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Ultrasound Guided Erector Spinae Plane Block For Post Operative Analgesia In Abdominal Surgeries

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Abstract
Introduction: *The analgesic regime for postoperative pain usually includes paracetamol, NSAIDs and opioids. The opioid epidemic as well as the opioid side effects like sedation, respiratory depression, constipation, delayed patient mobilization has led Anesthetist to find a way of decreasing the use of opioids.*
Materials and Methods: *The study was conducted in the Anaesthesiology And General Surgery Departments of Government Vellore medical college and hospital after obtaining Institutional Ethics Committee approval. Written and informed consent was obtained from each patient in the prescribed format prior to performance of any study related procedures, before physical examination, laboratory screening or any other investigational procedure and before administration of any study related medication. The patients and patients relatives were explained in detail about the nature, procedure and importance of the study. Result values were recorded using a proforma sheet for all cases.*
Results: *Group 1- patient received GA only, Group 2- patient received GA and Erector spine plane block. The number of patients needed rescue analgesia and total tramadol consumption during the first 24 h after surgery was recorded. Intravenous metoclopramide 10 mg was given for severe nausea or vomiting. Patients satisfaction with the technique was assessed at 24 h after operation on an 10-point satisfaction score (0 = unsatisfied, 10 = most satisfied.*
Conclusion: *We concluded that combined erector spine plane block with general anaesthesia provided good postoperative analgesia and It decreases postoperative analgesia requirement than general anaesthesia alone.*
Key Words: *opioids, GA, metoclopramide, erector spine plane block*

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I. Introduction

Combined use of an epidural catheter and general anaesthesia is a technique commonly used for surgical procedures associated with severe post-operative pain. Procedures in general surgery may cause significant postoperative pain and discomfort to the patient.

The analgesic regime for postoperative pain usually includes paracetamol, NSAIDs and opioids. The opioid epidemic as well as the opioid side effects like sedation, respiratory depression, constipation, delayed patient mobilization has led Anesthetist to find a way of decreasing the use of opioids.

The Erector spinae plane (ESP) block is a relatively new technique used for analgesia. The technique was originally described by Forero et al in 2016[1], when it was used to treat thoracic neuropathic pain. The technique is considered a quality standard because the block provides good control of the pain.

A great advantage of the ESP block appears to be the provision of both somatic and visceral analgesia.ESP block leads to efective postoperative analgesia when performed at T 4-5 level for breast and thoracic surgery, and T 7 level for abdominal surgeries[28].

The other concern relates to the volume of the local anaesthetic drugs and its impact on the muscles. It is well-known that moving away from the central nerves requires an increase in the volume of the anaesthetic drug for optimal anaesthesia and analgesia.

This is primarily related to variable amount of connective tissue that needs to be penetrated by the local anaesthetic for its effect. It is known that spinal cord roots have less connective tissue but the amount of connective tissue increases as we move towards the peripheral nerves.

This connective tissue barrier mandates the use of high volumes of drug for optimal analgesia. The use of ultrasound has brought down the drug volume as the exact location of drug delivery can be confirmed and the drug spread could also be visualised in real time.

However, in fascial plane blocks, the drug needs to be deposited in a plane and thus mandates appropriate volume. Although ultrasound guides the appropriate spread of the drug in a particular plane[25], the most optimal volume of drug is yet to be defined for individual fascial plane blocks.

II. Materials And Methods

The study was conducted in the ANAESTHESIOLOGY and GENERAL SURGERY Departments of Government Vellore medical college and hospital after obtaining Institutional Ethics Committee approval.

STUDY PERIOD: May 2018 to July 2019

SOURCE OF DATA: All patients undergoing elective abdominal Surgery at Government Vellore Medical College Hospital, Vellore.

SAMPLE SIZE: 50 Patients, 25 in each group

STUDY DESIGN: Prospective randomized single blinded comparative study.

STUDY POPULATION: All patients undergoing elective Abdominal Surgery and who fulfilled the criteria were selected for the study. The procedure was explained to them in detail and written consent was obtained from them.

ETHICAL REQUIREMENT: Ethical approval of the study protocol was obtained from the Ethical Committee at the institution before the study was undertaken.

INFORMED CONSENT: Written and informed consent was obtained from each patient in the prescribed format prior to performance of any study related procedures, before physical examination, laboratory screening or any other investigational procedure and before administration of any study related medication. The patients and patients relatives were explained in detail about the nature, procedure and importance of the study. Result values were recorded using a proforma sheet for all cases.

The aim and objective of the study is to evaluate the efficacy of ULTRASOUND GUIDED ERECTOR SPINAE PLANE BLOCK FOR POSTOPERATIVE ANALGESIA IN ABDOMINAL SURGERIES taking into account the following:

- Haemodynamic parameters - Systolic Blood Pressure (SBP), Diastolic Blood Pressure (DBP), Mean Arterial Pressure (MAP),
- Pulse Rate, Oxygen saturation (SPO2) – intraoperatively & post operatively
- Duration of surgery
- The interval between the discontinuation of anaesthetic agents to response of eye opening to verbal command and time to extubation.
- Time to attain Modified Aldrete post-anesthesia recovery score 9.
- Verbal Numerical Rating Scale (NRS), nausea & vomiting postoperatively.
- Time to first analgesic request.
- Total inj. Tramadol consumption.
- Any complications.

Study Design- A prospective, Randomized, Single-Blinded Controlled study.

The study was conducted after receiving Institutional Ethics Committee approval and written informed consent from all the patients.

Randomization

Simple randomized sampling was done by computer generated random numbers.

Sample Size

Fifty patients were studied, randomized into two groups of 25 each.

Group allocation

Patients were allocated into two groups:

Group 1 (n= 25): Patients receiving GA

Group 2 (n= 25): Patients receiving GA with erector spine plane block.

Inclusion Criteria

1. Age 18 - 60 yrs
2. ASA I & II patients
3. Posted for elective intra abdominal surgery.

Exclusion Criteria

1. Patient refusal
2. ASA grade III and IV
3. Known allergy to study drug
4. Pregnant patients

5. Systemic hypertension
6. Diabetes mellitus
7. Patients with coagulopathies or receiving drugs influencing blood coagulation
8. Coronary Artery Disease
9. Renal, Hepatic or Cerebral insufficiency
10. Any type of A-V block on electrocardiogram (ECG), heart failure, severe bradycardia.
11. Current psychiatric disorder or any respiratory disorders.
12. Impaired ability to communicate (e.g., confusion, poor hearing or language barrier).

