Thoracic epidural analgesia versus intravenous opioid analgesia for the treatment of rib fracture pain

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Abstract

Background: Rib fractures are common and pain from rib fractures can be difficult to control, particularly in first few days. This pain may affect the pulmonary function, morbidity and intensive care unit stay. The limited evidence from the previous studies illustrates the difficulties in determining the relevant outcomes.

Objective: To compare and evaluate the efficacy of epidural analgesia versus systemic intravenous opioid analgesia for the treatment of rib fracture pain.

Methods: The case records of patients with rib fractures from January 1, 2007 to June 30, 2010, were reviewed. Data was collected from 94 patients who had three or more rib fractures. Entry criteria included patients older than 18 years with 3 or more than 3 ribs fractures and no contraindications to epidural catheter placement. All patients had initiation of thoracic epidural analgesia with bupivacaine or intravenous opioid analgesia within 24 hours of admission in intensive care unit.

Results: Injury Severity Score was not significantly different between two groups, while patients in epidural group had significantly more rib fractures. Patients who received epidural analgesia had significantly lower pain scores, improved pulmonary functions and decreased intensive care unit stay.

Conclusion: Thoracic epidural analgesia provided better pain control than systemic intravenous opioid analgesia in rib fractures. However, further research is needed to strengthen this conclusion.

Key words: Epidural analgesia, Rib fracture, Thoracic trauma

Introduction

Pain due to traumatic rib fractures may be associated with increased morbidity and mortality. Fracture ribs cause severe pain that adversely affects patients' ability to cough and breathe deeply, that may lead to decreased ventilator efforts, atelectasis, pneumonia and finally respiratory failure. That further results in longer intensive care unit (ICU) and hospital length of stay and higher mortality.[1] Effective pain relief, chest physiotherapy and respiratory care are the points of management. Effective analgesia enables the patient to breathe deeply, cough out the secretions and comply with chest physiotherapy.[2] Multiple pain relief treatment options are available, such as oral analgesics, intravenous opioids, patient-controlled opioid analgesia, interpleural blocks, intercostal blocks, paravertebral blocks, and epidural analgesia.

Recent studies reported that epidural analgesia reduces morbidity after major thoracic, abdominal and vascular surgeries, but in patients with rib fractures, retrospective studies showed inconsistent benefits of epidural analgesia compared to other analgesic modalities.[3,4,5,6,7] The use of epidural analgesia is still controversial because outcomes are variable in available studies.[5,7,8] However, recent guidelines report that epidural analgesia is a better option in patients with multiple rib fractures.[9] No meta-analysis on this topic is yet completed. Further this subject is not properly addressed in national and regional literature.

Epidural catheters are commonly use with intend of pain relief, yet there exist no definite indications for epidural analgesia. Additionally epidural analgesia in not a benign procedure and associated with potential complications like haematoma and abscess in the spinal space.[10] The purpose of our recent experience is to evaluate epidural analgesia versus intravenous opioid analgesia for rib fracture pain.

Methodology

We reviewed retrospectively, the case records of patients with rib fractures from 1st January 2007 to 30th June 2010. The study was conducted at Surgical Intensive Care Unit of Pakistan Institute of Medical Sciences Islamabad Pakistan. Patients older than 18 years of age with 3 or more than 3 ribs fractures were included in the study, which had either epidural analgesia or intravenous opioid analgesia as pain relief modality. Exclusion criteria included contraindication to epidural catheter placement (sepsis at insertion site, coagulopathy, or hypovolemic shock), pregnancy, allergy to local anaesthetics or opioids, or who had associated injuries like intracranial haematoma.

Patients demographics like age, gender, injury severity score, length of intensive care unit and hospital stay, complications, and type of pain control used (epidural analgesia or intravenous opioid) were recorded. Progress of the patient was noted through case files during the hospital stay and follow-up chest radiographs reporting effusion, infiltrate, and/or pneumonia. All patients had initiation of thoracic epidural analgesia with bupivacaine or intravenous opioid analgesia within 24 hours of admission in intensive care unit. Epidural catheter was placed and analgesia was maintained by department of Anaesthesiology. Catheters were inserted in the

thoracic region (T5 through T8), with a standard loss-of-resistance technique. Pain relief was assessed for both groups using a standard verbal rating scale. Pain scores (1 to 5 scale as reported by the patient with 1 = no pain, 2 = mild pain, 3 = moderate pain, 4 = severe pain, 5 = unbearable pain) were obtained from a standardized form used in all patients. Pain scores were obtained every 4 hours by the nurses and recorded for both epidural and IV analgesia.

