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REVIEW ARTICLE

An argument for the conservative management of small traumatic pneumathoraces in populations with high prevalence of HIV and tuberculosis: an evidence-based review of the literature

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Abstract
Background Traumatic pneumothoraces are common. Many are managed with tube thoracostomy. However, there is a high complication rate from chest tube placement, particularly in patients with HIV, TB, or both.
Aims We sought to investigate the literature on the conservative management of traumatic pneumothorax in patients with HIV and/or TB.
Methods The literature search was broken into two parts. In the first part, we searched for articles comparing tube thoracostomy versus conservative management in traumatic pneumothorax. In the second part, we sought articles describing the incidence and outcome of pneumothoraces in patients with pre-existing HIV or tuberculosis. In both, relevant articles were reviewed, and citations were hand-searched.
Results For the first portion, we identified 384 papers. From these, six studies were relevant. For the second portion, we identified 327 articles. A total of four unique articles were selected. The heterogeneity of the studies did not allow any pooled analysis. The studies of conservative management demonstrated a low percentage of patients with small pneumothoraces (most often <1.5 cm or less than 10%) later required tube thoracostomy for clinical deterioration (range 6–25%). No studies focused exclusively on pneumothoraces in patients with TB. In patients with HIV, there were no prospective trials of conservative management. Mortality for all HIV-infected patients with pneumothorax was high (25–50%), and the rate of complications from tube thoracostomy was also high. *Pneumocystits carinii* pneumonia (PCP) independently increased mortality.
Conclusions A review of the literature suggests that selected small pneumothoraces may be managed conservatively and that there is a high rate of complications related to tube thoracostomy in HIV patients. We propose a trial of the safety of conservative management of traumatic pneumothoraces in an area with a high prevalence of HIV and TB.

Keywords Pneumothorax · Tube thoracostomy · Chest tube · Chest trauma · HIV · Human immunodeficiency virus · AIDS · Acquired immunodeficiency syndrome · Emergency medicine · Trauma · Africa · Global health

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Introduction

Traumatic pneumothorax resulting from either blunt or penetrating injuries is a condition commonly encountered by the Emergency Department (ED) physician. It is reported that pneumothoraces are present in 15–50% of

patients with chest trauma [1]. Morbidity and mortality can be quite variable depending on the type and size of the pneumothorax, as well as the presence of co-morbidities and associated injuries.

Pneumothorax can be divided into three classifications: *simple*, *open*, and *tension*. A *simple* pneumothorax is an abnormal accumulation of air in the pleural space between the lung and chest wall with no communication to the atmosphere. An *open* pneumothorax is an accumulation of air into the pleural space with an open communication to the atmosphere through a defect of the chest wall or tracheobronchial tree. A *tension* pneumothorax is a progressive accumulation of air into the pleural space, resulting in increasing intrathoracic pressure on the lung and thoracic organs resulting in hemodynamic instability. The clinical cause of pneumothoraces can be further classified as spontaneous (which includes the subsets of primary, secondary or catamenial) or traumatic (which includes the subsets of iatrogenic or noniatrogenic) [2].

This review article consists of two parts. In the first part we will review the pertinent literature regarding conservative management of simple traumatic pneumothoraces. In the second part, we will review the relevant literature on pneumothoraces and available management strategies in patients with TB and HIV. The goal of this review is to examine the safety of the current management of simple traumatic pneumothoraces in all patients and in the subgroup of patients with HIV/TB to determine if management practices can be altered in the future to decrease morbidity to the patient.

Part one

Introduction

The standard teaching for emergent management of traumatic pneumothoraces has been immediate tube thoracostomy (TT) [3]. However, this procedure can often cause morbidity to the patient with frequent complications, including pain, infection, bleeding, intraparenchymal placement, extra-thoracic placement, diaphragm injury, and mediastinal injury [3]. These complications occur in as many as 30% of tube thoracostomies placed for traumatic pneumothoraces [4–6]. In addition to tube thoracostomy, other accepted management options have included simple aspiration and pigtail catheter placement, which may have a lower complication rate than tube thoracostomy [7–9]. Because of the morbidities associated with tube thoracostomy placement, a recent review of the literature suggested that patients with simple traumatic pneumothoraces may be managed conservatively by close observation rather than tube thoracostomy [10, 11].

