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ORIGINAL RESEARCH

Comparative Study of Pre-Operative Ultrasound Guided Transversus Abdominis Plane Block Versus Post-Operative Ultrasound Guided Transversus Abdominis Plane Block on Perioperative Hemodynamic Status and Post-Operative Analgesic Requirement in Patients Undergoing Laparoscopic Abdominal Surgeries

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ABSTRACT

Background:Although abdominal laparoscopic surgery is known for less pain compared with that of laparotomy, many patients still complain considerable post-operative pain. Pneumoperitoneum affects several homeostatic systems leading to alteration in cardiovascular, pulmonary physiology and stress response. The benefits of an adequate analgesia include a reduction in stress response of surgery, reduction in perioperative morbidity and effective pain control can also facilitate rehabilitation and accelerates recovery from surgery.

Materials and Methods: This is a Randomized control study and single blind study conducted at Done in Hospitals attached to Bangalore Medical College and Research Institute, Bangalore over 10 months -from November 2019 to September 2020. Patients undergoing laparoscopic abdominal surgeries admitted to hospital. Group I (n=40) – will receive ultrasound guided transversus abdominis plane block prior to surgical procedure (starting with skin incision). Group II(n=40) –will receive ultrasound guided transversus abdominis plane block after surgery (following skin suture and closure).

Results: The two groups were comparable in terms of age, sex, weight, ASA grading, mean duration of surgery, mean duration of anesthesia and mean duration of insufflations. The two groups were comparable in terms of intraoperative EtCO2 and respiratory rate. Comparison of heart rate at regular intervals with basal heart rate, P value was significant from 45 minutes to 90 minutes in both the groups. Comparison of SBP at regular intervals with basal SBP, the difference was not statistically significant from 30 minutes to 75 minutes in group I, while the difference was statistically significant in group II. In comparison of DBP at regular intervals with basal DBP, the difference was not statistically significant at intervals of 45 to 90 minutes in both the groups. In comparison of MAP at regular intervals with basal MAP, the difference was not statistically significant at intervals from 30 to 90 minutes in both the groups (Table 4).

Conclusion: For patients undergoing laparoscopic surgery, preoperative TAP block was recommended for duration of surgery <180 min for lower consumption of intraoperative opioids, while postoperative TAP block was better than preoperative manipulation for duration of surgery >180 min, which might obtain lower postoperative pain score, less postoperative analgesics, and higher satisfaction score.

Keywords: TAP Block, Ultrasound Guided, Intra Operative Hemodynamic, Postoperative Pain.

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INTRODUCTION

Challenge to anesthesiologists is to minimize the opioid consumption intraoperatively, postoperatively and to prevent opioid related side effects, most serious of which is respiratory depression, post-operative nausea and vomiting.[1]

Although abdominal laparoscopic surgery is known for less pain compared with that of laparotomy, many patients still complain considerable post-operative pain.[2] Pneumoperitoneum affects several homeostatic systems leading to alteration in cardiovascular, pulmonary physiology and stress response.[3]

The benefits of an adequate analgesia include a reduction in stress response of surgery, reduction in perioperative morbidity and effective pain control can also facilitate rehabilitation and accelerates recovery from surgery.[4]

Transversus abdominis plane block is widely practiced peripheral nerve block, utilized to anaesthetize somatic nerves supplying anterior abdominal wall by depositing local an aesthetic in neurovascular plane between internal oblique and transversus abdominis muscle layers.[5] Transversus abdominis plane block is given before occurrence of noxious stimulation which could relieve postoperative pain by alleviating pain of peripheral and central sensitization.[6]

As there are fewer studies available, this study aids in comparing the efficacy of intraoperative hemodynamic stability and analgesic effect of preoperative versus postoperative transversus abdominis plane block, in patients undergoing laparoscopic abdominal surgeries.

Aim and Objectives:

To compare the outcome and efficacy of preoperative versus postoperative ultrasound guided transversus abdominis plane block. By comparing perioperative hemodynamic status. Postoperative analgesic requirement and recovery profile.

