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ULTRASOUND GUIDED UNILATERAL TRANSVERSUS ABDOMINIS PLANE BLOCK VERSUS UNILATERAL SPINAL ANESTHESIA FOR UNILATERAL OPEN INGUINAL HERNIA REPAIR: A COMPARISON ON HEMODYNAMIC PROFILES

Anaesthesiology

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ABSTRACT

Background: Inguinal hernias account for 75% of abdominal wall hernias, with a lifetime risk of 27% in men and 3% in women. Inguinal hernia repair is one of the most common operations in general surgery, requiring more than 100 000 hospital bed days Inguinal hernia repair can be done under General Anaesthesia (GA), neuraxial anaesthesia (Spinal or epidural) or peripheral nerve block and TAP block.Virtually, the ultrasound-guided TAP block is highly effective and easy technique for rendering analgesia for post anterior abdominal incision as supported by literature; however, it can also be used as a sole anesthetic technique for abdominal surgeries where the autonomic innervation is partly or not involved. **Aim:** The present study aims to compare safety and efficacy of unilateral TAP block and unilateral spinal anaesthesia for unilateral inguinal hernia repair surgery in patients regarding hemodynamic changes. **Method:** A total 80 patients will be included in the study of age group 20 to 60 years of either sex and were divided into two groups of 40 each. They were given either USG TAP block (Group T) or unilateral spinal anaesthesia (Group S) for unilateral inguinal hernia repair surgery. Their hemodynamic profiles were compared **Results:** Intra-operative vitals(Blood Pressure) is comparable and becomes more stable in TAP block than unilateral spinal anesthesia and is statistically more significant (p value is less than 0.05).

KEYWORDS

Inguinal Hernia Repair Surgery, Unilateral Spinal Anaesthesia, Ultrasound-Guided Transversus Abdominis Plane Block.

INTRODUCTION:

Inguinal hernia repair is probably the most commonly performed procedure in general surgery and consumes an important part of health care resources because of the high incidence of the condition. It is estimated that 20 million inguinal hernia repairs are performed globally every year.[1]

Inguinal hernia repair can be done under General Anaesthesia (GA), neuraxial anaesthesia (Spinal or epidural) or peripheral nerve block and TAP block. Neuraxial anaesthesia generally causes hypotension and other haemodynamic changes. Autonomic nervous system response decreases with aging and sympathetic block with epidural anaesthesia cannot be controlled. Hypotension is the most frequent adverse effect of spinal anaesthesia occurring in more than 30% of patients.[2] Ward et al[3] reported that mean arterial pressure decreases by 21.3% of the baseline following spinal anaesthesia. The unilateral spinal anaesthesia has been claimed as an alternative technique to restrict the undesired sympathetic block[4] and is useful in patients having unilateral surgeries.

The Transversus Abdominis Plane Block (TAPB) is a relatively new regional anaesthesia technique that provides analgesia to the parietal peritoneum as well as the skin and muscles of the anterior abdominal wall.[5] It has a high margin of safety and is technically simple to perform, especially under ultrasound guidance. TAPB can preserve bladder and lower limb motor function, thereby assisting early mobilisation after surgery.

First described two decades ago, it has undergone several modifications which have highlighted its potential utility for an increasing array of surgical procedures.[6]Despite a relatively low risk of complications and a high success rate using modern techniques, TAP blocks remain underutilised.[7]There is no study comparing the potential of TAP block with unilateral spinal anaesthesia. Hence, this study was undertaken to compare the safety and efficacy of unilateral TAP block and unilateral spinal anaesthesia for unilateral inguinal hernia repair surgery in patients.

METHODS:

The study was carried out in Swaroop Rani Nehru Hospital, attached to Motilal Nehru Medical College, Prayagraj. over a period of one year [August 2021 to July 2022] after approval from Institutional ethics committee and obtaining written and informed consent from all the patients. Study design will be a randomized, prospective, comparative, interventional study.

Formula Used For Sample Size Calculation:

$$N = \frac{(u + v)^2(\sigma_1^2 + \sigma_0^2)}{(\mu_1 - \mu_0)^2}$$

N	= Sample size
μ1 , μ0	=Difference between the means (μ1=23.75 and μ0=8.8)
σ1, σ0	=Standard deviations (σ1=3.58 and σ0 =2.6)
u	=two sided percentage point of the normal distribution corresponding to 100 % - the power = 95%, u =1.645
v	=Percentage point of the normal distribution corresponding to the (two sided) significance level for significance level = 5%, v = 1.960

The required sample size as per the above-mentioned calculation is 36 in each group. To account for a non-participation rate/ loss to follow up rate of a about 5%, another 4 subjects will be added to the sample size in each group. Hence the final required sample size would be 40 subjects in each group.

