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# THE EFFICACY OF PATIENT CONTROLLED THORACIC EPIDURAL ANALGESIA FOR THE TREATMENT OF RIB FRACTURE PAIN İN INTENSIVE ÇARE UNIT

# YOĞUN BAKIMDA KOT KIRIKLARININ AĞRISININ TEDAVİSİNDA HASTA KONTROLLÜ TORAKAL EPİDURAL ANALJEZİNİN ETKİNLİĞİ

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Key words: thoracic trauma, patient controlled analgesia, thoracic epidural analgesia, bupivacaine, fentanyl
Anahtar sözcükler: toraks travması, hasta kontrollü analjezi, torasik epidural analjezi, bupivakain, fentanil

***SUMMARY***

*Pain from rib fractures may affect cardiopulmonary functions. The aim of this study is to evaluate the efficacy of patient controlled thoracic epidural analgesia (PCTEA) for pain relief in chest trauma patients.*

*Ten patients were included. Heart rate, mean arterial pressure, pain scores by Visual Analogue Scale (VAS) at rest, cough and movement, respiratory rate, PaO2 and vital capacity (VC) were measured behre and after PCTEA. The patients were monitored for 72 h during analgesic treatment. After the placement of the epidural catheter, a PCA pump was used for PCTEA. 10 mL of 0,125% bupivacaine plus fentanyl citrate (2 jj,g/mL) was delivered as a loading dose and the same analgesic mixture was used for the maintenance at the foilowing dosages: basal infusion rate 5 mL/hr, PCA bolus dose 10 mL and lockout time 30 min. VAS scores were recorded at 4-hour intervals, VC and PaO2 was measured before PCTEA and at predetermined intervals.*

*VAS scores (at rest, cough and movement), VC and PaO2 were improved during 72 h follow-up period.*

*PCTEA could be applied safely and successfully for pain relief in chest trauma patients.*

***ÖZET***

*Kot kırıklarına bağlı ağrı kardiyopulmoner fonksiyonları olumsuz etkilemektedir. Bu çalışmanın amacı toraks travmalı hastalarda ağrı tedavisi için kullanılan hasta kontrollü torasik epidural analjezinin etkinliğini araştırmaktır.*

*10 hasta çalışmaya alındı. Kalp atım hızı, ortalama arter basıncı, istirahat, öksürük ve hareket sırasında Vizüel Analog Skala (VAS) ile belirlenen ağrı skorları, solunum sayısı, arteriyel oksijen parsiyel basıncı ve vital kapasite ölçümleri epidural analjezi öncesi ve sonrasında yapıldı. Hastalar analjezik tedavi sırasında 72 saat takip edildiler. Epidural kateter takıldıktan sonra PCA cihazı bağlandı. Yükleme dozu olarak 10 mL 0,125% bupivakain ve fentanil sitrat (2 /ıg/ mL) verildi, aynı analjezik karışımla bazal infüzyon 5 mUsaat, PCA bolus dozu 10 mL ve kilitli kalma süresi 30 dk olarak belirlendi. VAS skorları 4 saat arayla, vital kapasite ve PaO2 değerleri önceden belirlenen aralar ile belirlendi.*

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## INTRODUCTION

Trauma, caused by various accidents, takes third line among the causes of death in today's population. Roughly 25% of these cases die because of complications of the trauma (1). İn thoracic trauma, muscle and bony structures of the thoracic wall, respiratory function pleural cavity, lung parenchyma, circulation dynamics of the heart and great vessels are affected. İn non-penetrating thorax traumas, rib fractures can be observed in 85% of the cases (1). One of the most important clinical features of rib fractures is the pain caused by movements of the thoracic wall during inspiration or by the pressure över the fractured rib. Trauma of the parietal pleura, bony structures and especially of intercostal nerves are very painful. This pain makes respiratory effort difficult, increasing the work of breathing. Ali of these prevent deep inspiration so that tachypnea and hypoventilation develop. As a result of these changes, there's a relative increase in dead space, a decrease in effective coughing and aiso there's retention of secretions. These deteriorations cause hypercapnia, hypoxia and later on atelectasis, infection and pneumonia (2). This chain of events makes accompanying pulmonary contusion and ventilatory deteriorations worse, resulting in acute respiratory distress syndrome (ARDS). So, pain control is one of the most important of part thoracic trauma treatment. It's been shown that blockade of neurogenic stimuli arising from traumatic area by epidural local anesthetic agents may reduce the increase in plasma catecholamine, ACTH, aldosterone, cortisol, renin, prolactin and antidiuretic hormone concentrations which are released as a neuroendocrine response to trauma (3). The deterioration in pulmonary function may be corrected by deep and forceful inspiration, forceful coughing and active participation of the patient to respiratory physiotherapy. This can be achieved by sufficient analgesia without oversedation (2). İn analgesic therapy of rib fractures in thorax traumas; minör analgesics and NSAIDs, intermittent or continuous intravenous or epidural opioids, intermittent/continuous epidural local anesthetic or local anesthetic plus opioid combination infusion, intercostal nerve block, intrapleural analgesia and TENS may be used.

