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## A clinical study of efficacy of thoracic epidural block for post-operative analgesia after thoracic and upper abdominal surgeries

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### Abstract

Surgical procedure on thoracic and upper abdominal region result in most severe postoperative pain and if treated inadequately or inappropriately result in higher incidence of postoperative complication and physical morbidity. We evaluate the postoperative analgesic efficacy of thoracic epidural block by administering inj. Bupivacaine (0.25%) after thoracic and abdominal surgeries. We concluded that it is the technique of choice for adequate analgesia in the immediate postoperative period following the thoracic and abdominal surgeries, where due to pain severe respiratory embarrassment, increase morbidity, delayed recovery, prolong hospital stay was anticipated.

**Keywords:** epidural anaesthesia, thoracic and upper abdomen surgeries, postoperative pain, local anaesthesia

### Introduction

The pain of mankind are always with us and post operative pain, in particular, is something which each of us must at sometime treat or endure.

Many millions of patients worldwide undergo surgery and benefit from the knowledge, skill and sophisticated technology that characterize most aspects of modern surgical treatment. Although effective pain control is essential for optimal care of surgical patients and anaesthesiologist have succeeded to a greater extent by rendering the patient absolutely pain free during surgery, yet many patients continue to experience considerable discomfort in postoperative period despite advances in knowledge of pathophysiology, pharmacology of analgesic and the development of more effective technique for postoperative pain control.

Post operative pain is a self limiting phenomenon, most severe during the first day following surgery, diminishing over the next 24 hours, and minimal after 3<sup>rd</sup> or 4<sup>th</sup> day. Maximal functional derangement due to pain occurs in first 48 hours following surgical trauma. Therefore, most potent and effective analgesia with minimal systemic side effects is required in first 48 hours to facilitate mobilization and recovery.

The pathophysiological consequence of thoracic and upper abdominal surgeries are intimately associated with severe post-operative pain, which result in reflex mediated increase in tone of abdominal muscles during expiration and decrease in diaphragmatic function. The effect is, reduced pulmonary compliance due to muscle splinting resulting in inability to breath deeply or cough forcefully, which cause changes in pulmonary function including increase in respiratory rate and reduced vital capacity, tidal volume, residual volume, functional residual capacity (FRC) and forced one second expiratory volume (FEV1).

Surgical trauma and postoperative pain produces hormonal and metabolic disturbance and results in postoperative negative nitrogen balance. Prolonged immobility due to post-operative pain is also associated with venous stasis, platelet aggregations and therefore increases risk of deep vein thrombosis.

The overall effect of inadequate postoperative analgesia is increase morbidity, pulmonary infection and other postoperative complication, delayed recovery, prolonged hospital stay and increased medical cost. Thus, satisfactory post-operative analgesia is essential not only to keep up the morale of the patients but also to avoid harmful effects. Moderate to severe postoperative pain as occur after thoracic and upper abdominal surgeries can be relieved by.

systemic administration of narcotic analgesics. However systemic opioids not only provide incomplete pain relief but are also associated with higher incidence of side effect like respiratory depression, sedation, emesis, constipation, tolerance and addiction.

In attempt to provide more complete relief of postoperative pain and avoid disadvantage associated with systemic opioids, the pain pathway can be peripherally interrupted using epidural route with a proper local anaesthetic agent. Epidural blockade of the appropriate segment with proper analgesic has following advantages:--

- i. It relieve both somatic as well as visceral pain, thus provide more complete post-operative analgesia.
- ii. Epidural analgesia using local anaesthetic also reduces the metabolic response to surgical trauma and thus prevents post-operative negative nitrogen balance.
- iii. Central nervous system depression is avoided, hence patient remain alert, co-operative and free from respiratory depression.
- iv. Epidural analgesia with local anaesthetic has a beneficial effect on postoperative pulmonary function and provides better arterial oxygenation.
- v. Complete analgesia without sedation provides better patient mobility in immediate post operative period, which results in reduced incidence of chest infection and deep vein thrombosis.
- vi. Postoperative analgesia can be provided for a prolonged period by simply placing an epidural catheter. Epidural analgesia using epidural catheter can be provided by either 'continuous infusion' or intermittent 'Top-up' technique. Disadvantage of infusion technique is that it requires sophisticated instrument like infusion pump and continuous monitoring, while 'Top-up' technique is simple, does not required specialized instrument and continuous monitoring, can be done in any hospital setting