Inclusion Criteria:

1. Patients who gave informed and written consent.
2. Age between 20-60 years of either sex.
3. ASA grade I and II patients.
4. Mallampatti class I and II patients.
5. Patients scheduled for elective surgery under general anaesthesia.

Exclusion Criteria :

1. Patient refusal.
2. Patient having age < 20 or > 60 years.
3. ASA physical status III or > III.
4. Mallampatti Grading III or > III.
5. Patient having BMI > 35 kg/m^2.
6. Pregnant and lactating women.
7. Patients with neuromuscular weakness and diseases affecting neuromuscular transmission (myopathies).
8. Patients having major cardiovascular, pulmonary diseases.
9. Patients having prior history of allergy to any of the drugs used in this study.
10. Anatomical malformation at puncture site.
11. Failed block.
12. Duration of surgery more than 60 minutes where duration is defined as onset of sensory block to completion of surgery.

The patients included in the study were divided into two groups: patients who received Ultrasound-guided (USG) Transversus Abdominis Plane Block (TAPB) (Group T) (n = 40) and patients who received a Unilateral Spinal Anaesthesia (USA) (Group S) (n = 40). Group - T patients received USG-guided TAPB with 25 mL of 0.5%

isobaric bupivacaine on the side of hernia repair and Group - S patients received USA with 10 mg (2 mL) of 0.5% hyperbaric bupivacaine.

Heart rate, non-invasive systolic, diastolic, mean blood pressure, oxygen saturation were recorded at 5 minutes intervals initially for 20 minutes, 30 minutes, 45 minutes, 60 minutes and post-surgery upto 24hrs.

In Group – T, patients were placed in supine position on OT table. Under all aseptic precautions, the ultrasound-guided (SonoSite, Micromaxx) TAPB were given using the following technique: A linear ultrasound probe (Micromaxx L 38e/10-5 MHZ) were placed transversely on the abdomen between costal margin and iliac crest in the midaxillary line on the side to be blocked. The probe was then slided anteriorly or posteriorly and tilted as necessary in a cephalocaudal direction until a clear optimised image of the three lateral abdominal muscles (namely external oblique, internal oblique and transversus abdominis from outside inwards) and the transversus abdominis plane are visualised. An 18-G Tuohy needle is introduced from an anteromedial position to a posterior and lateral direction using in-plane technique with entry point in the skin being 2 cm away from the probe in order to improve needle visibility in the long axis after skin infiltration with 1 mL xylocaine 1%. A small test dose is used to confirm the transversus abdominis plane by observing the separation of fascia between internal oblique and transversus abdominis muscle. After confirming the transversus abdominis plane, a total of 25 mL of 0.5% isobaric bupivacaine is injected in real time. The block is assessed by pin prick on the side of surgery every 5 minutes till 30 minutes. A successful block means a sensory block of unilateral T10 to L1 dermatomes by 30 minutes, after which it will be considered as a failure and patient will be given GA and excluded

In Group S the unilateral spinal block is applied as follows: First, the extremity to be operated on is placed in the lateral decubitus position. After taking aseptic precautions, the subarachnoid space is entered in midline with a 25-gauge Quincke's needle from the L3 - L4 intervertebral space. After dural puncture, bevel of the needle is turned towards the dependent side and 2 mL (10 mg) of 0.5% hyperbaric bupivacaine is injected. Lateral position is maintained for 10 minutes and then patients is turned to supine position. The pin prick method is used to evaluate sensory block. Time of onset and time taken to achieve highest dermatomal level of sensory block is recorded. Motor blockade is assessed by using modified Bromage scale at the end of surgery. Patients with inadequate block in Group S are also converted to GA and excluded. The Quality of Block is Assessed according to the following Scale Numeric Scale for Quality of Block. Grade IV - (Excellent) No complaint from patient. Grade III - (Good) Minor complaint with no need for the supplemental analgesics. Grade II - (Moderate) Complaint that required supplemental analgesia. Grade I - (Unsuccessful) Patient is given general anaesthesia. Motor blockade is assessed by using modified Bromage scale. Grade 0 - No block. Grade 1 - Inability to raise the extended legs. Grade 2 - Inability to flex knee. Grade 3 - Inability to flex ankle and foot. Tramadol 50 mg intravenous is used as a rescue analgesic in patients who had VAS score ≥ 4 postoperatively.