In this study we intended to evaluate the efficacy of patient-controlled thoracic epidural analgesia (PCTEA) for pain relief in patients with thoracic trauma with rib fractures.

## MATERIALS AND METHODS

The study was approved by Institutional Ethics Committee of Ege University and 10 trauma patients between 20-50 years of age (9 male, 1 female) admitted to our Intensıve Çare Unıt (ICU) were included after informed written consent was obtained. Patients with at least four rib fractures without hemopneumothorax who do not need mechanical ventilation were involved in the study. Ali of the patients were neurologically intact, conscious and cooperated. Patients with sepsis and central nervous system trauma were excluded. Patients were informed about the use of spirometer and patient controlled analgesia (PCA) device, and visual analog scale (VAS) scoring system. Before placing the epidural catheter, coagulation tests such as bleeding time, clotting time, thrombocyte count, prothrombin time and activity, partial thromboplastin time were checked. Those with abnormal test results were excluded. Heart rate (HR), mean arterial pressure (MAP), respiratory rate (RR) and arterial blood gas values were obtained before inserting the epidural catheter. Vital capacity was measured by spirometer. Then baseline VAS scores at rest, at cough and at movement were recorded before epidural catheter placement. For evaluation of pain intensity, 10 cm VAS scale (0:no pain, 10:worst pain ever) was used. Thoracic epidural space was entered by 16G Tuohy needle by midline approach in sitting position corresponding to the dermatomes of fractured ribs. Epidural space was found by loss of resistance technique with şaline and a thoracic epidural catheter (18G, Minipack, Portex Limited, Kent, England) was advanced 3-5 cm in the epidural space. After fixation of the catheter, 5 mi of local anesthetic (lidocaine 2%) containing 1:200000 epinephrine was administered as a test dose. Then we waited for 5 minutes and after verifying the absence of motor block and tachycardia, we provided a PCA pump to the patient (APM Abbott Pain Management Provider). As a bolus dose, 10 mi of 0,125% bupivacaine plus fentanyl citrate (2 u.g/ml) was injected through the catheter. We infused this analgesic solution continuously for 72 hours during the follow-up period. Basal infusion rate was determined as 5 ml/hr and bolus dose as 10 mi. Lock-out time was limited to 30 minutes. Ali of the patients received 5 mi/ h supplemental oxygen during follow- up period. Pain intensity by using VAS, RR, HR, MAP and SpÜ2 values were recorded at 4-h intervals. PaO2 and vital capacity were measured before and 12, 24, 48, 72 hours after starting epidural analgesia. We checked sensory and motor blockade levels in regular intervals during the study. Statistical analysis was done by ANOVA and Chi-square tests and $p < 0.05$ was accepted as statistically significant.

## RESULTS

Demographic values, duration of stay in ICU and total number of fractured ribs are seen at Table 1. PaÛ2 and vital capacity values showed significant improvement (Table 2).

VAS scores at rest, movement and cough were decreased significantly at ali times after starting epidural analgesia throughout the study when compared to the baseline values (Figures 1-3). During the study period cardiorespiratory variables remained in physiological ranges (Table3). Motor blockade was not observed. Sensory blockade was determined between T4-T10 dermatomes. During the 72 h follow-up, the average number of PCA demand was 111 ±94 and PCA delivery was 48±32 in reply to these demands.

Table 1. Demographic values, duration of stay in ICU and the number of fractured ribs

| | |
|---|---|
| Sex | 9 M, 1 F |
| Age (year) | 41,5±7,3 |
| Weight (kg) | 74,3±9,1 |
| The number of fractured ribs | 6,3±2,0 (min:4max:11) |
| Length of stay in ICU (days) | 7±3 |

Table 2. $PaO_2$ and vital capacity changes of the patients

| | $PaO_2$ (mmHg) | Vital Capacity (mi) |
|---|---|---|
| Before epidural analgesia | 72.68± 15.69 | 1032.50± 617.12 |
| 12 h after starting PCTEA | 92.62± 22.39 * | 1430.00± 512.18* |
| 24 h after starting PCTEA | 83.29±21.34 | 1535.71± 502.26* |
| 48 h after starting PCTEA | 97.43± 28.90 * | 1605.56± 685.31* |
| 72 h after starting PCTEA | 86.98± 15.65* | 1500.00± 296.65* |

