International Journal of Current Pharmaceutical Research

ISSN- 0975-7066 Vol 16, Issue 3, 2024

Original Article

THORACIC SEGMENTAL SPINAL ANAESTHESIA IN UPPER ABDOMINAL SURGERIES AND SIMPLE MASTECTOMY-A CASE SERIES

MADHUCHANDA BORAH[1], KAVERI DAS*[1], BIJOY AHIR[1], ANJALI VERMA[1], PYDIMALLA VENKATA GOWTHAM[1], KARUNA KUMAR DAS[1], PRITANU DEB BARUAH[2]

[1]Department of Anaesthesiology, Assam Medical College and Hospital, Dibrugarh, Assam, India. [2]Department of Anatomy, Assam Medical College and Hospital, Dibrugarh Assam, India
*Corresponding author: Kaveri Das; *Email: drkaveridas@gmail.com

Received: 24 Feb 2024, Revised and Accepted: 06 Apr 2024

ABSTRACT

Objective: To observe safety and efficacy of Segmental thoracic spinal anesthesia (STSA) in upper abdominal and breast surgeries.

Methods: 14 cases were selected, out of which 6 laparoscopic cholecystectomy (LC), 4 open cholecystectomy (OC), 3 emergency exploratory laparotomy and 1 simple mastectomy. Under full aseptic precaution, segmental thoracic spinal anesthesia was administered through midline approach in T_{8-9} space for upper abdominal surgeries and T_{5-6} space in a simple mastectomy. Using 25G Quincke spinal needle 1.5 ml [7.5 mg] of 0.5% Isobaric Levobupivacaine mixed with 0.4 ml (20µg) Fentanyl was given in abdominal surgeries and 1.2 ml [6 mg] of 0.5% Isobaric Levobupivacaine mixed with 0.4 ml (20µg) Fentanyl in simple mastectomy.

Results: Age group of patients ranged from 25 to 65 y, Male: Female ratio of 4:10, Body Mass Index (BMI) range of 22 to 24.9 with physiological status of ASA I to ASA III. Hemodynamically, hypotension was observed in every patient after 5-10 min of STSA well managed with fluid and vasopressors with no bradycardia. Average width of sensory block was T_3 to L_{1-2} in upper abdominal surgeries and T_1 to T_8 in a simple mastectomy. Motor block was Modified Bromage Scale (MBS) of 0 to 1 during and postoperatively. Regarding analgesia, Visual Analogue Scale (VAS) score was 0 intraoperatively and 0-1 postoperatively. Sedation score was 2 both intraoperatively and postoperatively with no significant complications and good patient and surgeon satisfaction.

Conclusion: Segmental thoracic spinal anaesthesia is a safe and effective procedure with good patient and surgeon satisfaction.

Keywords: Thoracic spinal, Upper abdominal surgery, Laparoscopy, Breast surgery

DOI: https://dx.doi.org/10.22159/ijcpr.2024v16i3.4088 Journal homepage: https://innovareacademics.in/journals/index.php/ijcpr

INTRODUCTION

Upper abdominal and breast surgeries can be performed under general, epidural and spinal anaesthesia. Since the introduction of spinal anaesthesia by Bier in 1892 it has been restricted to lumbar region only due to fear of injuring the spinal cord. Over the years spinal anaesthesia has undergone many modifications. Dr T Jonnesco (1909) [1] recommended that subarachnoid block can be performed from cervical to lumbar intervertebral space and emphasized on thoracic approach T_{1-2} and T_{12} to L_1. So segmental thoracic anaesthesia is now a century-old technique and anesthesiologist are focusing on it over lumbar approach.

