laparoscopic cholecystectomy, providing the post operative analgesia with USG guided ESPB decreases consumption of analgesic in first 24 hours when compared with OSTAP block and port site infiltration of LA.[14,15]

Dexamethasone is a long-acting glucocorticoid with anti-inflammatory, analgesic with immunosuppressive and antiemetic properties. Use of dexamethasone as an adjuvant to local anaesthetic is known to prolong duration of nerve block,[16,17] decrease the incidence of post operative nausea and vomiting, which can have greater impact on patient comforts [9]. The peripheral nerve blocks used for abdominal and orthopedic surgeries with dexamethasone as an adjuvant prolonged the duration of analgesia.[18] Dexamethasone used as adjuvant to LA during supraclavicular block prolonged the duration of analgesia with minimal volume of local anaesthetic being used[17] and 8mg dexamethasone was found to significantly prolong duration of post operative analgesia compared to 4mg.[19]While comparing perineural with systemic dexamethasone to prolong analgesia after peripheral nerve block for orthopedic surgeries the meta-analysis concluded that perineural dexamethasone prolongs duration of postoperative analgesia compared to systemic dexamethasone.[20] Following lumbar spine surgeries ESPB with local anaesthetic and dexamethasone offered prolonged duration of postoperative analgesia and reduced opioid consumption.[21]

In pediatric patients undergoing open splenectomy USG guided ESPB reduced the intraoperative fentanyl and postoperative paracetamol consumptions.[22] Following percutaneous nephrolithotomy, ESPB decreases the postoperative VAS scores, prolongs the time to rescue analgesia and reduces paracetamol and tramadol use without any side effects compared to general anesthesia with conventional analgesia and incision site LA infiltration.[23,24]

Post operative nausea and vomiting is one of the most common and distressing complications after anaesthesia and surgery.[1] The main risk factors for PONV are history of PONV, motion sickness, postoperative opioids, female sex and non-smoking status. The use of regional anaesthesia reduces need for systemic medications[3] and ESPB significantly lowers the incidence of PONV.[8]

With our study we conclude that in patients undergoing laparoscopic surgeries under GA the routine use of ESPB with 4mg Dexamethasone as an adjuvant to Inj. Bupivacaine 0.25% 20 mL on either side as a method of acute postoperative analgesia prolongs the duration of analgesia as well as reduces the dose of rescue analgesic requirement with minimal incidence of PONV.

The limitation of our study is that we had included only non-diabetic patients in our study and the effect of Dexamethasone on the blood glucose level were not studied.

CONCLUSION

USG guided ESPB using Dexamethasone 4mg as adjuvant to Bupivacaine 0.25% 20 mL on either side, was found to significantly prolong duration of post operative analgesia in Laparoscopic surgeries under GA. The total consumption of PCT was reduced during study period. No side effects like nausea & vomiting were observed.

Conflicts of interest: Nil

Financial support: Nil

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