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Comparison Thoracic Epidural and Intercostal Block to Improve Ventilation Parameters and Reduce Pain in Patients with Multiple Rib Fractures

Shahryar Hashemzadeh[1], Khosrov Hashemzadeh[2], Hamzeh Hosseinzadeh[1*], Raheleh Aligholipour Maleki[1], Samad Golzari [3]

[1]*Department of Thoracic Surgery, Tabriz University of Medical Sciences, Tabriz, Iran*
[2]*Cardiovascular Research Center, Tabriz University of Medical Sciences, Tabriz, Iran*
[3]*Medical Philosophy and History Research Center, Tabriz University of Medical Sciences, Tabriz, Iran*

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ABSTRACT

Introduction: Chest wall blunt trauma causes multiple rib fractures and will often be associated with significant pain and may compromise ventilator mechanics. Analgesia has great roll in rib fracture therapies, opioid are useful, but when used as sole agent may require such high dose that they produce respiratory depression, especially in elderly .the best analgesia for a severe chest wall injury is a continuous epidural infusion of local anesthetic. This provides complete analgesia allowing inspiration and coughing without of the risk of respiratory depression. ***Methods***: sixty adult patients who with multiple rib fractures were enrolled in this study. They were divided into Group A or thoracic epidural with bupivacaine 0.125 % +1mg/5ml morphine and group B or intercostal block with 0.25% bupivacaine. The patients were assessed through ICU and hospital stay length, ventilation function tests. Pain score among the patients was measured with verbal rating scale, before and after administration of the analgesia. ***Results***: We found a significant improvement in ventilatory function tests during the 1st, 2nd, and 3rd days after epidural analgesia compared with the intercostal block ($P < 0.004$). Changes in the visual Analogue Scale were associated with marked improvement regarding pain at rest and pain caused by coughing and deep breathing in group A compared group B... ICU and hospital stay markedly reduced in Group A. ***Conclusion***: thoracic epidural analgesia is superior to intercostals block regarding pain relief of rib fractures. Patients who received epidural analgesia had significantly lower pain scores at all studied times.

Introduction

Multiple rib fractures and blunt chest traumas are accompanied by considerable mortality and morbidity. One third of these patients suffer from pulmonary complications as well and 30% of them suffer from pneumonia.[1-3] Patients who are over 65 years old are susceptible to serious complications which are due to blunt chest trauma.[1,4-6] Lung morbidity for the patients with pure rib fractures reported 38%. Blunt chest traumas can directly cause death (due to pulmonary and non pulmonary complications). The rate of the mortality which is due to these traumas is 6% from which 65% is directly related to secondary lung complications.[7] The rate of mortality of the patients suffering from flail chest is 16%.[8] Multiple rib fractures cause considerable pain compromising respiratory mechanics, exacerbating underlying lung injury and predisposing the patients to respiratory failure. Oxygenation of patients suffering from chest wall injury is directly affected by pain relief. Multiple rib fractures due to blunt chest traumas are caused by road accident, fall and....The bases of treatment for the patients who suffer from fractures analgesia, pain relief and pulmonary toilet Opioid analgesics are useful but may cause respiratory depression especially if it is used in high doses. [9,10] Intercostals block and epidural block are other two alternative methods. In this study, intercostals block and thoracic epidural analgesia are compared regarding respiratory parameters, ICU stay and pain score.

Materials and methods

60 patients with multiple and severe rib fractures were compared in this clinical trial study. 30 patients were

***Corresponding Author:** Hamzeh Hosseinzadeh (MD), Tel.: +98 9141149082, Fax: +98 411 3344798, E-mail**:** hosseinz@tbzmed.ac.ir

inserted epidural catheter (group A) and 30 patients were treated through intercostals block (group B). This study, after receiving the permission from research committee, was performed in Tabriz Imam Khomeini hospital from Aug 2007 to Dec 2008. All the patients referring to Imam Hospital who were admitted in ICU and had the necessary inclusion criteria (in the case of interest and consent) were enrolled in the study and divided randomly into one of the A, B groups. At the first 24 hours after admission all the patients were performed spirometry tests. Group A (thoracic epidural) was performed epidural thoracic block with marcaine (0.125) from the spaces of T5-T6 or T6-T7 and 1mg morphine, as analgesic for each 5 m of the solution. For every segment, 1ml of the above-mentioned solution (with the consideration of equal spread of drug upward and downward and the number of fractured ribs) was administered through catheter and repeated every 8 hours. Epidural catheter insertion method was performed using loss of resistance using needle number 18. Group B received intercostals block with marcaine 0.25% and 3 ml of this solution was injected in the form of single shot in every intercostals space and it was repeated every 8 hours. Both groups received pethidine 0.5 ml PRN.