MRI study revealed variation in distance between the anatomical structure of importance for neuraxial block around the spinal canal at various level. The spinal cord is in ventral position in the thoracic curve, whereas more dorsal in the lumbar region. The posterior duramater to the cord distance on the needle path is significantly different [2] (T_6 =9.5±1.8 mm, T_{12}= 3.7±1.2 mm, T_1=4.7±1.7 mm, P<0.001). Moreover, the geometry at the midthoracic level that direct the needle with more angulations also increase the distance. The lumbar spinal cord takes up more space because of the lumbar enlargement so there is greater risk of needle injury [3].

Van Zundert A. A. published a case report of successful segmental thoracic spinal anaesthesia for laparoscopic cholecystectomy using Combined Spinal Epidural (C. S. E) technique in a patient with severe functional impairment on O_2 support, homozygote α-1-antitrypsin deficiency type ZZ awaiting lung transportation. The patient was a heavy smoker with severe emphysema [4].

It was followed by a case series by him on 20 patient ASA I or II grade undergoing elective laparoscopic cholecystectomy under segmental thoracic spinal anaesthesia. (T_{10}) using 1 ml plain bupivacaine (5 mg) and 0.5 ml of sufentanyl (5 µg) and concluded that the technique can be used effectively in healthy patient [5].

For the last two decades the anaesthesiologists all over the world are practicing it as an alternative to general anaesthesia for various thoracic and abdominal procedures, particularly in patient with co-morbidities where general anesthesia is considered high risk [6, 7]. Patients' safety, surgeon's satisfaction and anaesthesiologist's comfort are the three important points of an anaesthetic technique along with other considerations. Operations that have been performed under thoracic segmental anaesthesia with success include abdominal cancer surgeries, breast cancer surgeries and laparoscopic cholecystectomy [8]. So, based on various appreciable reports and paucity of literature in the north east region of India, the present study is being undertaken to evaluate the efficacy of segmental thoracic anesthesia in regards to analgesia, hemodynamic stability, patient comfort, surgeon's satisfaction and any adverse effect related to the technique.

MATERIALS AND METHODS

The study was carried out in a tertiary care hospital, Assam Medical College and Hospital, Dibrugarh in the Department of Anaesthesiology and Critical Care. After obtaining written informed consent from the patient, fourteen patients aged 25 to 65 y of ASA grade I to grade III of either gender, BMI<25 wt/m^2, GCS 15/15 who were to undergo elective and emergency upper abdominal and breast surgery and having no contraindication for spinal anaesthesia were enrolled in the study.

After a thorough preanaesthetic evaluation, baseline investigations were done. The anesthetic procedure and VAS score were explained to all patients. The elective cases were kept nil per hour for 8 h. On the day of surgery, a volume preload of 10 ml/kg Ringer lactate was given using 18G IV cannula and injection pantoprazole 40 mg and midazolam 1 mg IV as premedication. ASA standard monitors, ECG, Noninvasive BP (NIBP), SPO_2 were attached and the operation table was kept in a neutral position. Under full aseptic precaution,

segmental thoracic anesthesia was administered in sitting position through a midline approach in T_{8-9} space for upper abdominal surgeries and T_{5-6} space in a simple mastectomy. Using 25G Quincke spinal needle 1.5 ml [7.5 mg] of 0.5% Isobaric Levobupivacaine mixed with 0.4 ml (20µg) Fentanyl was given in abdominal surgeries and 1.2 ml [6 mg] of 0.5% Isobaric Levobupivacaine mixed with 0.4 ml (20µg) Fentanyl for simple mastectomy. Confirmation of subarachnoid space was done by clear flow of CSF. None of the patients complained of paresthesia during the procedure.

O_2 inhalation was started at 3L/min via face mask. The onset and width of the sensory block was assessed by pinprick method, upper limb motor block by hand grip and wrist flexion and lower limb by modified bromage scale [MBS]. Vital parameters like Heart Rate (HR), NIBP, Respiratory Rate (RR), SPO_2 were recorded every 3 min for first 15 min, then every 5 min till the end of the surgical procedure. The surgery was allowed to proceed once the block reached T_4 dermatome. The laparoscopic surgery was performed using CO_2 insufflation with pressure limit 10 to 11 mmHg.