Bupivacain is a local anaesthetic agent with long duration of action. It also has a greater affinity for sensory than motor nerve fibres and in concentration of 0.25%, it primary block the sensory fibres and thus provide the adaequate analgesia without muscles paralysis.

This study will therefore evaluate the postoperative analgesic efficacy of thoracic epidural block by administering inj. Bupivacain (0.25%) after thoracic and upper abdominal surgeries.

### Aims and Objectives

The aims and objectives of present study are:-

- To study the efficacy of thoracic epidural block by administering inj. Bupivacain for post-operative analgesia after thoracic and upper abdominal surgeries.
- To study the effect of epidural Bupivacaine on cardiovascular and respiratory dynamics.
- To study the side effects.
- To study the complications.
- To study the patients acceptance.

### Material and Methods

The present study was carried out in the Department of Anesthesiology, MGM Medical College & M.Y. Hospital Indore (M.P.).

The study group includes thirty patients both male and female, aged between 20-60 yr. with ASA physical status I-

III, scheduled for thoracic and upper abdominal surgeries. Exclusion criteria were patients less than 20 years or over 60 years, addicted to narcotic or other drugs, chronic alcoholics, patient with psychiatric disorder or allergic to bupivacaine. Patient with the accepted contraindications to performance of an epidural block or patient who refused insertion of an epidural catheter were excluded from study. Also excluded were patients with a history of cerebrovascular or cardiac disease whose condition could be compromised by the hypotension, which might be associated with epidural analgesia.

### PRE Operative Period

An informed written consent was obtained from the entire patient. A detail preoperative assessment was done before operation. At the same time visual analogue scale (VAS) for assessment of pain was also explained.

### PRE Medication

All the patients was premedicated with tablet *alprazolam* 0.25 mg orally night before operation. Inj. glycopyrolate intramuscular was given 45 minutes before operation.

### Material

1. Epidural tray with
2. Epidural needle- Tuohy needle 16 G.
3. Disposable epidural catheter No. 18 G.
4. Bupivacaine 0.25 % vial
5. 5 cc, 10 cc, 20 cc syringe with needle.

### Method

Before induction of anesthesia, patient was examined and pulse, blood pressure and respiratory rate were recorded. A vein was secured and all the routine preparations were done. In sitting position of patient, after local infiltration of inj. Lignocaine 2% 2ml, a 16G epidural needle was inserted with all aseptic precaution through the midline approach at a suitable space between T6 to T9 depending on the level of surgical incision. Epidural space was identified by "Loss of resistance" technique and a disposable 18G epidural catheter was inserted cephalad 2-3 cm into the epidural space and secured with adhesive. Technical complication in relation to epidural puncture or insertion of catheter was recorded. Patient was now placed in supine position.

After catheter placement a test dose of 2 ml inj. Lignocaine 1% with adrenaline 1:200000 was infused to exclude the possibility of subarachnoid or intravascular placement of catheter.

After negative test dose and confirmation of adequate placement of the catheter, induction was done as per normal general anaesthesia protocol.

In the postoperative ward, as soon patient complained of pain at surgical site inj. Bupivacaine 0.25% 6-8 ml was injected through epidural catheter. Pulse rate, blood pressure and respiratory rate were recorded just before and then 5, 10, 15, 20, 30, 45, 60 minutes after injection.

Top-up dose of inj. Bupivacaine 0.25% 6-8 ml was given when patient complained even mildest pain at surgical site.

### Evaluation

Pain intensity at rest and during function was evaluated using a 10 point Visual Analogue Scale, one end (0 point of VAS) of which shows no pain and other end (10 point of VAS) worst possible pain.