Study inclusion criteria

Patients over 18 years old with more than one rib fractures, GCS>14, absence of recognized epidural catheter insertion contraindication.

Exclusion criteria

One and two rib fractures, patients under conservative treatment of liver or blunt splenic trauma, patients with decreased consciousness, patients who suffer from cerebral injury or other injuries and are under mechanical ventilation, patients with coagulopathy, fever and systemic or epidural infection.

Collected data

number of fractured ribs, unilateral or bilateral, flail chest, and need for chest tube placement, sternal fracture, (tidal volume, vital capacity, minute expiratory volume, functional residual capacity before and 72 hours after block spirometry), ABG (before and after the block) . Need for mechanical ventilation, ICU stay and pain score of the patients in both groups and demographic information were collected.

Statistical methods

Acquired data have been presented in the form of mean, standard deviation and percentage. Quantitative variables were compared through paired test and independent t-test. Qualitative variables (categorical) were compared through Chi-squared test and Fisher's exact test in accordance with circumstances. In all the cases P value <0.05 was considered significant (Tables 1-5).

Results

Demographic data including age, gender, weight, and history of illness and being smoker are presented in Table 1.

Discussion

In this study, we compared two methods of analgesia (thoracic epidural block and intercostal nerves block).Comparing the results of spirometry which were performed after treatment showed that respiratory condition of the group undergoing thoracic epidural block in most of the factors such as tidal volume and minute expiratory volume except for vital capacity was better than intercostal block group. (P is 0.014 and 0.038 respectively).furthermore analysis blood gases (except for PaCO2) after treatment shows that epidural method is more superior to intercostal block method.

According to the study performed by Mackersie and colleagues, thoracic epidural method, (improving lung and respiratory performance), is a useful method for the patients with multiple rib fractures.[11] Similar results have been reported by Dittmann et al.[12] In 2002, through a wide ranging study, Govindarajan et al showed that respiratory condition and ventilation performance are increased through thoracic epidural method more than other prevail methods like systemic injection.[13] Moon and colleagues in their study confirmed the superiority of this method.[14] Jayr et al emphasized the improvement of the pressure of arterial oxygen.[15] All these studies are in line with our findings.

Debreceni and colleagues in their study which comparing thoracic epidural block with intercostal block (on patients undergoing thoracotomy), showed that there was significant difference in spirometry standards.[16] Luketich et al reported similar results in patients with multiple rib fractures.[17] In our study, there was no difference regarding incidence of respiratory complications between two groups and generally there were fewer respiratory complications in our study. Abouhatem et al, in a study which was performed on 19 patients, introduced thoracic epidural method as a safe method and reported similar results.[18] No significant differences were reported by Wu and colleagues.[19] However, the number of respiratory complications (pneumonia) has been reported to be fewer when compared with systemic analgesics.[20] Further results with studies carried out on larger samples could be achieved. The risk of infections can be increased through stimulation of catecholamine response in systemic analgesia method. There is however fewer or no catecholamine response in epidural analgesia.[14] On the

other hand, faster improvement and better long performance prevent infections such as pneumococcal infections in the patients undergoing thoracic epidural block. In our study although ICU stay length of epidural group was shorter than intercostal block group but differences were not significant and ward stay length in epidural group was shorter than intercostal but the differences were however not statistically significant. Many confounding factors may have influenced this case such as inadequate facilities in our hospital ICU and the absence of optimal and adequate nursing. In order to gain sufficient and optimal results further prospective studies are required.