Methods

The first part of the literature search was an evaluation of studies that reported outcomes for conservative management of traumatic pneumathoraces. We included studies where the target intervention was observation compared with tube thoracostomy in patients with traumatic pneumothorax. The outcome measures were defined by the study authors and included success rate of the intervention, progression to invasive management, complications, mortality, hospitalization, duration of hospitalization, and cost. This search was primarily done on MEDLINE (last update from 21 January 2010). We limited our review to human subjects, and we imposed no language limits. We searched the MEDLINE database (MEDLINE 1966 to January 2010) using the following MeSH terms: (chest tubes OR thoracostomy) AND (pneumothorax OR hemopneumothorax OR hemothorax) AND (Trauma). We identified 384 articles by MEDLINE, which were all screened in abstract form. Potentially relevant articles were acquired and reviewed in full text. In addition, the reference list of all publications seen in full text was reviewed for potentially relevant citations not found with the data bank search. A total of six unique articles were selected for evaluation in the results [12–17].

Results

We reviewed six original studies that evaluated observational therapy as a management option for traumatic pneumothorax (Table 1). In the first study by Hegarty, 131 patients with chest trauma were prospectively examined [12]. Most cases in this study were due to penetrating trauma. Fifty-eight patients had a pneumothorax size <1.5 cm or hemothorax below the 9th rib on chest X-ray (CXR) and were initially managed without TT. Of this group, eight later required TT. There were no in-hospital deaths in this group. The authors support the conservative management of these limited cases of traumatic pneumothorax.

In the case series by Knottenbelt et al. of 804 patients with primarily penetrating traumatic pneumothorax, 333 patients with pneumothorax <1.5 cm in width were initially managed conservatively (no chest tube) [13]. Patients needing positive pressure ventilation and those with bilateral pneumothoraces, pulmonary disease or high spinal cord injury underwent TT. In the observation group, 33 patients (10%) later required tube thoracostomy for enlarging pneumothorax. The authors conclude that routine thoracostomy is not needed, but that follow-up after discharge is necessary.

Table 1 Conservative management of traumatic pneumothorax

Authors	Type of study	Patients	Outcome/result	Notes/limitations
Hegarty MM 1976 [20]	Prospective case series	131 patients with traumatic chest injuries. 58 with pneumothorax <1.5 cm or hemothorax below 9th rib managed without TT initially	8 of 58 later required TT. No in-hospital deaths in the group initially managed without TT	Pneumothoraces and hemothoraces not separated in conservative group
Knottenbelt and vander Spuy 1990 [21]	Prospective observational case series	803 adult patients with traumatic pneumathoraces, observation occurred in 333 with pneumothorax size <1.5 cm	Need for thoracostomy drainage. 33/333 (10%) required subsequent drainage	Definition of failure of conservative therapy no specifically defined. Long-term outcomes weren't evaluated
Bridges KG et al. 1993 [22]	Retrospective case series	90 patients with traumatic pneumothorax. 35 patients were identified as having an occult pneumothorax noted on CT	10 of the 35 'occult pneumothorax' got immediate TT due to need for ventilation. 20% (5) of the remaining pts required delayed TT	Retrospective, no clarification on reason to intubate on the 5 patients who were initially observed. No documentation of follow-up or complication rates
Johnson G 1996 [23]	Retrospective case series	54 adult patients, observation management in 29	Need for thoracostomy drainage. 2/29 (6%)	Small N, no specification of pneumothorax classification
Dural K et al. 2005 [24]	Prospective observational trial	108 patients with pneumothoraces classified as 20%, 10% or less than 10% initially treated with conservative management	46 patients (43%) required TT due to enlarging pneumothorax. A larger initial pneumothorax was associated with increased need for TT	Single study
Barrios C et al. 2008 [25]	Retrospective trauma registry review	59 occult pneumothoraces, 51 had conservative management, including 16 of 20 who received PPV had conservative management	Occult pneumothoraces receiving TT had higher Revised Trauma Score, higher ICU and hospital LOS	Retrospective, with no protocol defined for conservative management