Materials

1. Boyles apparatus/ Work station
2. Laryngoscope with different blade sizes
3. Monitors- ECG, NIBP, Pulse Oximeter,Etco2
4. Airway gadgets used in case of difficult intubation
5. Endotracheal tubes
6. Drugs for administering general anaesthesia
7. bupivacaine for giving peripheral nerve block
8. tramadol for postoperative analgesia
9. Equipment & drugs for resuscitation Working suction apparatus
10. Ultrasound machine

PRE-OPERATIVE PREPARATION

The patients were assessed preoperatively and they were explained about the purpose , procedure of the study and about the possible adverse events that can occur due to the study drug and written informed consent was obtained from those patients who were willing to take part in the study.

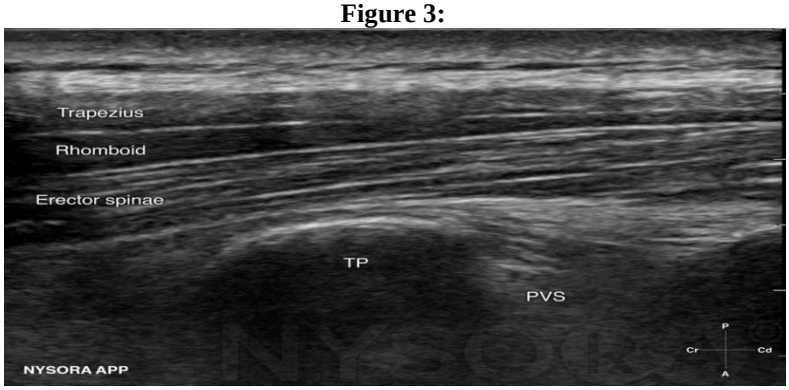
The patients were premedicated with oral diazepam 0.1 mg kg-1 at night and 2h before surgery. Patients were randomly allocated into groups by using computer generated table. Randomization was done by statistician .Group of the patient was revealed only when the patient was shifted to preanaesthetic room.

Patients belonging to group 1 and group 2 were straightaway shifted to operating room. On arrival of the patient in the operating room, monitors were connected (Pulse oximeter, Non-Invasive Blood Pressure (NIBP), capnography (ETco2) and ECG were connected and baseline values were recorded. One 18G intravenous cannula were inserted, for administration of fluids and other anaesthetic drugs. All patients were pre-medicated with IV Glycopyrrolate 5µg/kg, IV Midazolam 0.05 mg/kg, IV Fentanyl 2µg/kg.

Group 2 (GA+ESP BLOCK) patients were placed in sitting position. Under aseptic precaution ultrasound high frequency linear probe was placed 3 cm lateral to the T 7 spinous process.

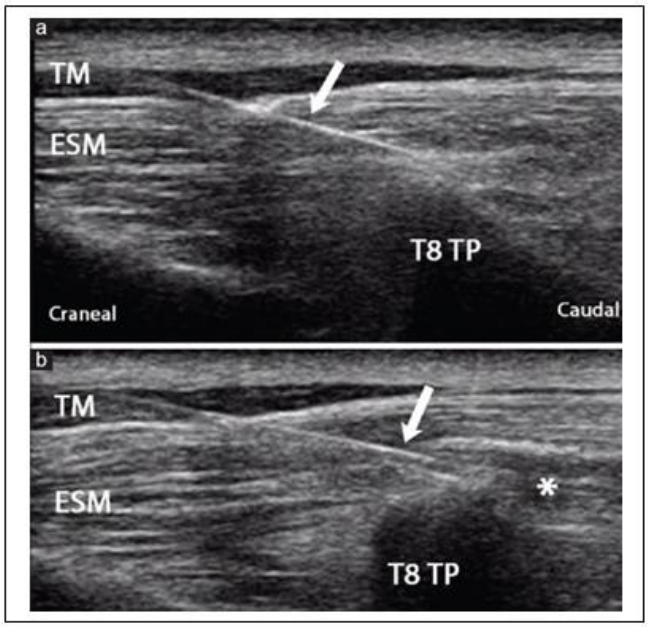
The three muscles from outward were recognised trapezius, rhomboidus major, and erector spinae muscle. A 18-gauge spine needle was inserted in-plane superior to inferior approach to place the tip into fascial plane on the deep (anterior) aspect of erector spinae muscle

Figure 3:



The location of the needle tip was confirmed by visible fluid spread (hydro dissection) below erector spinae muscle off the bony shadow of the transverse process. Total 40 ml of 0.25% bupivacaine was injected through the needle bilaterally. The patients were observed for 30 min after performing the block. The sensory level of block was assessed by a blinded observer with pin-prick sensation every 5 min in each dermatomal distribution from T4 to T12.

Figure 4:



The total number of dermatomes that had less pain to pin prick compared with opposite side was noted. If the pin-prick sensation did not decrease in any segment up to 30 min, it was considered as a block failure.

The patients ECG and SpO2 were monitored continuously, and heart rate (HR) and NIBP were recorded at baseline, after performing the block, and every 5 min for 30 min. Any block-related complications, such as hypotension or vascular puncture, were recorded.

Patient belonging to both group, were induced with Thiopentone 5mg kg−1 in both the groups. Tracheal intubation was facilitated by Suxamethonium 1.5mg kg−1. Anaesthesia was maintained by sevoflurane (2%) and 66% nitrous oxide in oxygen. Ing.atracuriun was used for muscle relaxation.

The following parameters were monitored and recorded intraoperatively:

Hemodynamic parameters such as Pulse Rate, Non-invasive blood pressure (Systolic Blood Pressure, Diastolic Blood Pressure and Mean Arterial Pressure), and SPO2 were recorded every 5 minutes during the 1st 15 minutes and every 15 minutes thereafter, until the end of surgery. Intraoperative monitoring included electrocardiogram (lead II and V5), end-tidal carbon dioxide, and skin temperature.

At end of the surgical procedure Residual neuromuscular blockade was reversed with Inj.Neostigmine (0.05 mg/kg) and Inj. Glycopyrrolate (0.01 mg/kg) . Emergence time, defined as the time interval between discontinuation of anaesthetics and eye opening in response to verbal command, is noted.

