

Simple Thoracostomy Avoids Chest Drain Insertion in Prehospital Trauma

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Abstract

Tension pneumothorax and hemothorax are life-threatening emergencies that require immediate treatment. Field stabilization of trauma patients often requires rapid surgical drainage of these injuries but inevitably delays departure for hospital. Conventional treatment involves the insertion of a chest drain but we describe a modified technique of simple thoracostomy that is faster and simpler to perform and avoids the risks associated with insertion of the chest drain. Following use of a simple thoracostomy as an alternative chest drain insertion in 45 patients at the roadside, this technique appears to have important advantages over conventional techniques and warrants further clinical evaluation.

Intubation and chest drain insertion at the roadside have been shown to be the most successful initial treatment of severe thoracic trauma. [1] Chest drain insertion is the definitive procedure for treating pneumothoraces and hemothoraces. It is a common procedure performed by doctors from the Helicopter Emergency Medical Service who are trained in prehospital advanced trauma life support. From August 1, 1991 to August 1, 1994 3,113 patients have been treated by the Service, 840 of whom have been flown back to the Royal London Hospital due to the severity of injury. Of these 3,113 patients, 216 required roadside insertion of at least one chest drain.

All patients with tension pneumothoraces or hemothoraces have a chest drain inserted the roadside. In addition, chest drains are inserted in all patients with small uncomplicated pneumothoraces, because a pneumothorax secondary to trauma often converts to a life-threatening tension pneumothorax which is difficult to treat within the confined space of a helicopter cabin. Chest drains are also required in patients with a simple pneumothorax wh

are intubated because intermittent positive pressure ventilation may rapidly convert a simple pneumothorax to a tension pneumothorax.

Although chest drain insertion can be a life-saving procedure, it may take several minutes to perform and thus further delays patient departure for the hospital. Although there is evidence that prehospital advanced trauma life support (ATLS) can improve outcome in multiple trauma, prolonged scene time may worsen outcome. [2,3] We have modified our technique of chest drain insertion in intubated patients to a technique that is quicker and simpler to perform and has several important advantages over conventional chest drain insertion.

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METHOD

Forty-five consecutive patients with the following criteria were selected for the study:

- Pneumothorax or hemothorax compromising ventilation.
- Glasgow Coma Scale score less than or equal to 8.
- Intubation necessary to establish or protect the airway or mechanically ventilate the patient.

A hemo/pneumothorax was diagnosed by lack of chest wall excursion and auscultation. Patients were intubated prior to thoracostomy using a general anesthetic with rapid sequence induction and increments of Propofol and suxamethonium as necessary. Local anesthetic was not therefore necessary in these patients.

The study group was comprised as follows:

- Mean age 42.3 years (range 17-83 years), 33 male, 12 female.
- 33 patients with unilateral pneumothorax (4 penetrating, 29 blunt).
- 5 patients with unilateral hemothoraces (2 penetrating, 3 blunt).
- 4 patients with bilateral pneumothorax (all blunt).

- 3 patients with both a hemothorax and pneumothorax; i.e., bilateral (all blunt).

As per ATLS guidelines, [4] the fifth intercostal space at the midaxillary line is usually chosen as a site for the thoracostomy. The skin is cleaned with iodine spray or an alcohol-soaked swab. A horizontal incision with a scalpel is made along the upper border of the sixth rib about 4 to 5 cm in length. Blunt dissection is performed through subcutaneous fat and intercostal muscle and the parietal pleura is pierced with Spencer-Wells forceps. A gloved finger is inserted through the thoracostomy and swept around the pleura to free any adhesions. This is the same technique as for conventional chest drain insertion but in this modified technique a chest drain is not now inserted. The incision is finally covered by a dry gauze dressing.

Spontaneous ventilation generates negative intrathoracic pressures that may be sufficient to overcome the collapsed tissue edges and suck air into the pleural cavity. This technique cannot therefore be used for spontaneously breathing patients.

With intubated patients, positive pressure ventilation expels air through the thoracostomy as the interpleural pressure rises. At the end of inspiration as the interpleural pressure falls to zero, the subcutaneous tissues close together acting as a one-way valve, preventing ingress of air. Pressure in the interpleural space in ventilated patients (paralyzed or not making a respiratory effort) never becomes negative and thus air is not sucked back through the thoracostomy.

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CLINICAL CONSIDERATIONS

In all patients, immediate clinical resolution of the pneumothorax occurred following thoracostomy as judged by improved chest wall excursion and return of breath sounds. The roentgenograms performed immediately on arrival in hospital showed very minor residual pneumothoraces or complete re-expansion of the lung(s) in all 45 patients. [Figure 1](#) shows a chest roentgenogram of a 35-year-old male who sustained bilateral tension pneumothorax following a fall onto concrete from 50 feet. He was intubated on scene and bilateral thoracostomies were performed. On arrival, the chest roentgenogram showed complete re-expansion of both lungs. Soft tissue evidence of a thoracostomy can be seen along the border

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ADVANTAGES

Simple thoracostomy is a quicker technique than full chest drain insertion because it avoids the additional time necessary to insert a chest drain, stitch it in place, insert a pursestring suture, and attach a Heimlich valve or urine bag. If bilateral chest drains are required, use of this technique can save as much as 10 minutes on scene. (Our data from chest drain insertion on cadavers at ATLS courses shows an average time of 5.1 minutes).

A simple thoracostomy is easier to perform and requires less training. It may be suitable for unsupervised use by experienced ambulance paramedics when needle decompression fails.

By avoiding insertion of the chest drain and with it any temptation to use the chest drain trocar, the risk of the well-documented complications of this procedure occurring at the roadside are minimized.

Although it is difficult to keep a sterile field whilst performing any prehospital invasive procedure, wound and thoracic infections have not been a problem encountered in the 216 chest drains we have inserted at the roadside (wound infection/sepsis requiring antibiotic treatment <5%). However, a single incision is less likely to introduce infection than conventional chest drain insertion and the chest drain can subsequently be inserted under sterile conditions immediately upon arrival in the accident and emergency department. None of these 45 patients had evidence of infection attributable to the thoracostomy site or subsequent chest drain insertion (unblinded observation).

We use urine catheter bags incorporating one-way valves to attach to the chest drain once it is inserted. Although these give a good indication of the rate of air leak, they often fill very rapidly if a large air leak is present. In the sometimes fraught prehospital environment it is easy to overlook the distending urine bags and we have had a case where a tension pneumothorax reoccurred because the urine bag was unable to fill further with air. Thoracostomy avoids the need to repeatedly check the urine bag and repeatedly empty it if a large air leak is present.

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CONCLUSION

A modified technique of chest drain insertion by which a thoracostomy is performed has been shown to be a practical alternative to conventional chest drain insertion in ventilated patients. It is quicker to perform thereby reducing scene time, requires less skill to perform

may reduce the risk of infection, and avoids complications from chest drain insertion.

We believe that this previously undescribed technique for prehospital decompression of pneumothorax or hemothorax has important advantages over conventional techniques and warrants further clinical evaluation.

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