MATERIALS & METHODS

This is a Randomized control study and single blind study conducted at Done in Hospitals attached to Bangalore Medical College and Research Institute, Bangalore over 10 months - from November 2019 to September 2020. Patients undergoing laparoscopic abdominal surgeries admitted to hospital.

Inclusion Criteria

- Patients giving informed written consent.(Annexure I)
- Patients undergoing laparoscopic abdominal surgeries
- Patients age between 20 – 60 years.
- Patients belonging to ASA I, II (Annexure III)

Exclusion Criteria

- Patients who refused to give informed written consent.
- Emergency surgeries
- Allergy for local Anesthetic and confirmed local anaesthetic toxicity.

Sampling Method: After obtaining informed written consent from patients during pre-operative visit, patients were randomly grouped by computer generated numbers and assigned to one of the two groups:
Group I (n=40) –will receive ultrasound guided transversus abdominis plane block prior to surgical procedure (starting with skin incision)
Group II(n=40) –will receive ultrasound guided transversus abdominis plane block after surgery (following skin suture and closure)
A thorough pre-operative evaluation was done on the previous day. All patients were kept nil per orally for 8 hours. Tab Ranitidine 150mg and Tab Alprazolam 0.5mg per orally was given night before the day of surgery. On arrival to the pre-operative room, intravenous access was secured with 18G cannula preferably in the right arm. Non-Invasive Blood Pressure (NIBP), Pulse Oximetry and Electrocardiogram (ECG) monitors were connected. The baseline Systolic, Diastolic and Mean arterial blood pressures (SBP, DBP and MAP), Heart Rate (HR) and Oxygen Saturation (SpO2) was recorded.
On arrival to the operating room, Blood pressure, Pulse Oximetry and ECG was connected. SBP, DBP, MAP, HR and SpO2 monitoring were recorded continuously.
All the patients were premeditated with Inj. Glycopyrrolate 0.005mg/kg IV, Inj midazolam 0.05mg/kg IV and Inj Fentanyl 2mcg/kg IV. After pre-oxygenation for 3 minutes with 100% oxygen, patients in each group were induced by InjPropofol 2mg/kg followed by InjVecuronium 0.1mg/kg. Bag and mask ventilation was done for three minutes. Laryngoscopy and intubation were done with appropriately sized cuffed endotracheal tube. After confirming proper placement of endotracheal tube, anesthesia was maintained with 70:30 mixtures of nitrous oxide and oxygen with isoflurane 1-1.5% and intermittent intravenous boluses of vecuronium 1mg as needed. Patients were mechanically ventilated through closed circuit. Intermittent positive pressure ventilation was adjusted to maintain end-tidal carbon dioxide (EtCO2) value between 30-40mmHg such that the airway pressures were kept at a minimum with tidal volume 6ml/kg and respiratory rate of 15 breaths/min with positive end-expiratory pressure of 5mmHg.
All transversus abdominis plane blocks are performed bilaterally with real-time ultrasound-guide using a 6-13MHz linear probe and 23g 90mm spinal needle, in-plane technique. Ultrasound probe is placed transversely in the flank between anterior superior iliac spine and the costal margin. The external oblique muscle, internal oblique muscle and transversus abdominis muscle are identified using ultrasound.
Two 20mL syringes are prepared with local anesthetic concentration of 0.25% bupivacaine. The local anesthetic solution injected after confirming with ultrasound that solution is spreading in the plane between the internal oblique and transversus abdominis muscles to the right and left abdominal walls Group I (n=20) –will receive ultrasound guided transversus abdominis plane block prior to surgical procedure (starting with skin incision) and Group II (n=20) –will receive ultrasound guided transversus abdominis plane block after surgery (following skin suture and closure).
Hemodynamic variables were monitored and recorded at every 5-minute interval for first 30 minutes, then at every 10 minutes for next 60 minutes and then at every 15 minutes up to completion of surgery and anesthesia.
After completion of surgery, the residual neuromuscular blockade was antagonized with inj. Neostigmine 0.05mg/kg and Glycopyrolate 0.01mg/kg IV. The patient was extubated once the patient regains consciousness and the patients were transferred to the post-anesthesia care unit (PACU).
Patients are familiarized with visual analogue score (VAS) (Annexure-IV) a day before surgery. VAS </= to 4 is considered as adequate pain relief. Patient first analgesic dose requirement is recorded and complications such as sedation assessed by Ramsay sedation