Figure 5: MODIFIED ALDRETE RECOVERY SCORE

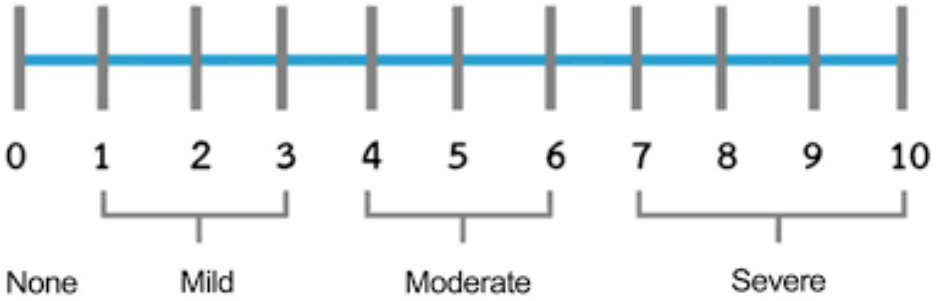
Criteria	Point value
Oxygenation	
SpO2 > 92% on room air	2
SpO2 > 90% on oxygen	1
SpO2 < 90% on oxygen	0
Respiration	
Breathes deeply and coughs freely	2
Dyspnoeic, shallow or limited breathing	1
Apnoea	0
Circulation	
Blood pressure ±20 mmHg of normal	2
Blood pressure ±20 – 50 mmHg of normal	1
Blood pressure more than ±50 mmHg of normal	0
Consciousness	
Fully awake	2
Aousable on calling	1
Not responsive	0
Activity	
Moves all extremities	2
Moves two extremities	1
No movement	0

Once the Modified Aldrete Score was attained to 9, patients we're shifted to post-operative ward. The secondary outcomes included severity of postoperative nausea and vomiting, and patient satisfaction score.

The patients were observed after surgery in the post anaesthesia care unit for 24 hours by an anaesthesiologist who was not present in operating room complex and he was blinded about the patient group. The pain score was evaluated by numerical rating scale (NRS; 0, no pain; 10, the worst pain) at the time of arrival in PACU and then after 2, 4, 6, 8,12, and 24 h after surgery .

Intensity of post-operative pain can be measured by Numeric Rating Scale. When NRS > 4, patients were treated with Inj. Tramadol 100mg IM.

Figure 6: NUMARICAL RATING SCALE



Patients were monitored in the postoperative ward for any complications including nausea, vomiting, bradycardia or tachycardia, hypotension or hypertension, etc. during the first 24 hours following surgery and were managed accordingly.

The number of patients needed rescue analgesia and total tramadol consumption during the first 24 h after surgery was recorded. Intravenous metoclopramide 10 mg was given for severe nausea or vomiting.

Patients satisfaction with the technique was assessed at 24 h after operation on an 10-point satisfaction score (0 = unsatisfied, 10 = most satisfied.

III. Results

Group 1- patient received GA only
Group 2- patient received GA and Erector spine plane block

Table 1: Patients characteristics

Patients characteristics				
	Group 1 patient received GA only(no=25)		Group2 Patient received GA and erector spine plane block (no=25)	
Sex	Male	Female	Male	Female
	12	13	11	14
Age	37.83+/-9.91	41.07+/-9.97	38.35+/-9.05	41.48+/-9.24

Figure 7: Sex Distribution

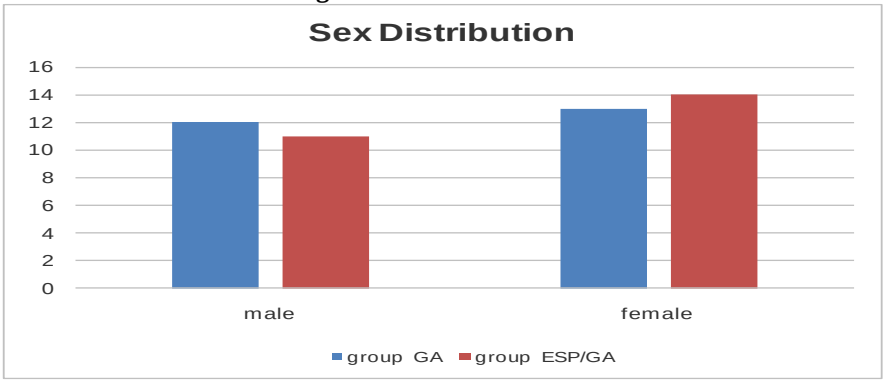
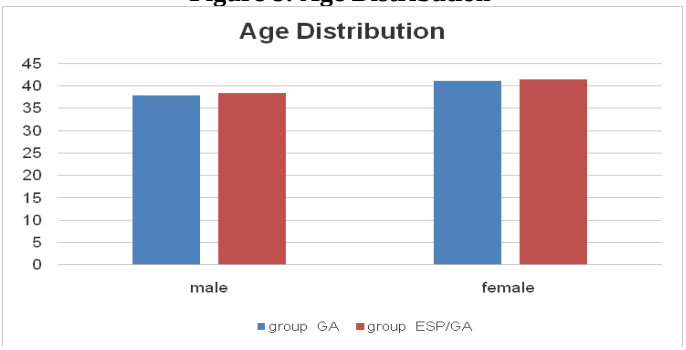


Figure 8: Age Distribution

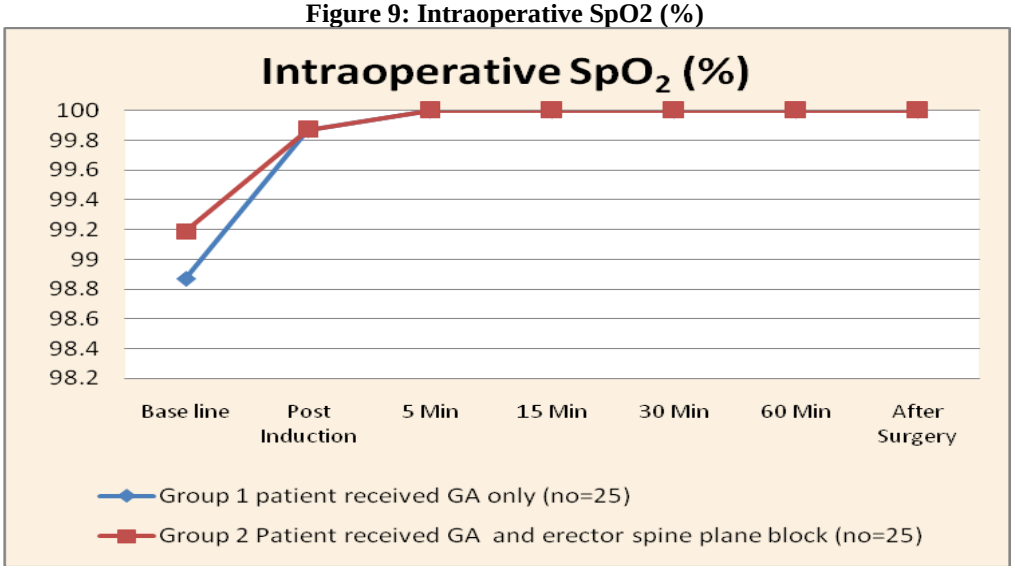


There was no statistical difference in age and sex distribution among both groups

Table 2: Intraoperative SpO_2 (%)

