Abstract: The aim of this study is to assess the safety of conservative management modalities in patients with traumatic pneumothorax (PTX). Materials and Methods: We retrospectively analyzed the records of 128 patients with the diagnosis of PTX and hemopneumothorax (HPTX) due to chest trauma between 2002 and 2007. The mechanism of trauma, the treatment modality, the size of PTX (we define small PTX less than 20% of thoracic volume) pulmonary and extra pulmonary injuries, and the number of rib fractures were analyzed. Results: There were 97 male and 31 female trauma patients whose age ranged from 16 to 77. The mechanism of injury was blunt trauma in 60 patients and penetrating trauma in 68 patients. Pulmonary complications were PTX in 71, hemopneumothorax (HPTX) in 57 patients. Forty seven patients with chest trauma had associated rib fractures. Thirty three (25.8%) injuries were treated initially without chest tube drainage. Four of these 33 patients subsequently had chest drain application because of asymptomatic enlargement of the pneumothorax size on chest radiography during the follow up period. None of the remaining 29 patients deteriorated clinically during conservative treatment. Conclusions: This study demonstrates that most traumatic small PTX can be safely managed without the surgical approach of chest tube drainage. Key Words: Traumatic pneumothorax, conservative therapy, chest drainage.
erized tomography scanning were defined as having occult PTX. Patients with small and occult PTX were just observed without any additional treatment. Patients who had a fluid-level setting sign on chest X-ray were assumed as HPTX and were treated by chest tube insertion, whereas patients who had a normal chest X-ray and minimal HPTX defined on CT scan were classified as small HPTX and were treated conservatively by observation. Patients who necessitated positive pressure ventilation (IPPV) were treated with tube thorocostomy even if they had small or occult PTX/HPTX. Associated orthopedic injuries were classified as major and minor injuries. Small bone fractures and soft tissue injuries were defined as minor injuries. Patients were classified according to the mechanism of injury, modality of treatment, pulmonary and extra pulmonary injuries, and number of rib fractures.

Results

The study group had 128 chest trauma patients with PTX and/or HPTX. Thirty three (25.8%) patients were treated conservatively. Ninety seven (75.8%) of the patients were male, 31 (24.2%) were female. The ages of the patients were between 16 and 77 (mean $44.65 \pm 11.2$). Sixty (46.9%) injuries were due to blunt trauma and 68 (53.1%) were due to penetrating injury. (Table 1) In the blunt trauma group motor vehicle accident was the most common injury with 37 patients, followed by 17 falling injuries, assault in four, and sports injuries in two patients (Table 1).

<table>
<thead>
<tr>
<th>Rib fracture</th>
<th>&lt;3</th>
<th>&gt;3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative</td>
<td>10</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Chest Tube</td>
<td>7</td>
<td>26</td>
<td>33</td>
</tr>
</tbody>
</table>

<3: less than 3 rib fractures; >3: more than 3 rib fractures

PTX was seen in 71 (55.5%) of the 128 patients studied. HPTX in 57 (44.5%) and pulmonary contusion in 16 (12%) patients were the other significant injuries. The injuries were bilateral in 25 (19.5%) patients. Eighteen of these bilateral cases had PTX whereas 7 of them had HPTX (Table 2). Thorocotomy was required in five of the 128 patients.

The major pathology seen in blunt chest trauma patients was rib fracture. Forty seven of 60 (78.3%) patients with blunt chest trauma had rib fractures. Of these 47 the number of ribs fractured was less than 3 in 17 (36.2%), more than 3 in 30 (63.8%) of patients (Table 3). Of all blunt trauma patients, only 16 (26.7%) of them had isolated lung injury. Forty four (73.3%) of them suffered 57 associated injuries.