A five point “Verbal Response Scale” was also used to assess the severity of the pain.

Score 0 - No pain on coughing

Score 1 - Pain on coughing but not on deep breathing

Score 2 - Pain on deep breathing but not at rest.

Score 3 - Pain at rest, slight

Score 4 - Pain at rest, severe

Pain assessment were made just before and then 15, 30, 45 and 60 minutes after each epidural injection. The duration of analgesia was taken as the time interval between the two subsequent epidural injections.

Analgesia with epidural catheter was provided for first 48 hours post operatively, then catheter removed and analgesia was maintained with conventional methods.

If in any patient VAS remained 5 or above despite epidural bupivacaine, then a standard ‘Rescue Analgesia’ (Inj. Diclofenac) was administered. Number of such rescue analgesic for the first 48 hours was also recorded. All side effects which include nausea, vomiting, backache sedation or drowsiness, hypotension, sign of excessive block or numbness weakness in limb were recorded.

At the 5<sup>th</sup> post-operative day each patient was interviewed regarding the acceptance of procedure then to grade overall pain relief in first 48 hours as excellent, good, fair or poor.

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Thirty patient posted for thoracic & upper abdominal surgeries were include in our study and efficacy of epidural administered Bupivacaine 0.25% at mid thoracic region using epidural catheter and intermittent ‘Top-up’ technique for post-operative analgesia during first 48 hours was studied.

The following observations were recorded.

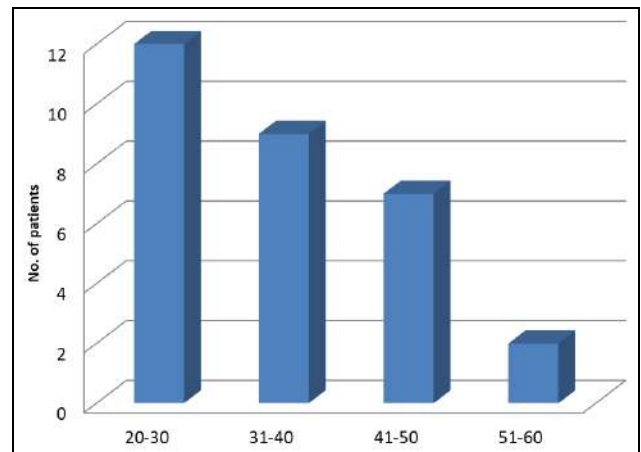


Fig 1: Showing the age distribution of the patient

**Observations**

The present study was carried out in the Department of

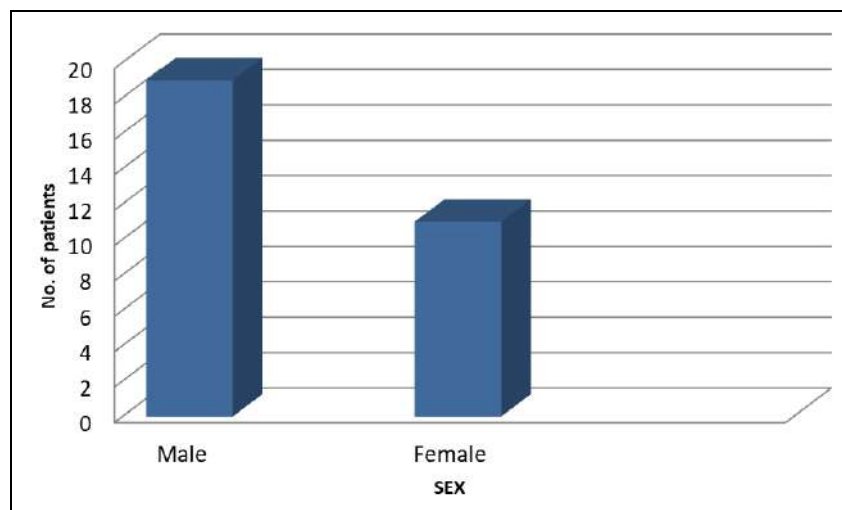


Fig 2: Showing the sex distribution of the patients

**Table 1:** Distribution of Onset Time of Analgesia in Both the Sexes

S. No.	Onset time (min)	Male percentage females percentage			
		Male	Percentage	Females	Percentage
1.	0-2	-	-	-	-
2.	3-5	3	15.79	3	27.27
3.	6-8	14	73.69	5	45.46
4.	9-11	1	5.26	2	18.18
5.	12-14	1	5.26	1	09.09
	TOTAL	19	100.00	11	100.00