Interval	Group 1 patient received GA only(no=25)	Group2 Patient received GA and erector spine plane block (no=25)	T test	P value
Base line	98.87 ± 0.02	99.19 ± 0.17	-1.246	0.218
Post Induction	99.87 ± 0.06	99.87 + 0.06	0.000	1.000
5 Min	100 ± 0	100 ± 0		
15 Min	100 ± 0	100 ± 0		
30 Min	100 ± 0	100 ± 0		
60 Min	100 ± 0	100 ± 0		
After Surgery	100 ± 0	100 ± 0		

Figure 9: Intraoperative SpO2 (%)

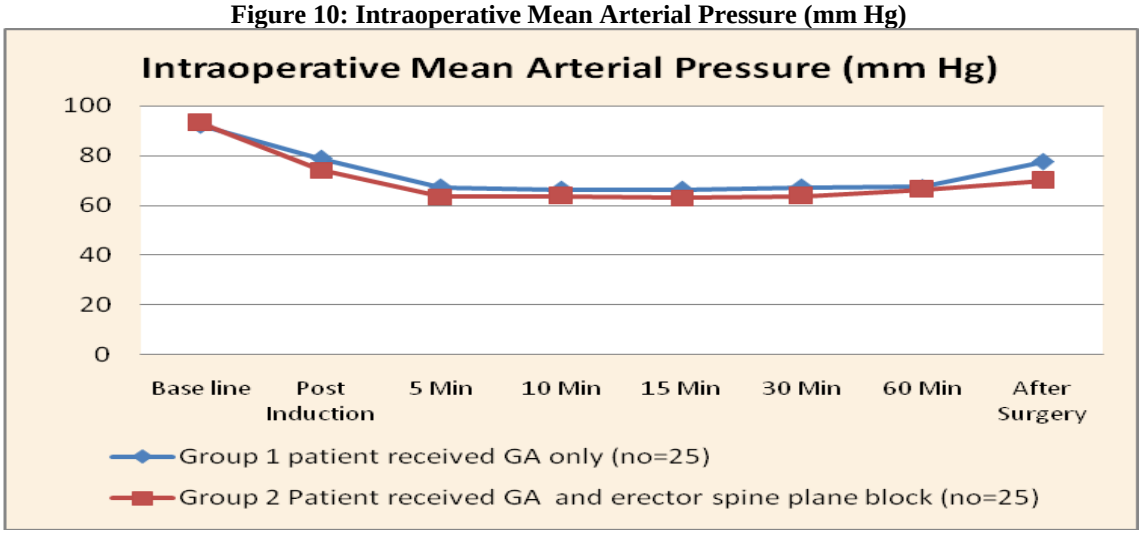


There was no statistical difference in spo2 among two groups

Table 6: Intraoperative Mean Arterial Pressure (mm Hg)

Intra Operative Mean Arterial Pressure	Group 1 patient received GA only(no=25)	Group2 Patient received GA and erector spine plane block (no=25)	T test	P value
Base line	92.10 ± 1.71	92.97 ±1.40	+0.395	0.695
Post Induction	78.90 ± 1.17	74.10± 1.05	+3.061	0.003
5 Min	67.23 ± 0.56	63.48± 0.58	+4.654	0.0001
10 Min	66.29 ± 0.57	63.61 ± 0.49	+3.554	0.001
15 Min	66.45 ± 0.59	63.03 ±0.48	+4.510	0.0001
30 Min	67.19 ± 0.38	63.74 ± 0.50	+4.421	0.0001
60 Min	67.45 ± 0.38	66.42 ± 0.53	+1.587	0.118
After Surgery	77.52 ± 0.77	69.84 ± 0.62	+7.779	0.0001

Figure 10: Intraoperative Mean Arterial Pressure (mm Hg)

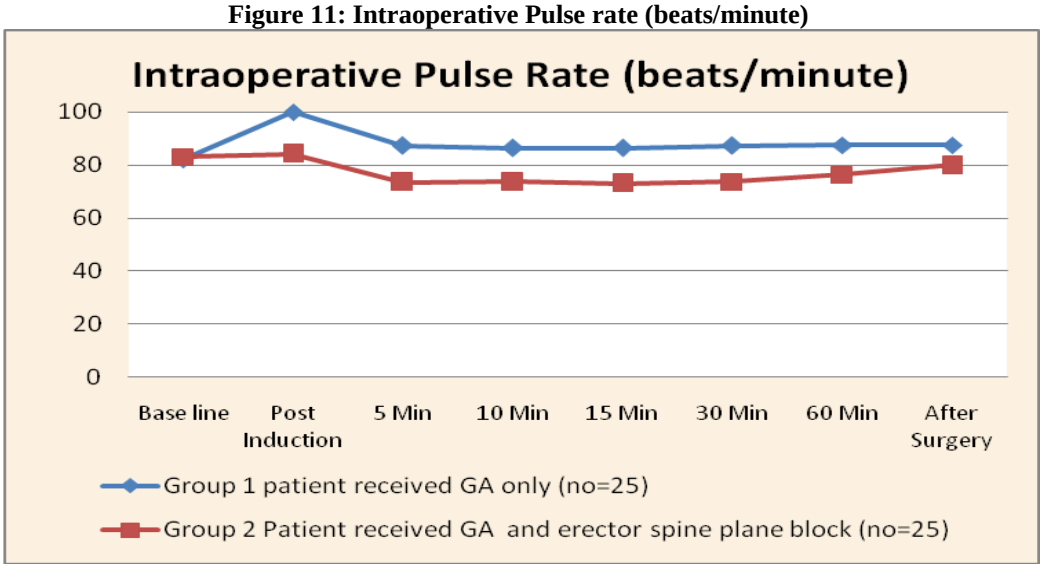


Intraoperative mean arterial pressure was lower in group 2 (patients received GA and Erector spine plane block) than in group 1(patient received GA only)

Table 7: Intraoperative Pulse Rate (beats/minute)

Intra Operative Mean Arterial Pressure	Group 1 Patient received GA only (no=25)	Group2 Patient received GA and erector spine plane block (no=25)	T test	P value
Base line	82.10 ± 1.71	82.97 ±1.40	+0.395	0.695
Post Induction	99.90 ± 1.17	84.10 ± 1.05	+15.061	0.001
5 Min	87.23 ± 0.56	73.48± 0.58	+14.654	0.0001
10 Min	86.29 ± 0.57	73.61 ± 0.49	+13.554	0.001
15 Min	86.45 ± 0.59	73.03 ±0.48	+13.510	0.0001
30 Min	87.19 ± 0.38	73.74 ± 0.50	+14.421	0.0001
60 Min	87.45 ± 0.38	76.42 ± 0.53	+11.587	0.118
After Surgery	87.52 ± 0.77	79.84 ± 0.62	+8.779	0.0001