score (Annexure-V), postoperative nausea and vomiting, respiratory depression (respiratory rate <10beats/min or oxygen saturation <95%) are noted. Postoperative monitoring recorded every 15 min for the first 1 h, hourly for next 6 h and 2 hourly for the 12-h period and then at 24h period.

A patient with VAS score of more than 4 was treated with inj. tramadol 100mg intravenous (I.V.). Further and subsequent doses of tramadol was given and after assessing VAS of more than 4. The total dose of analgesia utilized was recorded.

RESULTS

The two groups were comparable in terms of age, sex, weight, ASA grading, mean duration of surgery, mean duration of anesthesia and mean duration of insufflations [Table1].

Table 1: Demographic data were comparable in both the groups

Study parameter	Group I	Group II	P value
Age	45.40	45.29	0.312
Sex M/F	10/25	13/21	0.134
Weight	57.36	58.37	0.441
ASA grading I/II	10/24	8/26	0.430
Duration of surgery	1.61	1.42	0.219
Duration of anesthesia	2.10	1.96	0.109
Duration of insufflation	1.29	1.10	0.481

Table 2: Baseline hemodynamic data were comparable in both groups

Study parameter	Group I	Group II	P value
Heart rate	90.13	85.71	0.237
Systolic blood pressure	128.27	137.17	0.104
Diastolic blood pressure	80.54	77.13	0.066
Mean blood pressure	98.38	98.69	0.618
Respiratory rate	12.13	12.59	0.198

The baseline HR, SBP, DBP, MBP and RR values were comparable in both groups [Table2].

Table 3: Comparison of HR, RR and EtCo2 among study groups

Time	Heart rate Mean (SD)			Resp. rate Mean (SD)			ETCO2 Mean (SD)		
	Grp l	Grp ll	P value	Grp l	Grp ll	P value	Grp l	Grp ll	P value
Baseline	90.34 (20.21)	85.28 (13.87)	0.267	13.26 (1.97)	13.59 (2.10)		32.21 (5.32)	32.45 (5.64)	
(AI) At Intubation	88.82 (12.34)	82.29 (13.24)	0.044	11.26 (2.05)	13.13 (2.03)	0.198	32.35 (4.79)	31.26 (4.01)	0.426
5 MIN AI *	86.21 (8.50)	81.53 (11.23)	0.146	11.39 (0.71)	11.12 (0.41)	0.758	30.24 (4.10)	31.93 (3.93)	0.869
Insufflation	84.16 (10.92)	80.37 (17.24)	0.149	11.29 (0.69)	11.30 (0.41)	0.33	26.29 (3.20)	29.51 (3.02)	0.084
5 min	86.21 (12.95)	84.37 (11.87)	0.268	10.26 (0.86)	11.61 (0.41)	0.397	29.85 (2.21)	29.23 (2.92)	0.569
10 min	89.23 (13.48)	85.12 (10.31)	0.212	11.59 (1.01)	11.36 (0.41)	0.548	30.10 (2.41)	30.61 (2.96)	0.842