In a review of 90 patients with traumatic pneumothorax by Bridges et al., 55 had pneumothorax seen on plain radiography, and 35 had negative plain films but had 'occult pneumothoraces' identified on computerized tomography (CT) [14]. Of these 35 patients, 10 required intubation for anesthesia or neurological injury and received chest tubes. Of the remaining 25 patients, 5 (20%) required chest tubes for clinical deterioration. This study did not define 'clinical deterioration'. The remaining patients were managed conservatively. The follow-up period or complication rate of those 20 patients was not reported. The authors recommended a prospective study of which patients require CT to identify occult pneumothorax.

Johnson retrospectively identified 54 traumatic pneumothoraces (primarily blunt), of which 29 were managed without a chest tube [15]. In those cases, the pneumothorax was described subjectively as "small," "minimal," or "moderate." In two of these patients, chest tubes were later inserted for asymptomatic increase in size on a 6-h film. No clinical deterioration was noted during an unspecified follow-up period. The author recommended a prospective randomized trial of conservative management in patients without other injuries.

The study by Dural et al. included 108 patients with traumatic pneumothoraces [16]. The pneumothoraces were classified by size to the following groups: 20%, 10%, and less than 10% based upon initial x-rays. All patients were initially managed conservatively. Subsequent chest x-rays at 6 and 12 h were done to determine if progression of the pneumothorax had occurred, which if present was managed with TT. TT was required in 25% of the less than 10% group, 40% of the 10% group, and 69% of the 20% group. The authors concluded that while TT was still the most important treatment method, initial observation is a safe and appropriate treatment strategy for small traumatic pneumothoraces.

Finally, Barrios et al., in a trauma registry review, found 59 occult pneumothoraces resulting from blunt trauma in a 1-year period [17]. They noted that 51 were managed conservatively without tube thoracostomy, including 16 of 20 who received positive-pressure ventilation within 72 h after admission. The authors conclude that close follow-up with serial chest radiographs is warranted in patients with occult pneumothorax and suggest further prospective studies to confirm these findings.

Conclusion

We identified six original articles that met our search criteria for observational management of traumatic pneu-

mothoraces. Intervention with tube thoracostomy ranged from 6% (Johnson et al.) to 25% (Dural et al.) for patients with small (<1.5 cm or <10%) traumatic pneumothoraces. Given these results, we propose that patients with simple small traumatic pneumothoraces may be managed safely with observation alone as long as close monitoring is provided. This strategy may be a safe alternative for patients, thereby preventing the complications and morbidity associated with tube thoracostomy.

Part two

Introduction

There are currently an estimated 33 million people living with HIV infection [18]. TB had a prevalence of 13.7 million people in 2007, five percent of whom were infected with HIV [19]. Injury is one of the leading causes of ED utilization by HIV-infected patients [20]. Given that patients are living longer with HIV infection in the Highly Active Antiretroviral Therapy (HAART) era, and that the countries with the highest prevalence of HIV/TB also have a high prevalence of chest trauma, the burden of traumatic pneumothoraces will disproportionately affect the HIV/TB population [21]. The mortality for patients with underlying HIV and pneumothorax has been reported as high as 43–92% in the high-risk subset of patients with advanced AIDS and pneumothorax [22]. Given this high mortality in a high-risk population, it has been advised that the least invasive and safest options be pursued when managing pneumothoraces in this population [23]. The HIV/TB population is at increased risk of complications and infections from tube thoracostomies, including pneumonia, empyema, sepsis, and necrotizing fasciitis [24].