	Male	Female	Total
Mean Onset Time	07	11	09
Standard Deviation	1.97	4.61	2.10

Z Value: 2.7369 P value :< 0.05. Significance-Significant The Above table compares the time of onset of analgesia in both the sexes. Out of 19 male patients, 17 (89.48%) have

the onset time of less than 8 minute. While out of 11 female patients, 8(72.72%) female have the onset time of less than 8 minutes.

**Table 2:** Showing Verbal Response Score (VRS)

S. No.	Time (minutes)	Verbal rating score									
		0		1		2		3		4	
		Pt No.	%	Pt No.	%	Pt No.	%	Pt No.	%	Pt No.	%
1	0	-	-	1	3.33	17	56.67	10	33.33	2	6.67
2	15	12	40	14	46.66	2	6.67	2	6.67	-	-
3	30	26	86.67	3	10.00	1	3.33	-	-	-	-
4	45	29	96.67	-	-	1	3.33	-	-	-	-
5	60	29	96.67	-	-	1	3.33	-	-	-	-
6	90	26	86.67	3	10.00	1	3.33	-	-	-	-

The above table shows the distribution of verbal rating score before (0 minute) and 15, 30, 45, 60 and 90 minutes after epidural bupivacaine. At 0 minute 2 patient (6.67%) have severe pain at rest, 10 (33.33%) patient have mild pain at rest 17 (56.67%) patient have pain on deep breathing and only one (3.33%) patient have pain on coughing. At 15 minute after epidural bupivacaine 12 (40%) patient have no pain at rest or during function, 14 (46.66%) have pain only on coughing, 2 (6.67%) have pain on deep breathing and 2

(6.67%) patient have mild pain on rest. 30 minute after epidural bupivacaine 26 (86.67%) patient having no pain while 3 (10%) patient have pain only on coughing and 1 (3.33%) on deep breathing. No patient had pain at rest. 45 minute after epidural bupivacaine 29 (96.67%) patient having no pain at all and only on patient having pain on deep breathing. At 60 minute after epidural bupivacaine, distribution of VRS remains same.

**Table 3:** The Mean Visual Analogue Scale at rest (Vas -R) after Bupivacaine 0.25%

S.no.	Time (minute)	Mean VAS-R	Standard deviation	P value	Significance
1	0	2.2	0.624	-	-
2	15	0.417	0.743	<0.01	Significant
3	30	0.083	0.456	<0.01	Significant
4	45	0.067	0.365	<0.01	Significant
5	60	0.033	0.182	<0.01	Significant
6	90	0.06	0.201	<0.01	Significant

The above table shows the values of 10-point visual analogue scale at rest. Before epidural Bupivacaine, mean value of VAS-R was 2.2 which dropped to 0.417 at 15

minute and maximum drop in VAS-R occurred at 60 minutes when it decreased up to 0.033.

**Table 4:** The Mean Visual Analogue Scale at Function (Vas-F) after Bupivacaine 2.25%

S. No.	Time (minute)	Mean VAS-F	Standard Deviation	P value	Significance
1	0	3.10	0.78	-	-
2	15	0.97	1.616	<0.01	Significant
3	30	0.18	0.59	<0.01	Significant
4	45	0.10	0.547	<0.01	Significant
5	60	0.07	0.365	<0.01	Significant
6	90	0.13	0.413	<0.01	Significant

The visual analogue score at function (VAS-F) was assessed by asking the patient to breathe deeply and cough forcefully while he/ she was sitting. The mean value of VAS-F was 3.10 at 0 minute and dropped to 0.97 at 15 minute after

Bupivacaine administration. The value of VAS-F was also decreased maximally at 60 minutes after epidural bupivacaine when it dropped up to 0.07.