15 min	90.86 (15.29)	84.33 (10.94)	0.059	11.64 (1.06)	11.37 (0.41)	0.564	31.35 (3.10)	31.41 (2.16)	0.121
30 min	89.97 (14.32)	82.73 (8.95)	0.067	10.23 (1.01)	11.32 (0.41)	0.399	31.86 (3.98)	31.61 (2.95)	0.643
45 min	85.33 (12.30)	80.24 (8.13)	0.05	11.37 (1.03)	11.28 (0.41)	0.399	31.73 (4.26)	30.31 (3.19)	0.601
60 min	82.49 (10.84)	78.93 (7.50	0.043	11.82 (1.11)	11.23 (0.41)	0.547	30.26 (4.96)	30.26 (3.13)	0.699
75 min	82.92 (11.16)	77.26 (8.69)	0.087	11.10 (1.11)	11.12	0.725	30.45 (4.94)	29.63 (2.73)	0.838
90 min	78.17 (9.78)	78.13 (8.28)	0.187	11.13 (1.13)	11.13	0.753	30.36 (5.18)	28.83 (2.91)	0.99
Extubation	88.56 (11.36)	86.25 (11.35)	0.324	15.36 (1.04)	16.37	0.003	29.45 (5.36)	28.64 (4.13)	

The two groups were comparable in terms of intraoperative EtCO2 and respiratory rate. Comparison of heart rate at regular intervals with basal heart rate, P value was significant from 45 minutes to 90 minutes in both the groups [Table 3].

Table 4: Comparison of SBP, DBP and MBP among study groups

Time	**SBP Mean (SD)**			**DBP Mean (SD)**			**MBP Mean (SD)**		
	Grp l	**Grp ll**	**P value**	**Grp l**	**Grp ll**	**P value**	**Grp l**	**Grp ll**	**P value**
Baseline SBP	134.27 (12.25)	141.93 (17.23)	0.101	81.58 (10.12)	78.34 (7.77)	0.064	99.12 (10.25)	98.82 (8.96)	0.726
(AI) At Intubation	129.00 (17.20)	138.31 (24.62)	0.071	81.24 (11.63)	81.02 (11.36)	0.761	97.46 (12.34)	100.21 (14.23)	0.294
5 min AI	116.20 (20.73)	117.23 (19.56)	0.436	74.37 (12.16)	73.98 (7.33)	0.700	88.23 (15.26)	88.45 (10.36)	0.634
insufflation	121.69 (14.26)	127.34 (29.76)	0.298	83.10 (13.12)	84.64 (16.28)	0.739	95.34 (13.46)	99.67 (21.34)	0.549
5 min	133.26 (21.63)	143.26 (20.23)	0.04	93.26 (15.67)	93.64 (12.85)	0.334	106.20 (16.21)	110.31 (15.29)	0.396
10 min	143.93 (14.30)	149.28 (19.27)	0.13	99.34 (13.26)	95.64 (8.26)	0.113	113.23 (11.46)	113.34 (10.41)	0.840
15 min	142.37 (13.29)	138.82 (18.62)	0.194	97.51 (10.63)	88.68 (10.03)	0.007	111.35 (10.12)	105.86 (12.36)	0.016
30 min	130.87 (15.07)	149.68 (8.23)	0	86.21 (8.13)	82.34 (5.69)	0.014	102.21 (9.75)	104.67 (5.68)	0.134
45 min	130.39 (16.49)	149.27 (12.63)	0	85.74 (9.62)	78.13 (7.12)	0	100.23 (9.23)	102.61 (8.29)	0.648
60 min	127.74 (12.27)	147.26 (11.50)	0	86.26 (7.67)	77.21 (7.34)	0	100.71 (7.60)	100.38 (8.41)	0.492
75 min	129.38 (12.41)	145.21 (12.18)	0	87.27 (7.26)	77.03 (8.93)	0.001	101.52 (8.53)	101.23 (9.36)	0.62
90 min	131.37 (10.87)	148.26 (13.47)	0	87.21 (7.71)	77.16 (9.67)	0	102.31 (7.63)	102.05 (10.34)	0.431
Extubation	144.39 (18.95)	146.35 (14.16)	0.573	89.23 (13.61)	91.31 (13.51)	0.613	107.18 (14.38)	109.31 (13.28)	0.637

Comparison of SBP among study groups, the difference was statistically significant from intervals of 30 minutes to 90 minutes, P values < 0.03 with group I having lesser values.