Methods

For the second portion of this review, we searched for studies that evaluated the incidence and outcome of pneumothoraces in the patients with preexisting HIV and/or tuberculosis. We reviewed observational and interventional studies with outcome measures defined by the study authors that included incidence of injury, management type, success rate of the intervention, progression to invasive management, complications, mortality, hospitalization, duration of hospitalization, and cost. This search was primarily done in MEDLINE (last update from 21 January 2010). We limited our review to human subjects, and we imposed no language limits. We searched the MEDLINE database (MEDLINE 1966 to January 2010) using the following MeSH terms: (HIV OR AIDS) AND (pneumothorax OR hemopneumothorax OR hemothorax) as well as a search for (Tuberculosis) AND (pneumothorax OR hemopneumothorax OR hemothorax) AND (Trauma). We identified 327 articles in MEDLINE, which were all screened. Selected articles were then reviewed in abstract form. Potentially relevant articles were acquired and reviewed in full text. In addition, the reference lists of all publications seen in full text were reviewed for potentially relevant citations not found with the data bank search. A total of four unique articles were selected [25–28].

Results

In this portion of our review, we evaluated four original studies concerning the management of pneumothorax in patients with HIV, AIDS, or TB (Table 2). The first study evaluated was a 2-year retrospective review by Coker et al., which included 298 patients with AIDS who were seen at a single center [25]. In this group, 16 pneumothoraces were identified in 10 patients. All of the pneumothoraces were moderate or large. Only three pneumothoraces were managed conservatively, and each was in a patient who received a contralateral tube thoracostomy. All of the patients with pneumothorax had current or past PCP infection. The authors found a 33% mortality rate in patients with concurrent PCP, compared to 17% overall.

Ingram et al. reviewed cases of HIV-infected patients diagnosed with pneumothorax over a 6-year period [26]. In 1,836 HIV infected patients, 60 pneumothoraces were identified in 39 patients. Of these, 23 pneumothoraces were defined as traumatic (primarily from central venous catheter insertion) and only 2 were the result of non-iatrogenic trauma. Of the 60 pneumothoraces, 10 were managed without chest tubes; 6 of these had thoracic venting devices, and 6 were given sclerotherapy with tetracycline antibiotics (two had both therapies). The authors note that patients with PCP and pneumothorax had 50% mortality, as compared to 25% in pneumothorax alone.

A review of 47 patients with AIDS and CD4 count <100 by Vricella et al. identified 59 pneumothoraces [27]. All were managed with tube thoracostomy. Eleven died in the hospital, and 36 were discharged. Of the 36 discharged, 26 had complete resolution by discharge; the remaining 10 had Heimlich valves placed. All 10 with Heimlich valves had complete pneumothorax resolution. The authors recommend outpatient Heimlich valve for patients who fail tube thoracostomy.

Finally, an observational study by Cabrera-Cordero et al. that included 12 patients with HIV and pneumothorax admitted to a Cuban hospital in a 5-year period was reviewed [28]. Ten had greater than 70% pneumothorax,

Table 2 Management of pneumothorax in HIV/TB patients

Authors	Type of study	Patients	Outcome/result	Notes/limitations
Coker RJ et al. 1993 [25]	Retrospective chart review	298 pts treated for AIDS, 16 episodes of pneumothorax	Treatment modality and mortality. 2 deaths. Increased association with PCP, 9.7% of PCP pts had pneumothorax	Small N, retrospective
Ingram RJ et al. 1996 [26]	Retrospective chart review	39 pts, 60 pneumothoraces total. 32 pneumothoraces from trauma	Mortality. Presence of PCP increased mortality 50% vs 25%	Not all trauma. Small N
Vricella LA and Trachiotis GD 2001 [27]	Retrospective, single institution chart review	47 patients with AIDS (CD4 <100) all with pneumothorax, a total of 59 pneumothoraces	11 patients died in-hospital (23.4%). 100% of patients had pneumothorax resolution with Heimlich valve after failed thoracostomy	Retrospective, use of Heimlich valve not controlled. No traumatic non-iatrogenic pneumothoraces
Cabrera-Cordero JA et al. 2008 [28]	Retrospective case series	12 pts, age >15, all HIV positive, admitted to hospital for pneumothorax. 11 were male. 10 had AIDS. 6.9% of all HIV-positive patients had pneumothorax	6 had spontaneous pneumothorax, 6 with iatrogenic traumatic pneumothorax. All pneumothoraces were large and managed with pleurectomies. 7 had post op complications. 4 (33.3%) died	Small observational study. All pneumothoraces were large. No traumatic non-iatrogenic pneumothoraces

and 2 had 40% pneumothorax. Six were spontaneous, and six were the result of subclavian vein catheterization. All were managed with tube thoracostomy. Four patients died from complications of their pneumothoraces, all had a persistent air leak, and two had empyema. The authors conclude that the presence of a persistent air leak and the severity of immunodepression are related to the patients' prognosis and recommend minimum pleurectomy as the first treatment option.