Figure 11: Intraoperative Pulse rate (beats/minute)

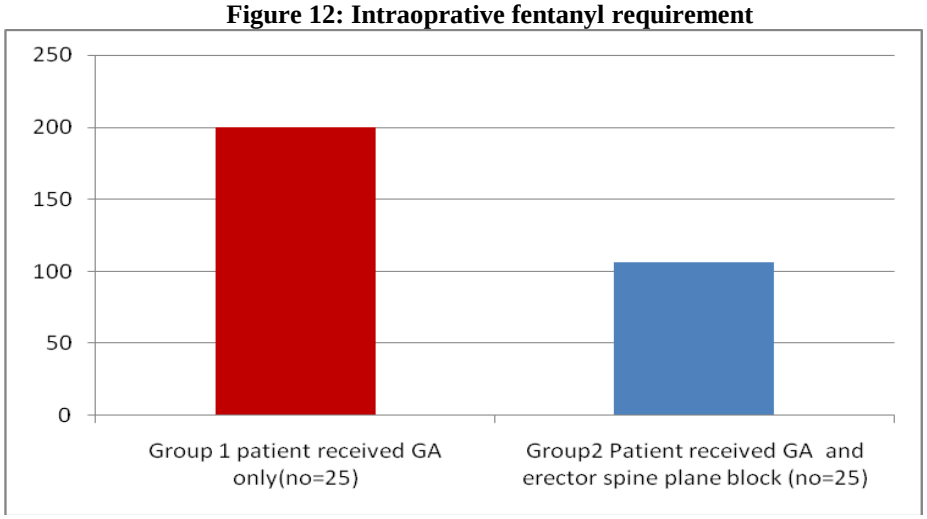


Intraoperative Pulse rate was lower in group 2(patients received GA and Erector spine plane block) than in group 1 (patient received GA only)

Table: 8 Intraaoprative fentanyl requirements (micrograms)

Group	Fentanyl requirement Intraoperatively	P value
Group 1 patient received GA only(no=25)	200+/-0	
Group2 Patient received GA and erector spine plane block (no=25)	106+/-16.58	<0.001

Figure 12: Intraoprative fentanyl requirement

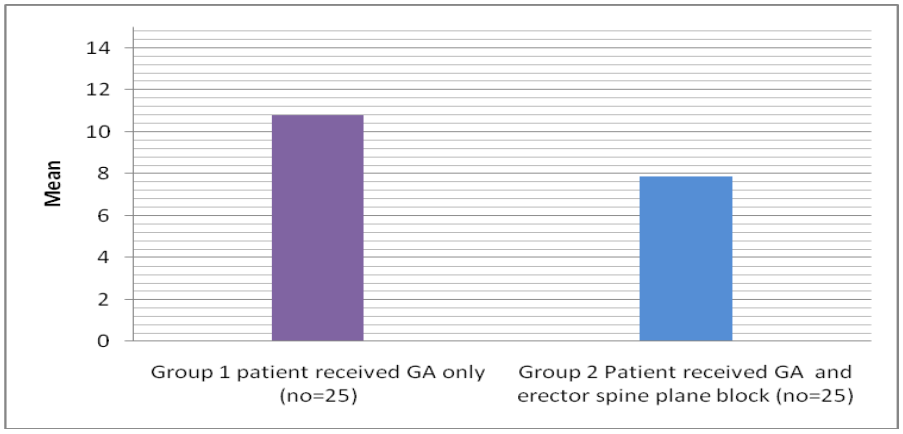


Intraoprative fentanyl requirement was less in Group 2 Patients who received GA and erector spine plane block (no=25)

Table: 9 TIME TO ATTAIN MODIFIED ALDRETE SCORE ≥ 9

Group	Time to attain Modified Aldrete Score(min)	P Value
	Mean	
Group 1 patient received GA only(no=25)	10.76± 1.64	<0.001
Group2 Patient received GA and erector spine plane block (no=25)	7.88 ± 1.48	

Figure: 13 TIME TO ATTAIN MODIFIED ALDRETE SCORE ≥ 9



There was statistically significant reduction (p value <0.001)in time to attain modified Aldrete recovery score >9 in Group 2.

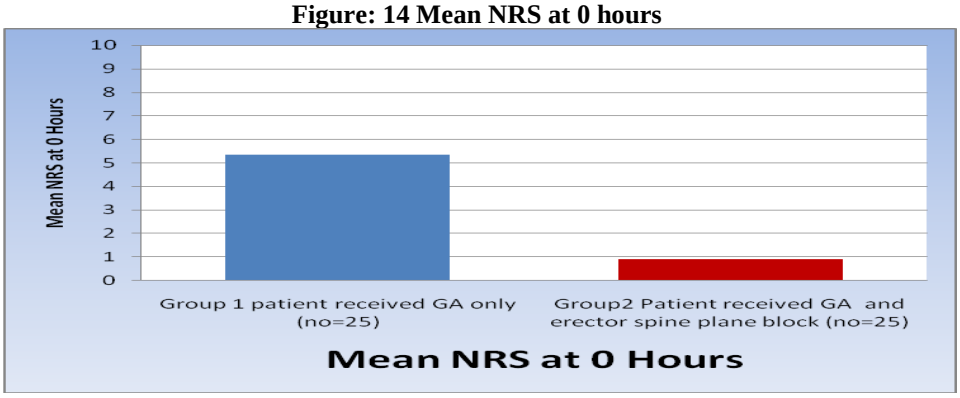
Table: 10 Numerical rating scale

Time (hours after surgery)	Numerical rating scale		P value
	Group 1 patient received GA only(no=25)	Group2 Patient received GA and erector spine plane block (no=25)	
0	5.36 ± 0.75	0.92 ± 0.99	P<0.01
2	2.8± 1.29	1.8 ± 0.64	P<0.01
4	2.48 ± 0.51	2.24 ± 0.72	P>0.05
6	3.04 ± 0.79	2.32 ± 0.85	P<0.01
8	5.24 ± 1.01	1.56 ± 1.00	P<0.01
12	3.16 ± 1.34	1.82 ± 0.94	P<0.01
24	1.6 ± 0.54	1.92 ± 0.95	P>0.05

Table: 11 Numerical rating scale after 0 hours after surgery

Time (hours after surgery	Numerical rating scale		P value
	Group 1 patient received GA only(no=25)	Group2 Patient received GA and erector spine plane block(n=25)	
0	5.36 ± 0.75	0.92 ± 0.99	P<0.01