**Table 5:** Duration of Pain Relief

S.no.	Duration of analgesia (min.)	Mean Duration (min)	Standard deviation	No. Of Patients	Percentage
1	<60	-	-	-	-
2	61-90	90.00	0.0	1	3.33
3	91-120	111.00	1.0	2	6.67
4	121-150	136.60	7.7	20	66.67
5	151-180	165.20	8.5	5	16.67
6	181-210	190.00	6.0	2	6.66
7	<210	-	-	-	-

The above table shows the distribution of duration of analgesia in 30 patients after epidural bupivacaine. There is a wide variation in duration of analgesia, which ranges from 90 minute to 210 minute. However, 20 (66.67%) patients out of 30 had the mean duration of analgesia of 136.6

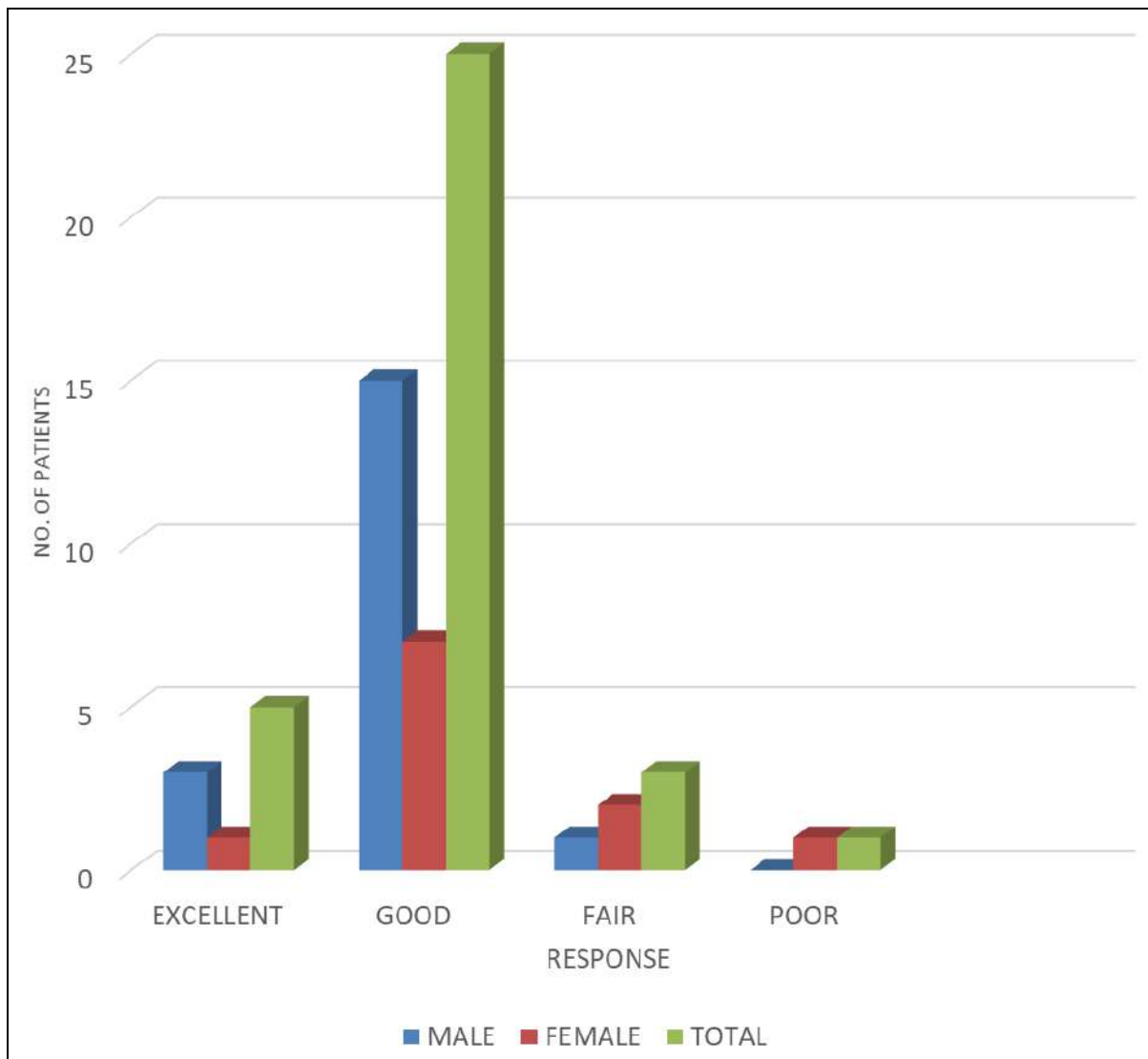
minutes, 5 (16.67%) patients had mean duration of pain relief of 165.2 minute, 2 patients of 190 minutes Only 3(10%) patient had duration of pain relief of less than 120 minute.