Table 1.demographic data

Group	Gender		age	weight	smoker	Coexisting disease*
	female	male				
Group A	5%	95%	45.5±15.4	66±11.24	50%	10%
Group B	10%	90%	65.45±7.15	68±14.7	25%	20%
P	0.9	0.9	0.35	0.45	0.10	0.19

*Co existing disease in group A: ischemic heart disease 3 cases and in Group B: Ischemic heart disease 2 cases, diabetes 2 cases and hyperthyroidism 1 case

Table 2. hemodynamic parameters (MAP, HR, and SaO2), consciousness status, respiratory rate and body temperature before block performance

	MAP Mean±SD	HR Mean±SD	BT Mean±SD	Sao2 Mean±SD	GCS Mean±SD	Respiratory rate Mean±SD
Group A	89.85±15.98	100.75±12.27	36.65±0.51	91.65±5.1	14.5±6.7	7.6±34.5
Group B	94.4±13.55	94±11.87	36.85±0.51	93.3±3.94	14.55±0.51	32.9±5.12
P	0.28	0.85	0.27	0.25	0.75	0.40

Mean and standard deviation and P are indicate of no significant difference during hospitalization

Table 3. Respiratory parameters before and after block in both groups

	FRC liter		Minute volume liter		Vital capacity liter		Tidal volume liter	
	Before	after	Before	after	Before	after	Before	after
Group A	2.5±0.46	1.95±0.25	44.2±4.7	35.6± 6.53	2.41±0.16	1.5.±0.26	0.52±0.26	0.42±0.13
Group B	2.32±9.3	2.08±9.19	41.24±5.2	36.63±7.95	2.24±0.03	1.53±0.04	0.48±0.14	0.38±0.17
P	0.73	0.95	0.03	0.67	0.08	0.93	0.04	0.41

Mean±SD and P revealed no significant difference in tidal volume whereas significant difference was observed in vital capacity, minute ventilation and FRC before and after block

Table 4. The mean ICU and ward stay length and pain score in epidural and intercostals block group

	Pain score cough	Pain score rest	Ward stay length	ICU stay Length
Group A	3.05± 0.88	2.2± 0.74	5.7 ± 1.97	1.58 ± 0.95
Group B	4.95± 0.99	3.3±1.005	7.65±3.72	1.9±1.35
P	0.00	0.03	0.04	0.05

Numbers are presented as mean and standard deviation and P<0.05 considered significant.

Table 5. Comparison of analyzed parameters of arterial gases between two studied groups before and after block performance with in 3 days of hospitalization

	Group A Mean±SD	Group B Mean±SD	P
Pao_2 before block	63.4±13,5	64.3±10.3	0.20
After block	74.75±19.7	66.42±10.21	0.06
1^{th} day	78.8±1.109	69.3±8.21	0.01
3^{th} day	77.36±8.92	78.8±10.25	0.01
Co_2 before block	36.15±4.18	34.45±5.2	0.74
After block	37.6±3.66	37.35±4.1	0.84
1^{th} day	39.5±3.66	37.85±3.24	0.10
3^{th} day	39.8±4.11	36.88±2.29	0.11
Co_3h before block	20.3±3.26	20.45±2.48	0.59
After block	21.18±1.8	20.32±2.35	0.58
1^{th} day	23.3±1,41	20.8±1.6	0.59
3^{th} day	23.3±1.35	21.65±1.64	0.00
Ph before block	7.34±0.07	7.33±0.07	0.87
After block	7.31±0.09	7.32±0.09	0.77
1^{th} day	7.35±0.03	7.36±0.04	0.71
3^{th} day	7.4±0.04	7.37±0.04	0.01

Numbers are presented as mean and standard deviation and $p<0.05$ considered significant.

Conclusion

Thoracic epidural analgesia of the patients with multiple rib fractures considerably lead to improvement of respiratory parameters in comparison with intercostal block which is due to improvement of tidal volume, minute volume, arterial oxygen pressure and arterial pH .All mentioned factors would consequently lead to considerable decreased hospital stay and provide better control of pain than intercostal block.

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Ethical issues: The study was approved by the Ethical Committee of Tabriz University of Medical Sciences, Tabriz, Iran. We kept personal information of patients as confidential. Also, patients signed informed consent form before launching of the study.

Conflict of interests: No conflict of interest to be declared.

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