RESULTS:

Demographic data of the groups

		Group T	Group S	p-value	Statistical Significance
Gender	F	7(17.5%)	10(25%)	0.5846 (Chi-square test)	Not significant
	M	33(82.5%)	30(75%)		
Mean (SD) Age (in year)		42.1(15.3)	42.8(15.5)	0.8561 (t-test)	Not significant
Mean (SD) Weight (in Kg)		67.6(9.1)	63(14)	0.0858 (t-test)	Not significant
Mean (SD) Duration of Surgery (in Min.)		60(2.1)	59.2(2.6)	0.148(t-test)	Not significant
ASA Grade	I	20(50%)	19(47.5%)	0.999 (Chi-square test)	Not significant
	II	20(50%)	21(52.5%)		

Table 1- Intra-operative mean (SD) of heart rate (HR) of patients at different time points and their significance

Time	Group T	Group S	P-value & statistical significance
5 Minute	84.7(12.2)	87(15.5)	0.47 (Not Significant)
10 Minute	84.3(12.3)	86.5(13.2)	0.447 (Not Significant)
15 Minute	84.6(11.7)	87.2(16.1)	0.399 (Not Significant)
20 Minute	83.3(11.8)	85.6(13.6)	0.428 (Not Significant)
30 Minute	83.8(11.1)	84.3(10)	0.849 (Not Significant)
45 Minute	83.6(11.7)	85.6(8.9)	0.392 (Not Significant)
60 Minute	84.2(12.1)	80.3(12)	0.16 (Not Significant)

Table 2- Intra-operative mean (SD) of MAP of patients at different time points and their significance

Time Point	Group T	Group S	p-value & statistical significance
5 Minute	94.8(13.3)	85.2(13.8)	0.0022 (Significant)
10 Minute	94.2(12.6)	78.6(12.5)	0.0369× (Significant)
15 Minute	94.2(12.6)	75.1(9.6)	0.00698× (Significant)
20 Minute	94.4(12.6)	78.7(7)	0.0361× (Significant)
30 Minute	94.3(13.1)	82.4(6.3)	0.0315× (Significant)
45 Minute	94.5(12.3)	88.7(6.6)	0.0103 (Significant)
60 Minute	95.1(13.6)	94.2(14.4)	0.7705 (Not Significant)

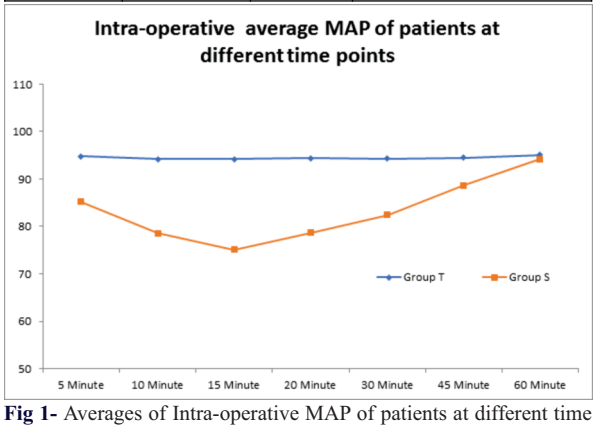

Fig 1- Averages of Intra-operative MAP of patients at different time points

Table 3- Post-operative mean (SD) of heart rate (HR) of patients in different time intervals and their significance

Time Intervals	Group T	Group S	p-value & statistical significance
0-6 Hours	83.9(12.7)	78.6(11.9)	0.06 (Not Significant)
6-12 Hours	84.1(11.5)	78.8(13.5)	0.061 (Not Significant)
12-18 Hours	84(12.4)	78.6(13.8)	0.069 (Not Significant)
18-24 Hours	83.7(11.1)	79(12.7)	0.082 (Not Significant)

Table 4- Mean (SD) of post-operative MAP of patients in different time intervals and their significance