Figure: 14 Mean NRS at 0 hours

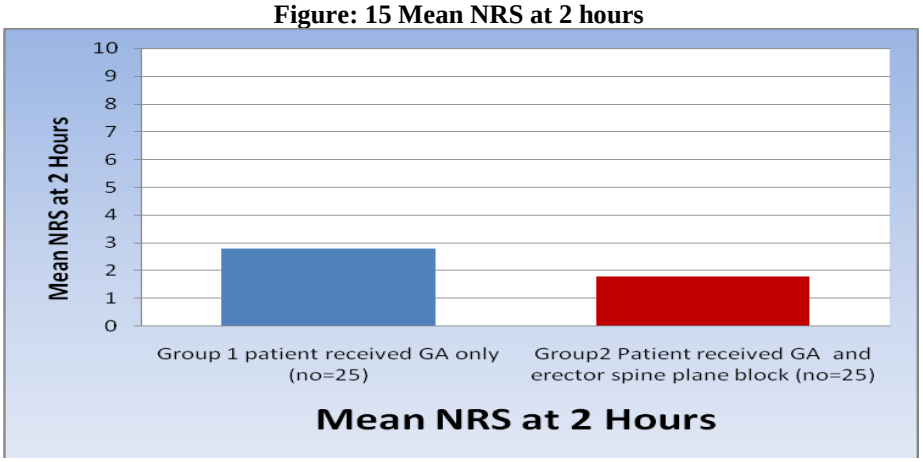


Numerical rating Score was less in Group 2 patient received GA and ESP block than Group 1 patient received GA only

Table: 12 Numerical rating scale after 2 hours of surgery

Time (hours after surgery	Numerical rating scale		P value
	Group 1 patient received GA only(no=25)	Group2 Patient received GA and erector spine plane block(n=25)	
2	2.8± 1.29	1.8 ± 0.64	P<0.01

Figure: 15 Mean NRS at 2 hours

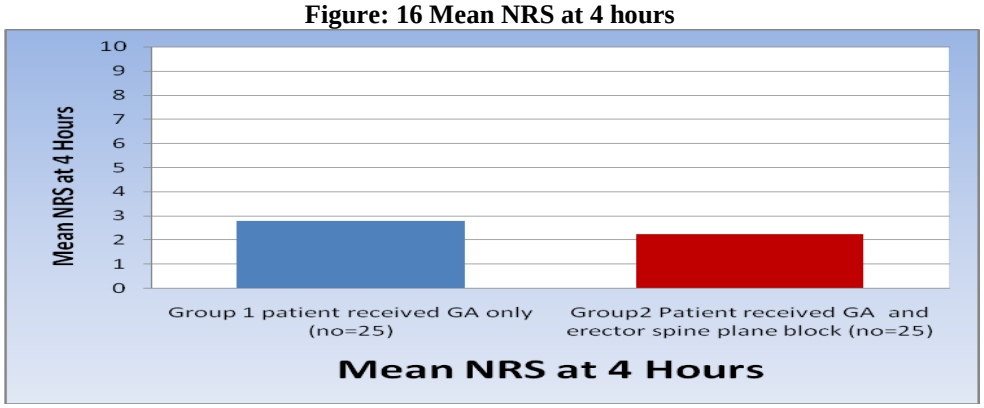


Numerical rating Score was less in Group 2 patient received GA and ESP block than Group 1 patient received GA only.

Table: 13 Numerical rating scale after 4 hours after surgery

Time (hours after surgery	Numerical rating scale		P value
	Group 1 patient received GA only(no=25)	Group2 Patient received GA and erector spine plane block(n=25)	
4	2.48 ± 0.51	2.24 ± 0.72	P>0.05

Figure: 16 Mean NRS at 4 hours

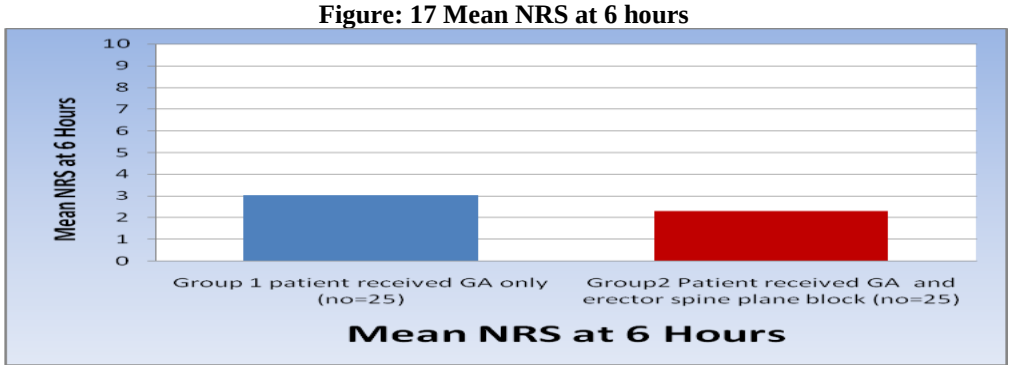


There was no statistical difference in Numerical rating scale among two groups

Table: 14 Numerical rating scale after 6 hours after surgery

Time (hours after surgery	Numerical rating scale		P value
	Group 1 patient received GA only(no=25)	Group2 Patient received GA and erector spine plane block(n=25)	
6	3.04 ± 0.79	2.32 ± 0.85	P<0.01

Figure: 17 Mean NRS at 6 hours

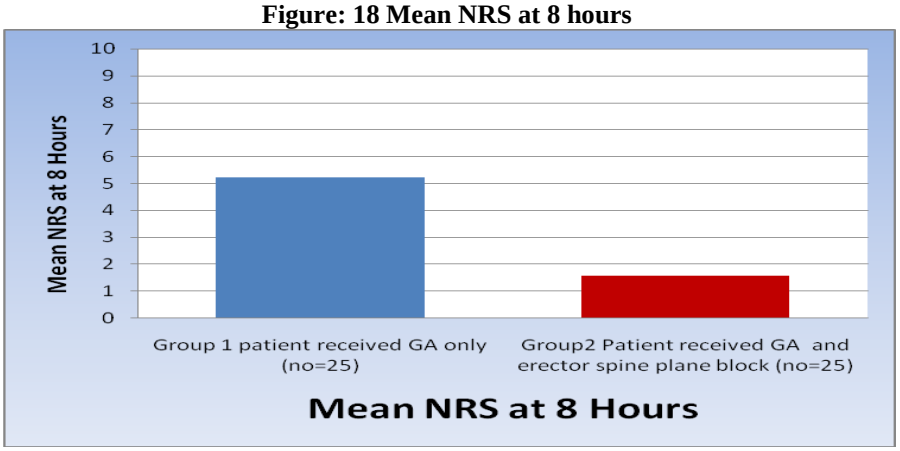


Numerical rating Scale Score was less in Group 2 patient received GA and ESP block than Group 1 patient received GA only.