**Table 6:** Incidence of side Effects

S. No.	Side Effects	Male		Female		Total	
		No.	%	No.	%	No.	%
1	No Side Effects	-	-	-	-	18	60.00
2	Nausea	1	5.26	1	9.09	2	6.67
3	Vomiting	-	-	1	9.09	1	3.33
4	Headache	-	-	-	-	-	-
5	Dizziness	1	5.26	1	9.09	2	6.67
6	Hypotension	3	15.79	2	18.18	5	16.67
7	Numbness In Hand	-	-	-	-	-	-
8	Leg Weakness	-	-	-	-	-	-
9	Backache	-	-	1	9.09	1	3.33
10	Drowsiness	-	-	-	-	-	-
11	Bradycardia	-	-	1	9.09	1	3.33
12	Others	-	-	-	-	-	-

Table shows the insignificant side effect except mild hypotension (BP<90 mm Hg or fall in BP > 20 mm Hg from

'0' minute value) in only 5 patients which respond well to rapid infusion of ringer lactate solution.



**Fig 3:** Showing the response to whole procedure

**Discussion**

Surgical procedures on thoracic & upper abdominal region results in most severe post-operative pain and if treated inadequately or inappropriately results in higher incidence of postoperative complication and physical morbidity. An ideal analgesic should provide relief of pain without change of consciousness or personality and should permit

return of nervous functions. It should have its effect localized to where analgesia is required and should not produce systemic effect. Local anesthetic agents can provide this sort of analgesia when used with the technique of regional analgesia. Thoracic epidural blockade of the appropriate segment has relieved both somatic and visceral pain and abolished reflex

muscle spasm while still leaving the patient alert, ambulatory, cooperative and free from respiratory depression.

Local anesthetic agents, while providing reliable and rapid relief of pain, have the disadvantage of short effectiveness. Bupivacaine, however is a local anesthetic agent with long duration of action. It also has a greater affinity for sensory than motor nerve fibers and in concentration of 0.25%, it primarily blocks the sensory fibers and thus provide analgesia without motor block.

Our study was undertaken therefore to evaluate the clinical efficacy of segmental thoracic epidural analgesia using bupivacaine 0.25%, after thoracic & upper abdominal surgeries to provide postoperative analgesia for first 48 hours.

Cleland (1949) was first person who relieved postoperative pain by means of continuous epidural analgesia and reported procedure effective.

Bonica (1955) after experience with several hundred cases considered segmental extra- Dural analgesia to be superior to any other method of managing postoperative pain. He used intermittent injection through indwelling catheter.

Epidural analgesia using epidural catheter can be provided by either 'continuous infusion' or intermittent 'Top-up' technique. In our study we have used intermittent top up technique because of its simplicity and lack of requirement of any specialized equipment and continuous vigilance in post operative ward as in our hospital. Peter Buckley and B. Ray Simpson (1980) also advocate the intermittent 'Top-Up' technique. They mentioned the advantage of intermittent injection that there is the potential problem of catheter movement into a blood vessel or sub-arachnoid space while infusion continues with infusion pump.