Time Interval	Group T	Group S	p-value & statistical significance
0-6 Hours	95.3(14.2)	91.8(10.4)	0.214 (Not Significant)
6-12 Hours	96(14.8)	91.3(10.5)	0.101 (Not Significant)
12-18 Hours	96(14.8)	91.7(11)	0.141 (Not Significant)
18-24 Hours	95.9(14.8)	92.4(9.9)	0.21 (Not Significant)

DISCUSSION:

Transversus abdominis plane block(TAPB) is a rapidly expanding regional anaesthesia technique which significantly reduces pain associated with lower abdominal surgery such as inguinal hernias, regardless of whether it is used as primary anaesthetic or for pain relief postoperatively. USG has provided the required precision and safety to this truncal block. Unilateral spinal anaesthesia using 0.5% bupivacaine heavy is a standard and effective regional anaesthesia technique in restricting sympathetic block.

The averages (SD) of intra-operative MAP of patients in Group T were higher than the average MAP of patients in Group S at every intra-operative time points. It was 94.8(13.3) at the time point 5 minute in Group T whereas 85.2(13.8) in Group S. Again, the average MAP in Group T was high and varied from 94 to 95 at the rest of the time points. The differences between both the groups were statistically significant on the basis of intra-operative MAP at every time points of intra-operative period except at 60-minute.

In the study of **Sulagna Bhattacharjee et al (2014)**, systolic and diastolic BP were significantly higher in Group N (TAP block with

normal saline followed by general anaesthesia) in comparison to Group B (TAP block with 0.25% Bupivacaine followed by general anaesthesia).[8] **K. O. Connor et al (2010)** reported that there is no haemodynamic sequelae of neuraxial sympathectomy in TAP block as in neuraxial block.[9] **Nesek Adam et al (2011)** had also noticed slight decrease in blood pressure in their unilateral group. They also noticed hypotension in 10% patients.[10] The fall in SBP and DBP after unilateral spinal was similar to study by **Casati et al (1999)** in the unilateral spinal anaesthesia group using hyperbaric 0.5% bupivacaine. They noticed hypotension in 10% patients that were treated with 100 mcg of phenylephrine. Clinical trials comparing unilateral spinal anaesthesia with conventional bilateral spinal block have demonstrated that cardiac index values are much more stable during USA with a smaller reduction in arterial blood pressure and heart rate and a much lower incidence of clinically relevant hypotension (5% Vs 20**%)**.(17) TAP block thus provides better perioperative haemodynamic safety profile.[11]

The mean (SD) of post-operative SBP of the patients was observed that the average SBP of the patients in Group T was higher than the average SBP of the patients in Group S at each of post-operative time intervals. In Group T, the variation in average SBP was from 133-136 whereas in Group S, it varied from 125-128. The differences between both the groups were significant at each of post-operative time intervals except in the time interval 18-24 hours**. Shitemaw T et al (2020)** showed the incidence of hypotension among mothers who underwent a cesarean section after spinal anesthesia was 64%. A baseline systolic blood pressure < 120mmHg (AOR = 6.293; (95%CI: 2.999–13.204)) was found to be associated with increased risk of hypotension.[12]

CONCLUSON:

Demographically age, sex, ASA class and MPG grading, pre-operative vitals are not comparable in both groups as values are statistically insignificant.

Intra-operative vitals(SBP, DBP, MAP) is comparable and becomes more stable in TAP block than unilateral spinal anesthesia and is statistically more significant (p value is less than 0.05).

Post-operative vitals except for systolic blood pressure in 0-6 hrs falls in group S significantly as compared to group T but other parameters are such as HR, DBP, AND MAP are not comparable as they are statistically insignificant.

Hence, to summarise TAP block is more efficacious than unilateral spinal block for unilateral inguinal hernia repair in patients in terms of excellent haemodynamic stability with minimal incidence of side effects or complications. On the other hand, unilateral spinal block provides excellent quality of intra-operative block. TAP block may be used safely as an alternative sole anaesthetic technique in patients who are not suitable for general or neuraxial anaesthesia.

Regarding limitations of our study, one was the small sample size and hence future studies need to be undertaken with a large size population. Another limiting factor is that although USG TAPB increases efficiency and safety of block it has a longer learning curve and so results are user dependent. There are various techniques to perform TAP block, so it must be realised that the block characteristics can change with each technique.

Complete blinding was not possible, which is another limitation of our study.

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