Length of ICU stay (days) was defined as the time of admission to ICU to transfer to surgical ward and length of hospital stay (days) was defined as time patient admitted to emergency to time of discharge from hospital.

Data was analyzed and expressed as mean ± SD. The Mann-Whitney U test was used for ordinal pain scores. A t test was used to compare numerical data. A p value less than 0.05 was considered statistically significant.

Results

Records of 218 patients were reviewed; 94 met the inclusion criteria. Nine cases were excluded as they received both epidural analgesia and intravenous morphine. Majority of patients were injured as a result of road traffic accident. There were 64 males and 21 females. Age ranged from 23 to 71 and mean age of the patients was 47 years. A total of 47 patients were treated with thoracic epidural analgesia and 38 patients were treated with intravenous opioid analgesia. Demographic data is shown in Table 1 and injury data in Table 2. There was no difference regarding age and gender between both groups, however patients in epidural group were significantly older and had more number of rib fractures. Further, the two groups did not differ in terms of injury severity score, nor were there significant differences with respect to pulmonary contusions, pneumothorax, haemothorax, and presence of chest tubes.

During the first 24 hours of start of analgesia, the patients of epidural group showed a significant ($p < 0.05$) reduction in pain score on coughing as compared with patients receiving intravenous opioid analgesia. Patients of epidural group had significantly lower pain scores at all intervals during the study. Data of analgesia and length of stay are presented in Table 3. There was statistically significant difference in duration of analgesia, length of ICU, and length of hospital stay. There was no difference between the two groups regarding pulmonary, cardiac, or neurological complications Table 4.

Discussion

Thoracic trauma is a significant cause of morbidity and mortality in our society. Incidence of thoracic trauma has rapidly increased in this century of high speed vehicles, violence and various other disasters. Thoracic traumas comprise 10–15% of all traumas and are the causes of death in 25% of all fatalities due to trauma.[11] Rib fractures are common thoracic injury associated with significant pulmonary morbidity.

Our study was based on patients with three or more rib fractures because the presence of three or more rib fractures is associated with an increase in mortality, hospital stay, and number of ICU days.[12,13] Ninety-four patients met this inclusion criteria of three or more rib fractures sustained after trauma and thoracic epidural analgesia with local anaesthetics or intravenous opioid analgesia initiated within 24 hours of admission. Patients who received epidural analgesia had a significantly superior analgesia at all time intervals. Our findings confirm results from other studies in which patients who received epidural analgesia had significantly less pain than those who received intravenous opioids.[1,2,5] The patients in the epidural group had significantly more rib fractures and were significantly older, but there were no differences between the groups with respect to gender, body weight, mode of injury, injury severity score, presence of flail segment, lung contusion and placement of chest tube.

Pain from multiple rib fractures may results in voluntary splinting and muscle spasms, which subsequently leads to atelectasis and decreased ventilation. Compromise of pulmonary function can also cause hypoxemia, an increase in shunt fraction, or pneumonia, which may require mechanical ventilation. The association of rib fractures with pulmonary morbidity and mortality strongly highlighted the subject of safety and efficacy of different analgesic modalities in patients with rib fractures.

The effectiveness of epidural analgesia to systemic opioids is well-established in providing pain relief after thoracotomy.[14,15,16,17] Hence the logic follows that patients who receive epidural analgesia after rib fractures should benefit similarly to post-thoracotomy patients. Many previous studies showed the advantages of epidural analgesia over other analgesia modalities.[18,19,20,21] Recent evidence reports that patients receiving epidural analgesia had greater tidal volumes and spent less time on mechanical ventilation.[5] Traditionally, physicians have used their choice for epidural analgesia in patients with greater number of rib fractures because these patients are at increased risk of morbidity and mortality.[3,6,22] But, no objective criteria or indications have been established for the use of epidural analgesia in patients with rib fractures especially the elderly patients.

Moon et al prospectively in a study of 24 patients, demonstrated superior analgesia and pulmonary function as well as decreased level of circulatory inflammatory mediators associated with acute lung injury in patients treated with epidural versus those treated with patient controlled analgesia.[23] In another study comparing epidural versus patient controlled analgesia, Wu et al reported significantly lower pain scores in patients treated with epidurals.[7] Mohta et al randomized 30 patients to either thoracic epidural analgesia or thoracic paravertebral infusion with continuous bupivacaine infusion and found improved pain scores and had similar complication rates, in patients with rib fractures.[24]