Every patient was encouraged to report if he/she experiences any discomfort and to report regarding muscle relaxation or any technical difficulty during the procedure. Visual Analogue Scale (VAS) score and Ramsay sedation scale were used to evaluate pain and sedation, respectively.

RESULTS

14 Cases were selected, out of which 6 were laparoscopic cholecystectomy, 4 open cholecystectomy, 3 emergency exploratory laparotomy and 1 simple mastectomy. Age group of patients ranged from 25 to 65 y of which Male: Female ratio was 4:10. BMI ranged from 22 to 24.9. Regarding physiological status, 10 patients were of ASA Grade I, 3 were of ASA Grade II and 1 with ASA Grade III.

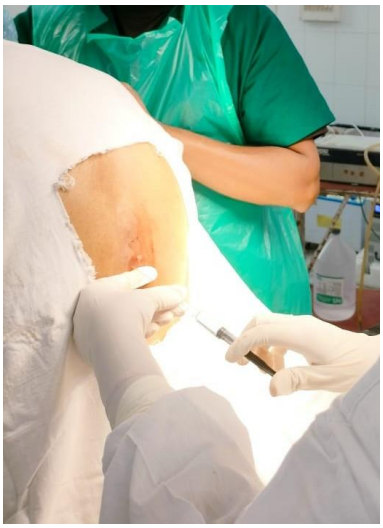

Fig. 1: Insertion of the spinal needle at T_{8-9} space

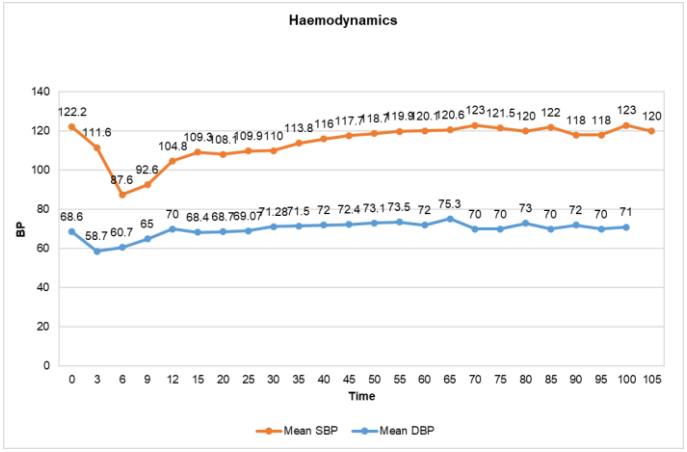

Fig. 2: Mean SBP and DBP plotted against time in minutes

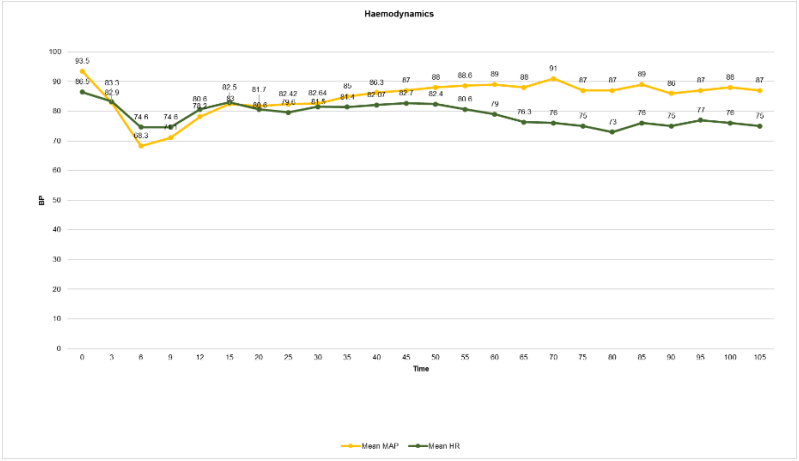

Fig. 3: Mean MAP and HR plotted against time in minutes

Regarding hemodynamic variation, hypotension was observed (SBP<90 mg) in every patient 5 to 10 min after administration of the spinal drug and in the laparoscopic cases, a second fall was observed after giving the patients reverse Trendelenburg position. All these patients responded to