Table: 15 Numerical rating scale 8 hours after surgery

Time (hours after surgery	Numerical rating scale		P value
	Group 1 patient received GA only(no=25)	Group2 Patient received GA and erector spine plane block(n=25)	
8	5.24 ± 1.01	1.56 ± 1.00	P<0.01

Figure: 18 Mean NRS at 8 hours

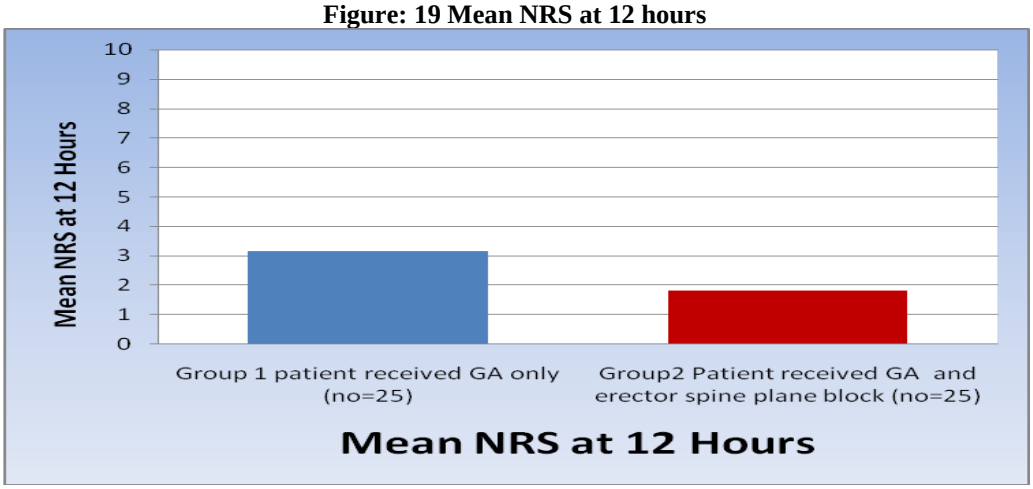


Numerical rating Scale Score was less in Group 2 patient received GA and ESP block than Group 1 patient received GA

Table: 16 Numerical rating scale after 12 hours surgery

Time (hours after surgery	Numerical rating scale		P value
	Group 1 patient received GA only(no=25)	Group2 Patient received GA and erector spine plane block(n=25)	
12	3.16 ± 1.34	1.82 ± 0.94	P<0.01

Figure: 19 Mean NRS at 12 hours

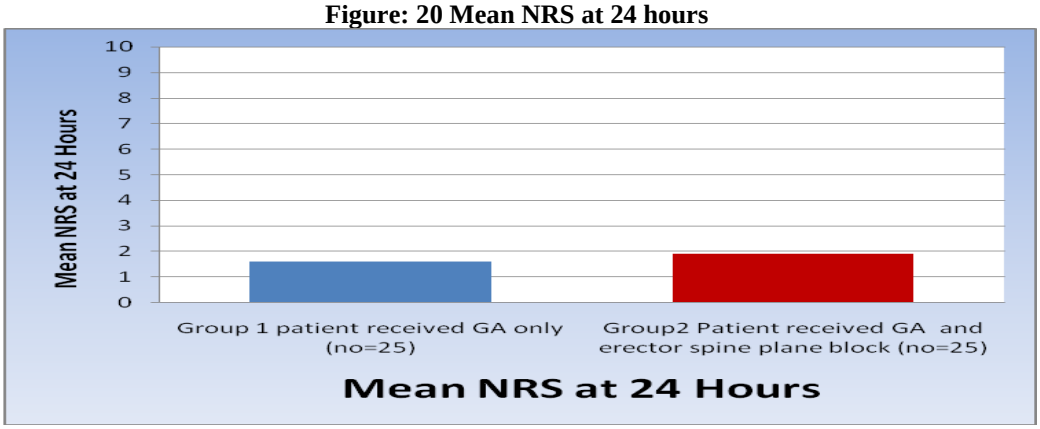


NRS Score was less in Group 2 patient received GA and ESP block than Group 1 patient received GA only

Table: 17 Numerical rating scale 24 hours after surgery

Time (hours after surgery	Numerical rating scale		
	Group 1 patient received GA only(no=25)	Group2 Patient received GA and erector spine plane block(n=25)	P value
24	1.6 ± 0.54	1.92 ± 0.95	P>0.05

Figure: 20 Mean NRS at 24 hours

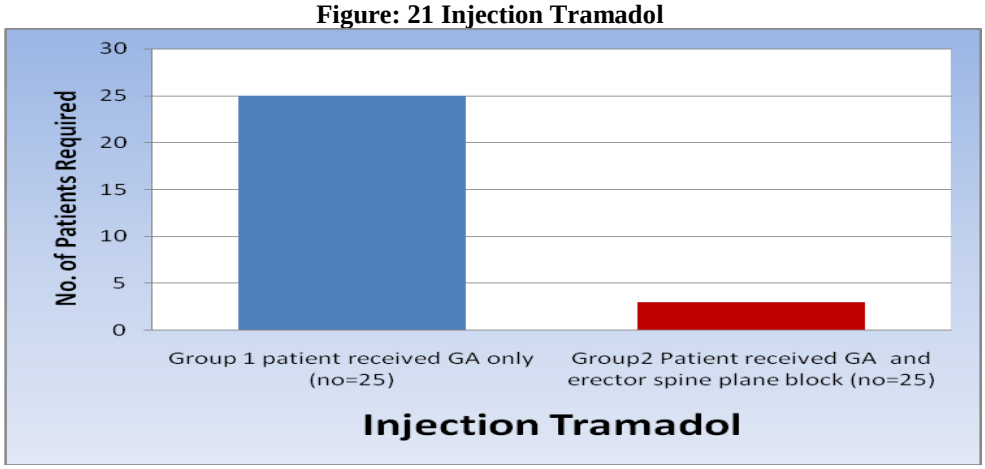


There was no statistical difference in Numerical rating scale among two groups

Table: 18 No of Patients Required Inject. Tramadol

	Group 1 patient received GA only (no=25)	Group2 Patient received GA and erector spine plane block (no=25)	P value
No of patients required inject. Tramadol	25	3	P<0.01