Comparison of SBP at regular intervals with basal SBP, the difference was not statistically significant from 30 minutes to 75 minutes in group I, while the difference was statistically significant in group II. In comparison of DBP among study groups, the difference was statistically significant from intervals of 15 minutes to 90 minutes. In comparison of DBP at regular intervals with basal DBP, the difference was not statistically significant at intervals of 45 to 90 minutes in both the groups. In comparison of MAP at regular intervals with basal MAP, the difference was not statistically significant at intervals from 30 to 90 minutes in both the groups [Table 4].

Table 5: VAS score comparison among both groups

Time	Grp l		Grp ll		P value
	Mean	SD	Mean	SD	
30 min	3.18	1.04	4.96	1.08	7.36E-07
1 hour	3.03	0.84	4.30	1.19	1.73E-06
2 hour	3.13	1.00	4.54	1.30	2.82E-05
4 hour	3.38	1.00	4.69	1.28	3.69E-06
8 hour	3.42	1.00	4.39	1.16	4.93E-06
12 hour	3.53	1.01	4.71	1.29	2.83E-04
24 hour	3.47	0.81	4.63	1.18	5.92E-05

In comparison among the study groups for VAS score, the difference between the median values among the two groups was statistically significant with group I having lower VAS score [Table 5]. In comparison among study group for inj. Tramadol given, p valve was significant with group I having lower requirement for the drug. In comparison among study group for incidence of shoulder pain, the difference was not statistically significant between the two groups.

DISCUSSION

The establishment of laparoscopic cholecystectomy as an outpatient procedure has accentuated the clinical importance of stabilizing intraoperative hemodynamic changes, reducing early postoperative pain and hasten early discharge. Pain can induce hemodynamic changes both intraoperatively and postoperatively. Improved postoperative pain treatment using opioid-sparing methods may facilitate a high success rate of outpatient laparoscopic cholecystectomy.[7] Although the pain following a laparoscopic cholecystectomy is less intense than open surgery, patients often suffer visceral pain with coughing, respiratory movements and mobilization and shoulder pain secondary to peritoneal insufflations. TAP block to reduce postoperative pain has been studied, but there are limited studies to evaluate intraoperative hemodynamic stabilization effect of the block with local anesthetics.

Mandy Perrin et al,[8] conducted a study to show that pneumoperitoneum causes increase in IAP which along with alteration in the patient's position and effects of carbon dioxide absorption cause changes in physiology, especially within the cardiovascular and respiratory systems. Ishizaki et al,[9] tried to evaluate the safe IAP during laparoscopic surgery. They observed a significant fall in cardiac output at 16 mm Hg of IAP. Hemodynamic alterations were not observed at 12 mm Hg of intra-abdominal pressure. Taking into consideration these factors IAP was preset to maximum 12 mm Hg in our study.

In a study done by Chen CK et al,[10] to determine the area covered by the type of TAP block, concluded that ultrasound guided oblique subcostal TAP block provides a wider analgesic blockade than the posterior approach, with the possibility of being suitable for surgery both superior and inferior to the umbilicus. So, in our study we decided to give subcostal TAP block rather than using the classical approach. When the block is performed by the so-called

"pop" or "double pop" technique in the anatomical area of the petit triangle, inadvertent needle position can result in severe complications like bowel puncture, nerve injury and puncture of the liver. A. A. El-Dawlatly et al,[11] performed a study to describe a method of ultrasound-guided TAP block. USG guidance enables exact placement of the local anesthetic for the block. In our study we preferred using USG rather than the landmark technique for correct placement of drug and avoid complications.

Yoon Suk Ra et al,[12] conducted a study to compare efficacy of local anesthetics according to the concentration in patients undergoing laparoscopic cholecystectomy. They concluded that the US-TAP block with 0.25% or 0.5% levobupivacaine 30 ml significantly reduced postoperative pain, and there is no significant difference in the quality of pain control by the concentration of levobupivacaine. In our study, we used 0.25% bupivacaine plain, as using higher concentration has no additional benefits.

