# Air Transport of Patients with Pneumothorax: Is Tube Thoracostomy Required Before Flight?

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## Abstract

**Objective:** It is conventionally thought that patients with pneumothorax (PTX) require tube thoracostomy (TT) before air medical transport (AMT), especially in unpressurized rotor-wing (RW) aircraft, to prevent deterioration from expansion of the PTX or development of tension PTX. We hypothesize that patients with PTX transported without TT tolerate RW AMT without serious deterioration, as defined by hypotension, hypoxemia, respiratory distress, intubation, bag valve mask ventilation, needle thoracostomy (NT), or cardiac arrest during transport.

**Methods:** We conducted a retrospective review of a case-series of trauma patients transported to a single Level 1 trauma center via RW with confirmed PTX and no TT. Using standardized abstraction forms, we reviewed charts for signs of deterioration. Those patients identified as having clinical deterioration were independently reviewed for the likelihood that the clinical deterioration was a direct consequence of PTX.

**Results:** During the study period, 66 patients with confirmed PTX underwent RW AMT with an average altitude gain of 1890 feet, an average barometric pressure 586-600 mmHg, and average flight duration of 28 minutes. All patients received oxygen therapy; 14/66 patients (21%) were supported with positive pressure ventilation. Eleven of 66 patients (17%) had NT placed before flight and 4/66 (6%) had NT placed during flight. Four of 66 patients (6% CI0.3-11.7) may have deteriorated during AMT as a result of PTX; all were successfully managed with NT.

**Conclusions:** In this series, 6% of patients with PTX deteriorated as result of AMT without TT, yet all patients were managed successfully with NT. Routine placement of TT in patients with PTX before RW AMT may not be necessary. Further prospective evaluation is warranted.


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## Introduction

Thoracic trauma is responsible for one-quarter of all trauma deaths and is a frequent component of multisystem trauma. Pneumothorax (PTX) is observed in 10%-22% of severe blunt trauma cases.[1,2] Many patients with thoracic trauma undergo air medical transport (AMT) either from the scene of injury or between hospitals. It is conventionally thought that patients with PTX require tube thoracostomy (TT) before AMT to prevent deterioration from PTX expansion and possible development of tension PTX.[2-5] The danger of PTX progression is further increased, theoretically, in unpressurized rotor wing (RW) aircraft and those receiving positive pressure ventilation. Some experts cite the mere presence of an unvented PTX as an absolute contraindication for AMT.[7]

TT placement may not be available in all settings and could be associated with transport delays and serious complications, particularly when placed by less experienced providers. The effectiveness of needle thoracostomy (NT) as an alternative to TT in the AMT setting is unclear.

This study aims to answer the question of whether patients with PTX could be safely transported by rotor wing AMT without TT. We hypothesized that patients with PTX transported without prior TT would tolerate AMT without serious deterioration, as defined by hypotension, hypoxemia, respiratory distress, intubation, bag valve mask ventilation, NT, or cardiac arrest during transport.