Conclusion

We identified a total of four articles that met our search criteria. All studies were retrospective reviews, and not all pneumothoraces in patients with HIV or TB were due to trauma. We did not find any studies that evaluated the outcomes of pneumothoraces in patients with TB. The results of our review demonstrate a high degree of morbidity and mortality associated with pneumothoraces and tube thoracostomy in patients with HIV or AIDS. No prospective studies have been performed looking at conservative management of small traumatic pneumothoraces in patients with HIV and/or TB.

Discussion

This review evaluated six studies that included conservative management of traumatic pneumothoraces and evaluated four studies that reported on the outcomes of pneumothorax in patients with HIV infection. The rates of failure of observational therapy and need for tube thoracostomy (TT) drainage ranged from 6–25% in patients with small traumatic pneumothoraces. The studies that evaluated pneumothorax management in patients with HIV infection included a heterogeneous population with pneumothoraces that were large and most often due to spontaneous pneumothorax. This population had high underling rates of comorbidities, was most often treated with TT, often required surgery, and had a high mortality.

A conservative approach to management of small traumatic pneumothoraces may be able to select a population that could avoid the morbidity associated with TT management, as well as save resources in often resource-poor settings [29]. We propose that a prospective randomized study of the conservative management of traumatic pneumothorax in a population with a high prevalence of trauma, HIV, and TB is necessary to evaluate if this population could benefit from conservative management in select cases.

This review has many limitations. The authors elected to use specific search criteria given that this was a two-part study with two separate searches. This proved efficient compared with more sensitive search criteria, though the sensitivity may have been limited. Inherent to any review are the limitations of the individual studies. Most studies included in this review are small, retrospective, and often the population we examined was a subset of the study population. Most of these studies did not uniformly define what constitutes a 'small' or 'minimal' pneumothorax. The literature supports a definition of 'small' pneumothorax as measuring less than 1.5 cm at the greatest lateral measurement on an upright chest radiograph [30, 31]. Despite previous studies documenting the safety of observa-

tional therapy in traumatic pneumothoraces, many recommendations are in favor of TT in all traumatic pneumothoraces regardless of size [3, 32]. Furthermore Enderson et al., in a study that predated the Barrios study reviewed previously, recommended that all patients with occult pneumothorax undergoing positive pressure ventilation receive TT [33]. There is currently insufficient data to recommend conservative therapy for small and occult pneumothoraces in patients undergoing positive pressure ventilation. Though no study has looked exclusively at small pneumothoraces in the HIV population, many recommend TT management in patients with HIV and pneumothorax regardless of the pneumothorax size or clinical presentation [16, 34]. The limited data about pneumothoraces in patients with HIV that is presented in this study demonstrate the high morbidity associated with this population. This population is at risk for failure of conservative therapy in cases of traumatic pneumothorax. Finally, no studies pertaining specifically to the management of traumatic pneumothorax in the tuberculosis patient were discovered. The response of this population to varying management strategies is unknown.

It is not by chance that the areas with the highest global burden of HIV and TB are also the areas with the highest incidence of trauma [13, 14, 35, 36]. These are diseases that thrive in poverty and are compounded by the often resource-poor setting in which they occur. The ability to select a low risk population that would benefit from conservative management could decrease the morbidity and mortality of associated interventions, decrease the use of resources, and improve patient quality of life. There is evidence to support the conservative management of small traumatic pneumothoraces. Patients with HIV/TB have a high mortality when subject to pneumothoraces and their management. The authors recommend that a prospective study evaluating conservative management for traumatic pneumothoraces be undertaken in a population with high HIV and TB prevalence.

Conflict of Interest None

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