In our study onset of analgesia was recorded from 4 to 12 minutes with mean onset of 7 (SD 2.10) minutes. However out of 30 patients, 25(84%) patients had the rapid onset time of less than 8 minutes and only 2 patients had the onset time of 12 minutes.

P.C. Lund *et al* in 1975 [7] reported the onset time for sensory block after bupivacaine was 6 to 8 minutes, which corresponds with our results.

Pain is such a subjective experience that it is extremely difficult to convey or assess its severity. In our study we have used a 10-point visual analogue and 5-point verbal rating scale for assessment of severity of pain.

N.V. Addison *et al* (1974) in their study of postoperative analgesia following cholecystectomy with thoracic epidural technique using Bupivacaine 0.5% assessed the pain with 100 mm visual analogues scale and found, 15 out of their 25 patients had more than 70% pain relief.

T.A. Torda and O.A. Pybus (1984) [11] in their comparative study of epidural bupivacaine with morphine also used the visual analogue scale for pain assessment. They showed that visual analogue pain score was decreased significantly by both agent ( $P < 0.001$ ) and bupivacaine was significantly better in this respect than morphine ( $P \text{ value} < 0.001$ ).

R.J. Cuschieri *et al* (1985) had used visual analogue pain score for measuring pain and observed the patient receiving epidural analgesia had significantly less pain for the first 12 hours than either intramuscular or infusion group ( $P < 0.001$ ) and visual analogue score dropped 21 from 53 in bupivacaine group.

An average duration of analgesia was also estimated in our study. There is a wide variation in the duration of pain relief

in our study, which ranges from 90 to 200 minutes with mean duration of analgesia of 141.6 (SD 22.07) minutes. However 20 (66.67%) patients had mean duration of analgesia of 136.6 (SD 7.70) minutes and only 3 (10%) patient had the duration of analgesia less than 120 minutes.

Buckly and Simpson (1975) using segmental thoracic epidural analgesia with bupivacaine for postoperative analgesia following upper abdominal surgery recorded the duration of analgesia with bupivacaine 0.5% was 100-150 minutes and 85-130 minutes with bupivacaine 0.375%.

In our study, monitoring of vital parameters does not show any significant variation in pulse and respiratory rate before and after Bupivacaine injection ( $p > 0.05$ ). However blood pressure shows a statistically significant drop at 15, 20, 30 and 45 minutes after bupivacaine injection, which again became insignificant at 60 and 90 minutes. Clinically, this variation in blood pressure is insignificant in most of the patients because of so many other reasons.

Addison and colleagues (1974) in their study of thoracic epidural analgesia with bupivacaine found that pulse rate and respiratory rate remained stable throughout study period and out of 25, only one patient developed hypotension.

Griffith *et al* (1975) [5] reported hypotension in 3 out of 10 patients given bupivacaine 0.5% with intermittent 'top up' technique while pulse and respiration remained stable in their study.

T. A. Torda and O.A. Pybus in their study found that there is a light decrease in heart rate and respiratory rate after epidural Bupivacaine 0.5% which is statistically not significant but significant decreases in systolic blood pressure noted at 15, 30, 45 minutes observation after epidural bupivacaine.

However out of 24 patients only 3 patients became significantly hypotensive and required vasopressor drugs.

In our study out of 30 patients only 5 (16%) patient develop significant hypotension (i.e. blood pressure less than 90mm Hg or drop more than 20 mm Hg.) and all 5 patients responded well to rapid infusion of ringer lactate.

Incidence of side effect other than hypotension in 5 patients and bradycardia in one patient are remarkably low. 2(6%) patients complained of nausea, one (3%) vomited, 2 (6%) patients developed dizziness on sitting and backache occurred in only one (3%) patient. No other complication was noticed in our study. Overall, 18 (60%) patients developed no side effects and only 7 patients suffered minor and nonspecific side effects.