* $p<0.05$ when compared with baseline

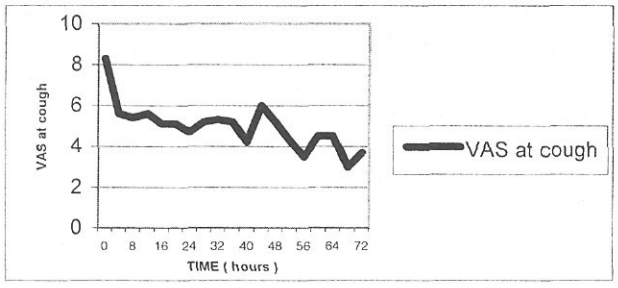
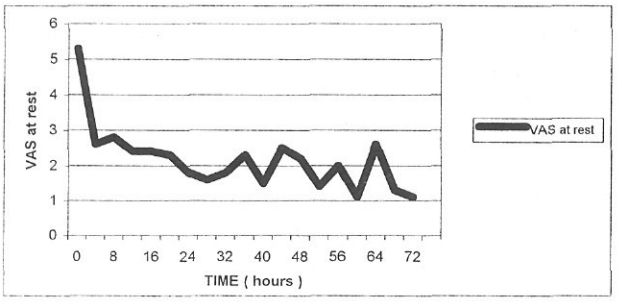
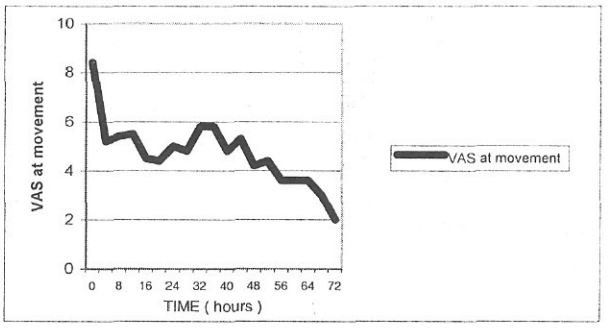



Figure 1. Changes in VAS scores at cough




Figüre 2. Changes in VAS scores at rest




Figüre 3. Changes in VAS scores at movement

Table 3. Heart rate, mean arterial pressure and respiratory rate changes of the patients

| | Heart rate (Beats/min) | Mean arterial Pressure (mmHg) | Respiratory rate (Breaths/min) |
|---|---|---|---|
| Before epidural analgesia | 81.12± 11.15 | 92.671 11.37 | 24.31±7.28 |
| 12 h after starting PCTEA | 78.72±10.12 | 87.271 10.25 | 21.35±6.73 |
| 24 h after starting PCTEA | 76.32111.62 | 86.92±12.07 | 20.18±3.35 |
| 48 h after starting PCTEA | 77.05± 11.27 | 87.351 11.25 | 20.26±4.72 |
| 72 h after starting PCTEA | 77.331 10.55 | 87.72± 9.63 | 19.3215.27 |

## DISCUSSION

Pain caused by rib fractures due to thorax trauma deteriorates respiratory functions and increase morbidity and mortality (4). The significant increase in mortality and morbidity caused by multiple rib fractures is especially related to respiratory complications (5). İn such cases, the aim of providing effective analgesia is to provide patient's easy coughing, comfortable exercising with spirometer and active participating into respiratory physiotherapy. By this way, respiratory complications may be prevented. Otherwise, pain precipitated by multiple rib fractures may lead to hypoventilation, atelectasis, infection, pneumonia and respiratory insufficiency (6).

İn cases with multiple rib fractures, minör analgesics and NSAIDs, intravenous opioids, intercostal nerve blockade, paravertebral blockade, intrapleural analgesia and opioids or local anesthetics by epidural route are advised to be used for pain relief (6).

In our study group, since patients had 4 or more rib fractures and are supposed to have severe pain, we chose local anesthetic and opioid combination by PCTEA instead of minör analgesic and NSAIDs. Another reason for our choice was that opioids, given systemically, may

preventing morbidity in cases with multiple rib fractures and thoracic traumas. It has been preferred in trauma patients with its high satisfaction rate and it also lets the patient to determine his analgesic requirement by himself. As a result PCTEA may be proposed as an effective technique of analgesia in patients with thoracic traumas and multiple rib fractures.

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