<table>
<thead>
<tr>
<th>Rib fracture</th>
<th>&lt;3</th>
<th>&gt;3</th>
<th>Total</th>
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<td>7</td>
<td>26</td>
<td>33</td>
</tr>
</tbody>
</table>

<3: less than 3 rib fractures; >3: more than 3 rib fractures

Table 1: Mechanism of trauma and treatment modalities (MVA: motor vehicle accident)

<table>
<thead>
<tr>
<th>Conservative</th>
<th>Chest Tube</th>
<th>Thorocotomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blunt MVA</td>
<td>14</td>
<td>22</td>
</tr>
<tr>
<td>Falling</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Assault</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Sports</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Penetrating</td>
<td>12</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>33 (25.8%)</td>
<td>90 (70.3%)</td>
</tr>
<tr>
<td></td>
<td>60 (46.9%)</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: Pulmonary complication after chest trauma (PTX: pneumothorax, HPTX: hemopneumothorax, PC: Pulmonary contusion)

<table>
<thead>
<tr>
<th>P. Complication</th>
<th>PTX</th>
<th>HPTX</th>
<th>PC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative</td>
<td>27</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Chest Tube</td>
<td>54</td>
<td>51</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>71</td>
<td>57</td>
<td>16</td>
</tr>
</tbody>
</table>

Table 3: Number of fractured ribs

<table>
<thead>
<tr>
<th>Rib fracture</th>
<th>&lt;3</th>
<th>&gt;3</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conservative</td>
<td>10</td>
<td>4</td>
<td>14</td>
</tr>
<tr>
<td>Chest Tube</td>
<td>7</td>
<td>26</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>30</td>
<td>47</td>
</tr>
</tbody>
</table>
Associated injuries included orthopedic injuries in 42, intra-abdominal injury in nine, and neurosurgical injury in six patients. Seventeen (40.5%) of 42 orthopedics injury were minor injuries. Five spleen, two liver, one kidney injury and one retroperitoneal hematoma were detected as intra-abdominal injuries (Table 4).

Table 4: Associated injuries

<table>
<thead>
<tr>
<th>Associated injuries</th>
<th>Conservative</th>
<th>Chest Tube</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor Oi</td>
<td>5</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>Major Oi</td>
<td>25</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>IAI</td>
<td>9</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>CI</td>
<td>6</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>52</td>
<td>57</td>
</tr>
</tbody>
</table>

OI: orthopedic injury; IAI: intra-abdominal injury; CI: cranial injury

Thirty three of the 128 patients in the study (25.8%) were treated conservatively without any intervention, including chest tube. Of these, eighteen patients had free air in the pleural cavity in PA chest X-Ray less than 20% of total hemithorax volume, and were defined as small PTX. Fifteen patients with normal chest PA X-Ray, but with PTX or HPTX on abdominal CT were included in the conservative management group. All patients were hospitalized, all received parenteral analgesia, regular monitoring of vital signs, and pulse oximetric follow up. PA chest x-rays were repeated at six and 24 hours after hospitalization. In four (12.1%) patients clinical choice for observation changed to chest tube insertion due to increase in pneumothorax amount in the follow up period, and none of these patients had any additional clinical symptoms after chest tube insertion (3 blunt, 1 penetrating trauma). The three patients with blunt trauma who subsequently underwent chest tube insertion had more than three rib fractures.

Discussion

One of the preventable causes of death due to trauma is PTX, and the incidence of traumatic PTX after major body trauma has been reported to be about 20% [5]. As the main treatment for traumatic pneumothorax, insertion of a chest tube is recommended [2,6]. Simple aspiration of traumatic PTX is risky because of the potential for converting to tension PTX, and the need for chest tube insertion for small traumatic PTX is controversial [7].

Chest tube insertion can be managed under local anesthesia, can be performed in a short time, and does not need too much experience. Although insertion of a chest tube is a simple procedure it may have morbidity and even mortality from complications due to lung perforation, nerve or blood vessel damage, and post-insertion complications due to chest tube kinking or clotting, pneumonia, empyema, or abscess formation. In different series, the complication rate of tube thorocostomy was reported between 9% and 30% [4,8]. In a study including 123 chest tube inserted patients, it was suggested that tube thoracostomy is associated with significant morbidity and extended hospitalizations, and may be partly related to inappropriate training of all individuals dealing with trauma care [9]. Further, pneumonia, empyema and abscess formation are complications that can be prevented by not placing a chest tube.