Figure: 21 Injection Tramadol

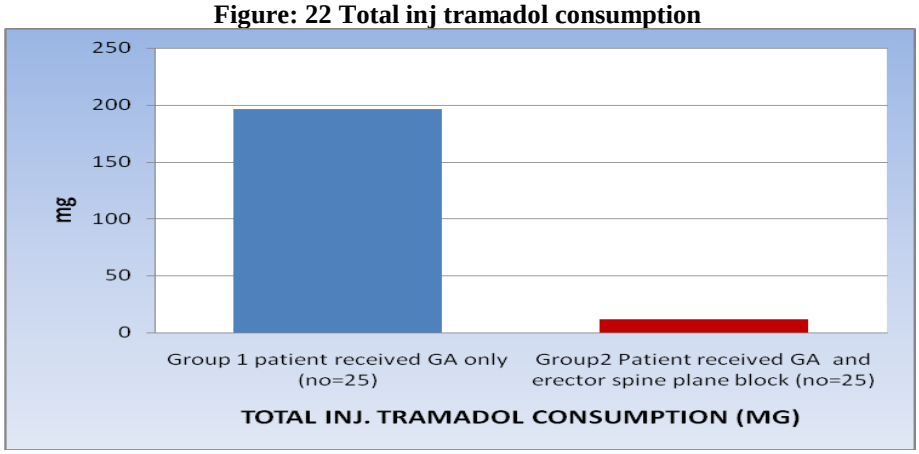


Almost all patients belonging to group 1 were required inj.tramadol postoperatively, but only 3 patient were needed inj.tramadol.

Table: 19 Total Inj.Tramadol Consumption (MG)

	Group 1 patient received GA only (no=25)	Group2 Patient received GA and erector spine plane block (no=25)	P value
Total inj. Tramadol consumption (mg)	196	12	P<0.01

Figure: 22 Total inj tramadol consumption

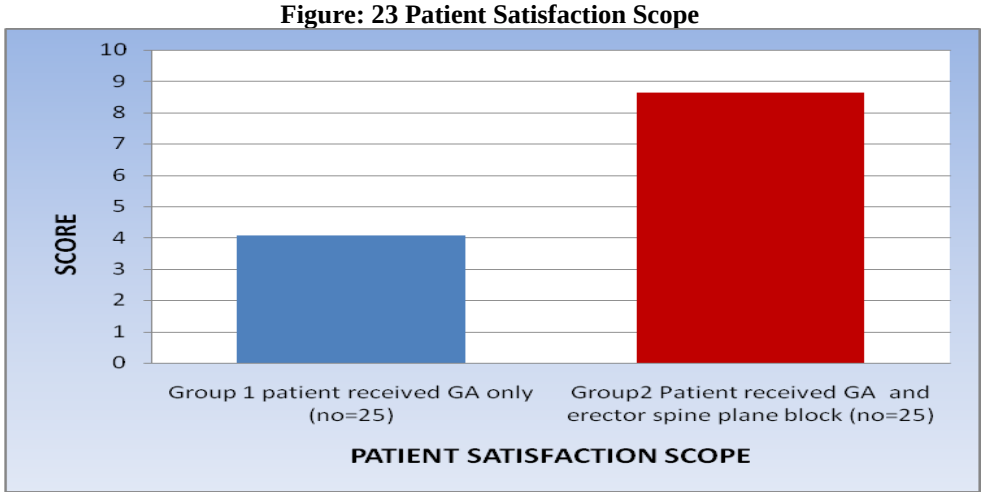


Total Tramadol consumption was less in Group 2 patient received GA and ESP block than group 1 patient received GA only.

Table: 20 Patient Satisfaction Score

	Group 1 Patient received GA only (no=25)	Group2 Patient received GA and erector spine plane block (no=25)	P value
Patient satisfaction score (0 = unsatisfied, 10 = most satisfied)	4.08 $\pm$ 1.03	8.64 $\pm$ 1.21	P<0.01

Figure: 23 Patient Satisfaction Scope



Patients belonging to group 2 were highly satisfied

IV. Discussion

US-guided ESP block was given preoperatively to patients who underwent abdominal surgeries. The result was a significant decrease in requirement of postoperative Ing. Tramadol in patients who received erector spinae plane block. Patient satisfaction score was better in ESP group without complication of postoperative nausea and vomiting requiring medications.

Compared with the epidural zone, the erector spinae plane is not a limited area surrounded by the spinal column. Local anaesthetic instilled in the myofascial plane deep to the erector spinae muscle and superficial to the tip of the transverse process is likely to provide sensory block at multidermatomal levels across the posterior, lateral, and anterior thoracic wall.

The analgesic effect seems to be due to the diffusion of LA into the paravertebral space, acting at both the dorsal andventral rami of the thoracic spinal nerves, in addition to its effect at the rami communicans that supply the sympathetic chain.

The ESP plane is larger than the epidural space as the erector spinae muscle runs along the length of the thoracolumbar spine, thus providing extensive craniocaudal spread. The ESP-block has a clear and simple sonoanatomy, it is easy to perform, not time-consuming, and generally well tolerated by the patients. The major limitation of our study was that patients knew they were receiving some intervention to decrease their pain.

V. Conclusion

We concluded that combined erector spine plane block with general anaesthesia provided good postoperative analgesia and It decreases postoperative analgesia requirement than general anaesthesia alone.

References

[1]. Forero M, Adhikary SD, Lopez H,Tsui C,Chin KJ.The erector spinae plane block: A Novel analgesic technique in thoracicneuropathic pain. Reg Anesth Pain Med 2016;41:621-7.
[2]. Chin KJ, Forero M, Adhikary SD. Reply to Dr. Ueshima andDr. Murouchi. Reg Anesth Pain Med 2017;42:124- 5.
[3]. Ueshima H, Otake H. Similarities between the retrolaminar and erector spinae plane blocks. Reg Anesth Pain Med 2017;42:123-4
[4]. Scimia P, Basso Ricci E, Droghetti A, Fusco P. The ultrasound-guided continuous erector spinae plane block for postoperative analgesia in video-assisted thoracoscopic lobectomy. Reg Anesth Pain Med 2017;42:537.
[5]. Ueshima H,Otake H.Clinical experiences of ultrasound guided erector spinae plane block for thoracic vertebra surgery. J Clin Anesth 2017;38:137
[6]. Muñoz F, Cubillos J, Bonilla AJ, Chin KJ. Erector spinae plane block for postoperative analgesia in pediatric oncological thoracic surgery. Can J Anaesth 2017;64:880-2.
[7]. El Boghdadly K, Pawa A.The erector spinae plane block: Plane and simple. Anaesthesia 2017;72:434-8.
[8]. Hamilton DL, Manickam B. Erector spinae plane block for pain relief in rib fractures. Br J Anaesth 2017; 118:474-5.
[9]. Forero M, Rajarathinam M, Adhikary S, Chin KJ. Continuous erector spinae plane block for rescue analgesia in thoracotomy after epidural failure: A Case report. A ACaseRep2017;8:254- 6.
[10]. Garg R, Bhan S, Vig S. Newer regional analgesia interventions (fascial plane blocks) for breast surgeries: Review of literature. Indian J Anaesth2018;62:254-62.

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