Some studies compared the use of epidural analgesia versus systemic opioid analgesia for the treatment of rib fracture pain in motor vehicle accidents. Winsor, in his retrospective study on 307 patients above 60 years of age, found that epidural analgesia was an independent predictor of decreased mortality and less incidence of pulmonary complications.[6] Previously, epidural catheters were placed in lumbar region and opioids were used as the sole analgesic agent. Mackersie et al reported that patients who received lumbar epidural fentanyl had a statistically significant improvement in their maximal inspiratory pressure, vital capacity and room air $PaCO_2$.[25] Analgesic variables that may affect the degree of pulmonary dysfunction include route

of analgesia administration (epidural vs. systemic), location of epidural placement (thoracic vs. lumbar), and type of analgesic agent (opioid vs. local anesthetics; lipophilic vs. hydrophilic opioids).[18]

Recently two meta-analysis reports were published with almost similar results. Carrier FM from Canada reported that there was no significant benefit of epidural analgesia on mortality, ICU and hospital length of stay was observed compared to other analgesic modalities in adult patients with traumatic rib fractures. However, there may be a benefit on the duration of mechanical ventilation with the use of thoracic epidural analgesia with local anaesthetics.[26] Jarvis AM et al in another meta-analysis from USA demonstrated that despite more rib fractures, greater injury severity and physiologic acuity among patients receiving epidural analgesia, the use of this therapy results in less time spent on mechanical ventilation, greater improvement in ventilatory tidal volumes during the first 24 hours of therapy, as well as lower incidence of pneumonia and pulmonary complications.[27]

Our study favours both above reports, however we observed significantly decreased length of ICU and hospital stay in patients who received epidural analgesia. There was a statistical trend toward longer hospital stays among patients receiving epidural analgesia for their rib fractures in the meta-analysis, but we have different results. Patient's variation and extent of injury may be different.

The overall mortality and morbidity regarding cardiac, pulmonary or neurologic complications between two groups in our study is not statistically significant. We noted complications related to epidural analgesia in our patients; that were conservatively managed. The use of epidural analgesia is associated with potential risks; some of them are rare but potentially devastating. Fortunately we did not have any complication associated with epidural insertion because catheters were placed by experienced anaesthesiologist in all our patients.

There were limitations to our study such as small sample size, inability to blind the doctors or patients, and assessment by the third person when reliability is questionable. Our study is certainly limited by its retrospective nature. Sometimes the patients were non co-operative and non-responsive or drowsy especially in the opioid group. Exclusion and even inclusion of some patients for epidural could have introduced some selection bias. Keeping in view the limitations of our study, a study with larger sample size might show some significant differences. Further prospective studies are needed to define the role of epidural analgesia in severe thoracic trauma.

In sum, rib fractures can be indicators of significant trauma. Morbidity and mortality increases as the number of fractured ribs increase. Patients with three or more rib fractures have an indication of hospitalization. Pain management is critical to prevent respiratory depression due to pain.

Conclusion

We conclude that epidural analgesia significantly reduced pain in patients with rib fractures compared with intravenous opioid analgesia. The duration of days spent on mechanical ventilation, ICU stay and hospital stay was reduced with the use of epidural analgesia.

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Conflict of interest: None

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Table 1: Demographic Data

Age (years)	54+17	45+22	0.04
Sex: Female	12 (25%)	9 (24%)	0.86
Weight (Kg)	74.4+11.5	71.7+17.0	0.38
Mode of Injury: Road traffic accident	33 (70%)	21 (55%)	0.89

Table 2: Injury Data

	Epidural Group (n=47)	IV Opioid Group (n=38)	p value
No of rib fractures	6.4+_2.1	5.2+_2.5	0.01
Injury Severity Score	23.6+_10.3	21.0+_6.7	0.38
Flail segment	9/47 (19%)	5/38 (13%)	0.86
Lung contusion	19/47 (40%)	15/38 (39%)	0.57
Pneumothorax	29/47 (62%)	22/38 (58%)	0.47
Haemothorax	21/47 (45%)	16/38 (42%)	0.88
Chest tube	42/47 (89%)	28/38 (74%)	0.91

Table 3: Analgesia & Length of Stay

	Epidural Group (n=47)	IV Opioid Group (n=38)	p value
Days on analgesia	4.25+_1.2	5.5+_3.2	0.015
Length of ICU stay (Days)	12+_2.4	14+_3.5	0.002
Length of hospital stay (Days)	19+_3.1	21+_4.1	0.01

Table 4: Mortality & Morbidity

	Epidural Group (n=47)	IV Opioid Group (n=38)	p value
Death	2 (4%)	1 (2.6%)	0.84
Complications	4 (8%)	7 (18%)	0.86
Intubation	12 (25%)	9 (24%)	0.93
Pneumonia	6 (13%)	10 (26%)	0.87
Cardiac	2 (4%)	1 (2.6%)	0.84