Qianlin Zhu et al,[13] conducted a study to investigate the effects of CO2 insufflation on hemodynamic and respiratory function during laparoscopic inguinal hernioplasty. It was observed that blood pressure, EtCO2 and PaCO2 increased significantly, whereas heart rate and pH decreased significantly ($P < 0.05$). In our study, it was found that the HR values during insufflation had deviated from the baseline values and were significant ($p < 0.05$) from 45 to 90 minutes in both the groups. This was in accordance with the earlier study. We also observed that giving TAP block did not prevent the heart rate variability. We compared the HR of control group to study group. Baseline of both groups were comparable. Also comparison between the two groups at insufflation and at regular intervals was not significant (p0.05). This was not in accordance with the studies done by Al-Sadek WM,[14] which states that giving TAP block controls hemodynamic variability. The possible explanation can be the small sample size of our study and needs further evaluation with a large sample size.

In our study it was observed that the SBP values in group II during insufflation had deviated from the baseline values and were significant ($p < 0.05$) from 30 to 60 minutes. The DBP values during insufflation had not deviated from the baseline at 45 to 90 minutes. Also the MAP values during insufflation had not deviated from the baseline at 45 to 90 minutes. This was in partial accordance with the study done by Joris JL et al,[15] who observed that laparoscopic cholecystectomy in head-up position results in significant hemodynamic changes in healthy patients, particularly at the induction of pneumoperitoneum. Our study showed that creation of pneumoperitoneum leads to significant changes in SBP after 30 minutes.

M. Tsuchiya et al,[16] performed a prospective, randomized study to compare a group receiving general anesthesia and TAP block with a group receiving general anesthesia alone for intraoperative hemodynamic stability in high risk abdominal surgery patients. They concluded that for abdominal surgery in patients with severe cardiovascular disease, combining TAP block with general anesthesia promotes intraoperative hemodynamic stability and early emergence from anesthesia. In our study we found that the SBP values during insufflation had not deviated from the baseline values and the difference was not statistically significant from 30 to 75 minutes ($p > 0.05$) in group I. This was in accordance with the earlier study. The control of SBP after 30 minutes must be due to the time taken for the local anesthetics to act on the peripheral nerve. The DBP and MAP values were neither deviated in control group or in study group after 45 minutes of insufflation.

Similarly when the SBP, DBP and MAP were compared between the two groups, it was not significant initially (p 0.05). But SBP values became statistically significant at intervals from 30 minutes to 90 minutes. Our study showed that giving TAP block has no effect on hemodynamic variability initially, but after 30 minutes it has effect on SBP up to 90 minutes. This might be due to the time taken by the drug to act on the peripheral nerves.

SBP is getting affected by many factors and pain is one of the major factor. TAP block controls pain at port insertion site and intraoperative pain by blunting the neuro-humoral response to abdominal insufflation as well as intraoperative procedures, so SBP gets controlled. In our study TAP block doesn't influences HR, DBP and MAP, this may be a due to smaller sample size.

In our study, the pain scores were compared by VAS scale and was significantly low in group I ($p < 0.05$) at all the times. It was found that preoperative administration of TAP block results in better postoperative pain outcomes. Main limitation of our study was sample size. Further studies need to be done with larger sample size.

CONCLUSION

It was necessary to decide the time of TAP block according to the duration of surgery. For patients undergoing laparoscopic surgery, preoperative TAP block was recommended for duration of surgery <180 min for lower consumption of intraoperative opioids, while postoperative TAP block was better than preoperative manipulation for duration of surgery >180 min, which might obtain lower postoperative pain score, less postoperative analgesics, and higher satisfaction score. Further research is warranted to investigate whether the TAP block technique can be improved by optimizing dose and technique-related factors.

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