Occult PTX is described as a PTX that is detected by CT scanning rather than routine chest X-ray and occurs in 2-6% of patients undergoing CT scanning for blunt abdominal trauma [10]. Although, most occult PTX patients can be treated conservatively, the approach to the cases who will undergo positive pressure ventilation (IPPV) is not clear. In a study of 40 occult PTX patients, 21 of the cases on IPPV were followed by clinical observation without chest tube [11]. Eight of the 21 patients had progression of their PTX with 3 developing tension PTX, and it is suggested that patients with occult pneumothorax who require IPPV should be treated by chest tube insertion. In another study, observation was successful in 16 of 20 occult PTX (80%) exposed to IPPV [12]. In our study, 15 patients on IPPV, 2 of whom were occult, were treated by chest tube insertion. Attempts to reduce morbidity associated with chest tube insertion by use of catheter aspiration and Heimlich flutter for traumatic PTX have been reported, but conservative management of traumatic PTX is rarely reported.
Knottenbelt et al reported a large series of patients from South Africa [17]. The study included 803 patients with traumatic PTX. Three hundred (37.3%) patients were successfully treated conservatively. Ten percent of these patients needed tube insertion because of enlargement of PTX size. Of the 504 patients who underwent chest thorocostomy, the chest drain of 333 (66.1%) patients were removed in 24 hours. In another study on delayed traumatic PTX from Taiwan, 5 (29.5%) of 17 patients who had the diagnosis of initial PTX were treated conservatively [18]. Delayed PTX occurred in 16 patients after approximately 2 days and 7 (46%) of them were observed closely without chest drainage. In our study there were no delayed PTX. Johnson treated 29 (54.7%) of 53 patients with traumatic PTX conservatively [19]. Six patients presented to the department after 24 hours and 3 of them were treated as an outpatient with daily clinical and radiological follow-up. Only 2 (7%) of 29 patients had chest tube insertion subsequently due to asymptomatic PTX enlargement. There was no clinical deterioration before tube insertion. In our series, all the patients were treated by hospitalization; only 4 (12%) patients needed subsequent chest tube insertion, and physical examination of these cases was totally normal before chest tube insertion.

In our study, 33 patients had clinical observation without chest drainage and 21 of them were the result of blunt trauma. Rib fracture was the most common associated injury. Ten (30.3%) of patients who were elected for conservative treatment had less than 3 rib fractures, whereas 4 had more than 3 rib fractures. Three (%75) of these 4 patients needed chest tube subsequently, and other patients who had less than 3 rib fractures were successfully treated without chest tube insertion. Although the number of patients was few, the number of rib fractures might be a criterion to decide about selecting patients for conservative follow-up.

Another point of this study is that there were no associated major injuries except for 5 minor orthopedic injuries in the patients treated conservatively. It should be kept in mind that patients with associated major injuries who were chosen to treat conservatively are at more risk for enlargement of PTX size.

Chest tube insertion is not a routine treatment for traumatic PTX due to chest trauma if the amount of PTX is less than %20 of thoracic volume. Occult PTX and small PTX seen on chest x-rays can be treated conservatively. Vital signs and peripheral oxygenation should be observed. Repeat chest X-Ray should be performed 6 and 24 hours after hospitalization. We need prospective, randomized clinical trials about chest tube insertion versus conservative therapy to define the criteria for treatment, especially about pneumothorax size and the number of fractured ribs.

Conclusions

The results of this study suggest that some traumatic pneumothoraces resolve spontaneously without any surgical intervention for drainage of free air in the pleural cavity. Patients should be carefully selected and must be watched closely for the risk of tension pneumothorax. The amount of free air in the pleural cavity less than 20% of total hemithorax volume, fractured rib number less than three, and the absence of associated major injuries should be the criteria for conservative clinical follow-up as the choice of treatment.

References

7. American College of Surgeons Committee on Trauma. Advanced Trauma Life Support course