

Management of Emergency Department Patients With Primary Spontaneous Pneumothorax: Needle Aspiration or Tube Thoracostomy?

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Study objective: The emergency management of primary spontaneous pneumothorax is controversial. This evidence-based emergency medicine review evaluates the existing evidence about the efficacy and safety of needle aspiration in comparison to tube thoracostomy for management of primary spontaneous pneumothorax.

Methods: We searched MEDLINE, EMBASE, the Cochrane Library, and other databases. We selected studies for inclusion in the review if the authors stated that they had randomly assigned hemodynamically stable patients with no underlying lung disease to needle aspiration or tube thoracostomy. The outcome measures of interest included admission rate, length of hospital stay, recurrence rate, failure rate of the procedure, dyspnea score during or after the procedure, pain score during or after the procedure, and complications.

Results: Three randomized trials with acceptable quality standards met the inclusion criteria. There was no significant difference between needle aspiration and tube thoracostomy when outcomes of immediate failure, 1-week failure, risk of complication, and 1-year recurrence rate were measured. Only 2 trials reported the rate of hospitalization; needle aspiration was associated with lower rates of hospitalization in both trials: relative risks of 0.26 (95% confidence interval [CI] 0.17 to 0.39) and 0.51 (95% CI 0.36 to 0.74). Length of hospital stay was lower in the needle aspiration groups in all 3 trials, with mean differences of -2.15 days (95% CI -0.99 to -3.30), -2.10 days (95% CI -0.57 to -3.63), and -1.10 days (95% CI -2.28 to 0.08), respectively. Needle aspiration was associated with less analgesia requirement in one trial and lower pain scores in another.

Conclusion: The existing evidence indicates that needle aspiration is at least as safe and effective as tube thoracostomy for management of primary spontaneous pneumothorax. Additionally, needle aspiration carries the benefit of fewer hospital admissions and shorter length of hospital stay. [Ann Emerg Med. 2008;51:91-100.]

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CLINICAL SCENARIO

You are an attending physician in a community emergency department (ED). At the beginning of your shift, you receive the sign-out from a colleague of yours about a 22-year-old man who presented with complaint of chest pain and shortness of breath for 2 days. He is tall and slender and smokes half a pack of cigarettes per day. Your colleague obtained a chest radiograph that showed a 50% pneumothorax, without tracheal shift, consolidation, or pleural effusion. He proceeded to treat the pneumothorax with a needle aspiration and asks you to observe the patient

in the ED for a few hours and discharge home after arranging follow-up with a primary care physician. You ask about the reason for choosing needle aspiration over tube thoracostomy. Your colleague explains that he selected this approach because the patient, who is a student, is very reluctant to stay in the hospital due to an examination the next day. He also asserts that needle aspiration is as effective and is less invasive than tube thoracostomy in management of spontaneous pneumothorax. You decide to review the evidence on this topic and evaluate whether you should choose this intervention for your future cases.

The following evidence-based emergency medicine review seeks an answer to the question prompted by this scenario.

FORMULATING THE QUESTION

A primary spontaneous pneumothorax is defined as a spontaneously occurring pneumothorax in a person without clinically apparent underlying lung disease or trauma.^{1,2} Endotracheal tube thoracostomy and needle aspiration are standard procedures and are explained in the literature.³

We were interested in comparing the ED-relevant outcomes of treating unilateral primary spontaneous pneumothorax in hemodynamically stable patients with needle aspiration as opposed to endotracheal tube thoracostomy. The following outcome measures were selected according to their direct impact on patients' care and satisfaction: hospital admission rate, duration of hospital stay from the time of presentation to the ED to discharge, recurrence of pneumothorax within a defined period (short term and long term), failure rate of the procedure, dyspnea score measured by any validated method during the procedure or daily after the procedure, pain score measured by any validated method during the procedure or daily after the procedure, and complications.