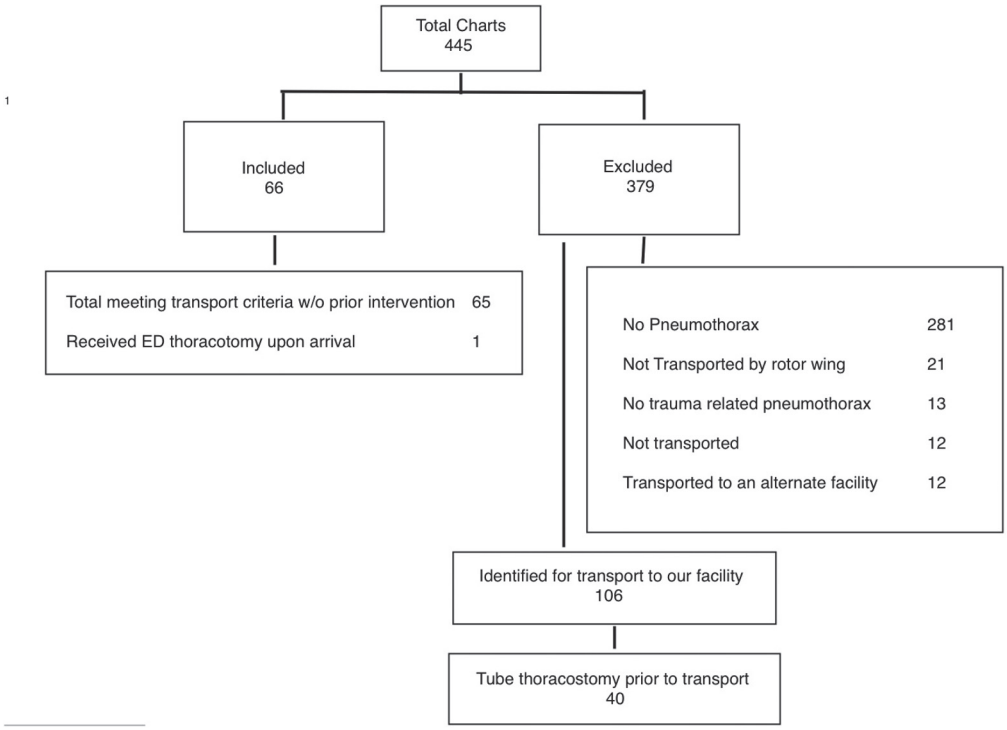
## Methods

We conducted a chart review for a case-series of trauma patients transported to our center via a single helicopter service between 2002 and 2008 with PTX confirmed radiographically upon arrival. This study was reviewed and approved by our institutional review board.

The AMT service transporting these patients completed approximately 1000 RW transports annually. Our center is a University Level 1 Trauma Center with annual emergency department census of 90,000, including approximately 2,000 trauma team activations.

Clinical data were contained in a computerized dispatch and charting system (GoldenHour™) that permitted systematic data abstraction on study subjects. We identified study subjects by searching "pneumothorax," "chest trauma," "multi-system trauma," or "thoracic trauma" in the impression section of the prehospital record. We excluded patients if

**Figure 1.** Study Selection




[1] Diagram 1: Study Selection

they were transported by ground or fixed-wing aircraft, transported to another receiving facility (unless this was unplanned due to deterioration in flight), had a TT placed before transport or had a non-traumatic mechanism for their PTX. PTX was confirmed by x-ray or computed tomography scan at the receiving hospital in all cases.

One author (GP) performed the preliminary review of records to determine whether or not PTX was present, if the presence of PTX was known before AMT, and whether TT was performed before transport; he also gathered demographic information and identified evidence of clinical deterioration as defined above. Three authors (DB, IT, and GP) then reviewed those charts with evidence for deterioration and jointly determined the likelihood that PTX was a major contributor to in-flight deterioration.

## Results

During the study period 445 charts were identified by the search terms and evaluated for inclusion in the study. Three hundred seventy-nine patients were excluded: 281 patients did not have a PTX, 21 were not transported by RW, 13 patients were medical rather than trauma patients, 12 were not transported, and 12 were transported to other facilities. Of the remaining 106 patients, 40 received TT before transport and were excluded. The AMT service involved in this study does not permit TT insertion by flight crews, so no TT was placed in flight.

Sixty-five patients with a confirmed PTX underwent RW AMT to our facility during the study period without a prior TT (Figure 1). One additional patient suffered a traumatic cardiac arrest on arrival to our facility and underwent ED thoracotomy before radiology; this patient was presumed to have a PTX and included in the study group for a total of 66 patients.

The average age of the patients was 39 years (range 9 to 84) and 50/66 (76%) patients were male. Penetrating trauma accounted for 10/66 (15%) and blunt trauma for 56/66 (85%). These patients were transported with an average altitude gain of 1884 feet, barometric pressure between 586-600 mmHg, and average duration of transport of 28 minutes (range 3 to 70). Sixteen of 66 (24%) were transported between facilities, with the remainder coming from the incident scene. Forty-four of 66 pneumothoracies (67%) were suspected or confirmed before transport. Fifteen of 66 patients (23%) received positive pressure ventilation: 2 via bag valve mask, 11 via endotracheal tube, and 2 via laryngeal mask airway. All patients received oxygen at the discretion of the transportation team. Eleven patients (17%) had NT placed before AMT, and 4 of 66 (6%) had an NT placed during AMT (Table 1).

Seven of the 66 patients (11%, CI 3.5-18.5) deteriorated during AMT (Table 2). In 3 of these cases (patients 1-3), the deterioration was unlikely to be a result of PTX or lack of TT. In the remaining 4 cases (patients 4-7) (6%, CI 0.3-11.7), deterioration was thought to be from the presence of PTX (Table 3). Each of these patients was successfully managed with NT and did not suffer any apparent morbidity from not having a TT placed before transport.