bolus dose of fluid and an injection ephedrine 6 mg IV. However, bradycardia HR<55/min was not observed in the study. The patients were comfortable throughout the intraoperative period and there was no complaint of respiratory difficulty, abdominal or shoulder pain or vomiting. SPO_2 was maintained at 98 to 100 % throughout the surgery. Total IV fluid administered was 700 ml to 1.5 L.

Table 1: Level of dermatome for sensory block during surgery

Type of surgery	Time interval	Upper dermatome	Lower dermatome
Upper abdominal surgery	5 min	T 4	L1
	15 min	T3	L1
	30 min	T3	L1
	60 min	T3	L1
	90 min	T3	L1 to L2
	105 min	T3	L1 to L2
Simple mastectomy	5 min	T3	T6
	10 min	T1	T8
	15 min	T1	T8
	30 min	T1	T8
	60 min	T1	T8
	70 min	T2	T8

Upper abdominal surgeries include-1. laparoscopic and open cholecystectomy, 2. Exploratory laparotomy 3. Gastrojejunostomy, The average width of sensory dermatome block was T_3 to L_{1-2} in upper abdominal surgeries and T_1 to T_8 in simple mastectomy.

Table 2: Motor block for upper limb and lower limb in STSA group in before and after surgery

Score±SD	Hand grip and wrist flexion (upper limb)	Modified bromage scale (lower limb)
Before surgery		
1. Upper abdominal surgeries	Yes	0 to 1
2. Simple mastectomy	Yes	0
Postoperative		
1. Upper abdominal surgeries	Yes	0 to 1
2. Simple mastectomy	Yes	0

During and at the termination of surgery, all the patients could assist themselves to shift to the stretcher indicating motor block of MBS 0-1.

Table 3: Postoperative level of dermatome for sensory block

Type of surgery	Time of interval	Upper dermatome	Lower dermatome
Upper abdominal surgery	15 min	T4	L1 to L2
	30 min	T4	L1 to L2
	60 min	T4	L2
	90 min	T5	L1
	120 min	T5	L1
Simple mastectomy	15 min	T2	T8
	30 min	T3	T7
	60 min	T4	T7
	90 min	T4	T7
	120 min	T4	T7

2 h postoperatively, the average width of sensory dermatome block was T_5 to L_1 in upper abdominal surgeries and T_4 to T_7 in simple mastectomy.

Table 4: Intraoperative ramsay sedation scale

Duration	Ramsay sedation scale	Number of patients
15 min	2	14
30 min	2	14
60 min	2	14
110 min	2	14

Data are expressed in number n (14) Ramsay sedation scale: 1. Anxious and agitated or restless or both; 2. cooperative, oriented and tranquil; 3. response to commands only; 4. brisk response to light glabellar tap or loud auditory stimulus 5. sluggish response to a light glabellar tap or loud auditory stimulus; 6. no response to a light glabellar tap or loud auditory stimulus.

Table 5: Post op VAS score

VAS	STSA
Immediate postoperative period	0
1 h post op	0
2 h post op	0
3 h post op	0
4 h post op	1
5 h post op	1
6 h post op	1

VAS score: visual analogue scale, 0: No Pain, 1-3: mild pain, 4-6: moderate pain, 7-9: severe pain 10: worst possible pain. Regarding analgesia, VAS score was 0 during the procedure and 0-1 postoperatively. Sedation score was 2 intraoperatively and 2 postoperatively.

The patients were kept in the postoperative care unit till complete regression of block and monitoring of vital parameters. VAS and Ramsay sedation scale scoring was continued hourly till 6 h. The longest duration of time to first rescue analgesia was 6 h in simple mastectomy case, the laparoscopic and open cholecystectomy cases 5 to 6 h, whereas the gastrojejunostomy case and explanatory laparotomy cases 4 to 5 h.