Edwin C. James *et al.* (1981) [6] reported no side effect except hypotension after epidural bupivacaine 0.5%. Spence and Smith (1971) also reported no side effect after epidural bupivacaine 0.5% used for postoperative analgesia after thoracic and upper abdominal surgery.

T. A. Torda and D.A. Pypus (1984) [11] also found no side effect of epidural bupivacaine except hypotension in 3 patients out of 10 patients.

Griffith *et al.* (1975) [5] found 20% incidence of drowsiness, 30% of hypotension, 30% of breathlessness and 37% of urinary retention, after intermittent top-up bupivacaine 0.5% given for postoperative analgesia after thoracic surgery.

Remarkably no complication was noted in our study regarding technique of epidural puncture or catheter insertion or removal. In our study at 5<sup>th</sup> post-operative day, all the patient were interviewed regarding acceptability of procedure and over all pain relief in first 48 hours.

Rober L. Shuman (1976) [9] in their study of epidural

analgesia following thoracotomy in patient with chronic obstructive airway disease reported excellent analgesia in 7 patients out of 8 patients. In our study, when interviewed at 5<sup>th</sup> postoperative day, 22 (73.44%) patients graded analgesia as good, 4 (13.33%) patient as excellent, 3 (10%) patients as fair and only one patient graded analgesia as poor in first 48 hours.

### Summary and Conclusions

The pathophysiologic consequences of thoracic upper abdominal surgeries are intimately associated with severe post-operative pain and resultant high incidence of postoperative complications and increased morbidity. Conventional method of narcotic analgesia not only provides inadequate pain relief but also is associated with deleterious systemic side effects.

Thoracic segmental epidural analgesia despite its technical difficulty and time consumption not only provides more complete analgesia but also has beneficial effects on postoperative pulmonary and metabolic functions.

Keeping in view this study was carried out in 30 patients who underwent various thoracic & upper abdominal surgical procedures. Patient of ASA grade I-III of either sex were included in our study. Epidural puncture and catheter insertion was done with all aseptic precautions general anesthesia was given with conventional method. At the end of operation reversal and extubation done.

In recovery room 6 to 8 ml bupivacaine 0.25% was injected through epidural catheter, when patient complained of even mild discomfort at surgical site.

All the patients were instructed to note the onset time of analgesia. All the vital parameters and pain score using analogue and verbal rating scale were recorded at regular interval. Further dose of 6-8 ml of bupivacaine was injected with intermittent 'top-up' method using epidural catheter at the patient's request, for first 48 hours post-operatively.

The mean onset time of subjective analgesia was 7 (SD 2.10) minutes, mean duration of analgesia was 141.66 (SD 22.07) minutes. The pain score as assessed by visual analogue scale at rest and at function and also with verbal rating score remained significantly reduced (P value<0.05) throughout study period.

There were no significant changes in vital parameters, except mild hypotension in only 5 patients, which was easily corrected with ringer lactate infusion.

The mean numbers of 'Top up' doses required are 15, mean volume of drug injected was 100.6 ml and mean amount of drug given was 325.45 mgs in 48 hours' study period, Incidence of side effects was remarkably minimal, which include mild hypotension (16%), nausea and vomiting (10%), dizziness (6%) and backache (3%).

Overall response to whole procedure was graded as excellent or good by 87% of patients, while only one patient graded analgesia as poor. s

It is concluded from above observations, results and discussion, that thoracic segmental extra-dural block abolishes, rather than relieving pain, setting an entirely new standard in post-operative analgesia. The limitation of technique is that it is time consuming and requires scrupulous asepsis, special training and skill. The only side effect of hypotension can be minimized by using minimum concentration of drug, which selectively blocks sensory fibers.

Although impracticable for all cases, it is the technique of choice for adequate analgesia in the immediate post-operative period following thoracic and upper abdominal surgeries, where due to pain severe respiratory embarrassment was anticipated.

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