The patient's satisfaction was good and didn't experience any discomfort during intraoperative period. Regarding the surgical procedure the surgeons appreciated relaxation with no technical difficulty. There was no report on headache or urinary retention.

The patients were in contact after discharge and none of the patients experienced neurological deficit.

DISCUSSION

It has been observed in the present study that upper abdominal and breast surgery can be performed successfully under segmental thoracic spinal anaesthesia by using a minute dose of isobaric levobupivacaine (7.5 mg) for abdominal surgeries and 6 mg for simple mastectomy in combination with an adjuvant (Fentanyl 20µg). The C. S. F. volume in the thoracic segment is comparatively less and radicules are thinner. So, it results in less dilution and more profound block and to attain sensory block up to $T_{2-3,}$ dose requirement is half that of lumbar approach. Low dose also has the advantage of minimizing the degree of thoracic nerve block in less spread of solution 2 lumbo-sacral nerve root, resulting in minimum or no lower limb paralysis.

In the present study, the root to diaphragm was intact (C_{3-5}) and no consequence of paralyzing the primary expiratory muscle. None of the patient experienced respiratory discomfort during the surgical procedure and during CO_2 insufflation in laparoscopic cholecystectomy. SPO_2 was maintained 98 to 100% with 3 L O_2/min supplementation via face mask. All the patient could assist themselves while shifting and MBS was 0 to 1 throughout.

The MRI study confirmed more anterior position of the spinal cord in the thoracic region within the dural sac, having greater distance between dura to cord at mid thoracic level [2]. Moreover, the spinal cord and cauda equina move with gravity and also ventrally with flexion [9]. So, the main concern of iatrogenic injury to the cord by needle tip was not there. None of the patient reported paresthesia during the procedure.

Imbelloni LL [10] reported 6.6% incidence of paraesthesia in his study of 300 case while using thoracic segmental anaesthesia technique without any neurological sequelae.

Spinal anaesthesia produces profound sensory, motor and sympathetic block. So, denervation at the surgical field produced stable hemodynamic and lower stress response to noxious stimuli. Neuraxial anaesthesia, mainly epidural and high spinal supplemented by general anaesthesia is the newest technique. High spinal is preferred over epidural.

In the present study all the patient developed hypotension within 5 to 10 min and responded well to bolus fluid and injection of 6 mg Ephedrine. Highest dose requirement was 18 mg but no one developed bradycardia.

Ahmed Mahmoud [11] in his study on 25 patients undergoing simple mastectomy and lumpectomy, used 1 ml of 0.5% plain bupivacaine with 50µg fentanyl in T_5 level and width of sensory block was T_{1-2} to T_{11-12} and reported no significant adverse effect. Systemic analgesia was not required, however, three patients developed hypotension and nausea. Another study [12], reported an uneventful breast debridement under thoracic spinal at T_{6-7} level in a 55 y old obese, diabetic, hypotensive patient with Mallampati grade III who refused general anesthesia. Patient was comfortable and vasopressor or parasympatholytic drugs were not required.

Mazy *et al.* [13] reported high patient satisfaction, adequate block, and good analgesia while administering thoracic spinal anaesthesia at T_{5-6} level in 35 ASA II-IV patient using 1.5 ml 0.5% plain bupivacaine with 5µg Dexmedetomidine undergoing modified radical mastectomy with axillary dissection. However, side effect like hypotension, nausea, vomiting though present but not significant and was managed well.

CONCLUSION

The present observational study provides the evidence that segmental thoracic spinal anesthesia is a feasible, safe and effective regional anaesthesia technique providing good intraoperative and postoperative analgesia, muscle relaxation, hemodynamic stability, good surgeon and patient satisfaction with early ambulation without having any significant untoward complications.

ACKNOWLEDGEMENT

We are thankful to the patient for giving consent to conduct the study.

FUNDING

Nil

AUTHORS CONTRIBUTIONS

All authors have contributed equally

CONFLICT OF INTERESTS

Declared none

REFERENCES

1. Jonnesco TB. Remarks on general spinal analgesia. Survey of Anesthesiology. 1978;3:301.
2. Lee RA, Van Zundert AA, Breedveld P, Wondergem JH, Peek D, Wieringa PA. The anatomy of the thoracic spinal canal investigated with magnetic resonance imaging (MRI). Acta Anaesthesiol Belg. 2007;58(3):163-7. doi: 10.1097/00115550-200709001-00018, PMID 18018836.
3. Reynolds F. Damage to the conus medullaris following spinal anaesthesia. Anaesthesia. 2001;56(3):238-47. doi: 10.1046/j.1365-2044.2001.01422-2.x, PMID 11251431.
4. van Zundert AA, Stultiens G, Jakimowicz JJ, Peek D, van der Ham WG, Korsten HH. Wildsmith segmental spinal anesthesia for cholecystectomy in a patient with severe lung disease. British Journal of Anaesthesia. 2006;96(4):406-6.
5. van Zundert AA, Stultiens G, Jakimowicz JJ, Peek D, van der Ham WG, Korsten HH. Laparoscopic cholecystectomy under segmental thoracic spinal anaesthesia: a feasibility study. Br J Anaesth. 2007 May 5;98:682-6. doi: 10.1093/bja/aem058, PMID 17371777.
6. Patel K, Salgaonkar S. Segmental thoracic spinal anesthesia in patient with byssinosis undergoing nephrectomy. Anesth Essays Res. 2012 Jul-Dec;6(2):236-8. doi: 10.4103/0259-1162.108352, PMID 25885628, PMCID PMC4173450.
7. Chauhan R, Sabharwal P, Sarna R, Meena S. Thoracic spinal anesthesia for cesarean section in severe pre-eclampsia: exploring a new dimension. Ain-Shams J Anesthesiol. 2021;13(1):22. doi: 10.1186/s42077-021-00143-9.
8. Khan IA, Paliwal NW, Ahmad S. Safety and feasibility of segmental thoracic spinal anaesthesia (STSA): a scoping review. Sch J App Med Sci. 2022;10(10):1718-22. doi: 10.36347/sjams.2022.v10i10.022.
9. Takiguchi T, Yamaguchi S, Hashizume Y, Kitajima T. Movement of the cauda equina during the lateral decubitus position with fully flexed leg. Anesthesiology. 2004;101(5):1250. doi: 10.1097/00000542-200411000-00044, PMID 15505480.
10. Imbelloni LE, Pitombo PF, Ganem EM. The incidence of paresthesia and neurologic complications after lower spinal thoracic puncture with cut needle compared to pencil-point needle. Study in 300 Patients. J Anesthe Clinic Res. 2010;1(2). doi: 10.4172/2155-6148.1000106.
11. Mahmoud AA, Hussein H, Kamal A, Nafady H, Girgis K. Hussein hazem abdulmegid ahmed nafady hesham ahmed girgis karim. The novel use of spinal anesthesia at the mid-thoracic level: a feasibility study. Egypt J Cardiothorac Anesth. 2014;8(1):21. doi: 10.4103/1687-9090.137233.

12. Upadhyay S, Khan I, Singh S. Breast debridement under segmental spinal anaesthesia in a low resource setting: feasibility and safety concerns. 2022. doi: 10.13107/jaccr.v08i03.205;8:01-4.

13. Mazy A, El-Domiaty A, Mageed NA, Motawi AA, Messeha M. Comparison between thoracic paravertebral block and segmental thoracic spinal anesthesia in breast cancer surgery. Ain Shams J Anesthesiol. 2022;14(1):88. doi: 10.1186/s42077-022-00281-8.