Patients with primary spontaneous pneumothorax are generally young, healthy, and productive individuals. The number of days lost from work or school is an essential consideration when treatment options are chosen for these patients. This factor justifies examining the outcomes of admission rate and length of hospital stay. Recurrence is defined as reappearance of pneumothorax on the follow-up chest radiograph despite resolution of pneumothorax immediately after the procedure. Evaluating the recurrence rate is important because repeated episodes of primary spontaneous pneumothorax may warrant definitive treatment such as pleurodesis. The long-term recurrence rate is relevant to the practice of emergency medicine because knowledge of this outcome may affect the clinician's decision in choosing the management strategy at the initial ED visit. The failure rate for needle aspiration is measured by failure of the procedure to resolve the pneumothorax after at least 2 attempts and requirement of tube thoracostomy. Failure of tube thoracostomy is defined by persistent air leak for more than 1 week or failure to resolve the pneumothorax after the chest tube insertion. Patients' discomfort, measured by analgesia requirement or intensity of pain during and after intervention, is also a sensible outcome worth consideration when one of these invasive procedures is selected over another.

An additional focus of this review was to assess the applicability and feasibility of performing needle aspiration procedures by emergency physicians. Although we did not include this factor in our formulated question, we planned to examine which clinicians performed the procedures in the selected studies.

We considered pneumothoraces of all sizes, ranging from small to complete lung collapse, as long as an intervention was indicated. Despite controversies about the management of

recurrent episodes of primary spontaneous pneumothorax, we did not find any evidence indicating that this issue influences the outcomes of tube thoracostomy or needle aspiration differently. Therefore, we decided to include studies that enrolled subjects with recurrent episodes of pneumothorax and, if data were available, planned to perform a subgroup analysis.

Consequently, the reformulated question of this review is: Is needle aspiration superior to, or as effective as, tube thoracostomy for treatment of unilateral primary spontaneous pneumothorax in hemodynamically stable ED patients when outcomes of length of hospital stay, failure rate, recurrence rate, patients' comfort, and complications are considered?

SEARCHING FOR AND SELECTING THE BEST EVIDENCE

We confined this review to randomized trials that specifically compared needle aspiration to tube thoracostomy in management of primary spontaneous pneumothorax in ED patients of all ages. We excluded studies that enrolled hemodynamically unstable patients (eg, patients with tension pneumothorax or those requiring mechanical ventilation), those with bleeding diathesis, patients with concurrent pleural effusion or hemothorax, and last, those with bilateral pneumothoraces. We excluded studies using aspiration catheters containing Heimlich valves that were not removed immediately after aspiration because these catheters function as small chest tubes.

We searched the MEDLINE database from 1966 to December 2006 and EMBASE from 1980 to December 2006, using search terms "spontaneous pneumothorax," "intercostal," "aspiration," "needle," "chest tube," "thoracostomy," and "tube drainage." (For detailed search strategy please see Appendix E1; available online at <http://www.annemergmed.com>).

The authors also scanned the databases of the Cochrane Library³ through 2006, Emergency Medical Abstracts⁴ (available online at <http://ccme.org>) from 1977 through December 2006, and online resources including BestBETS⁵ (available online at <http://www.bestbets.org>), using the search words "spontaneous pneumothorax," "aspiration," "chest tube," and "tube thoracostomy." We also searched the registry for clinical trials (available at <http://www.clinicaltrials.org>). We reviewed the bibliographies of the relevant trials for citations of additional eligible studies.

These databases yielded a total of 230 results. The process in which clinical trials were selected or excluded is presented in a diagram (Figure 1). After the selection criteria were applied, 3 randomized trials were included in the final review.⁶⁻⁸ Although we had planned to exclude trials in which Heimlich valves were used or catheters were left in place after initial aspiration, we did not identify any randomized trial with this technique.

We also identified 1 brief review in the BestBETS database,⁹ 1 Cochrane database systematic review,¹⁰ and 1 independent systematic review.¹¹ The recent trial by Ayed et al,⁶ which was published in 2006, was not included in any of these references. The Cochrane database systematic review analyzed only the trial

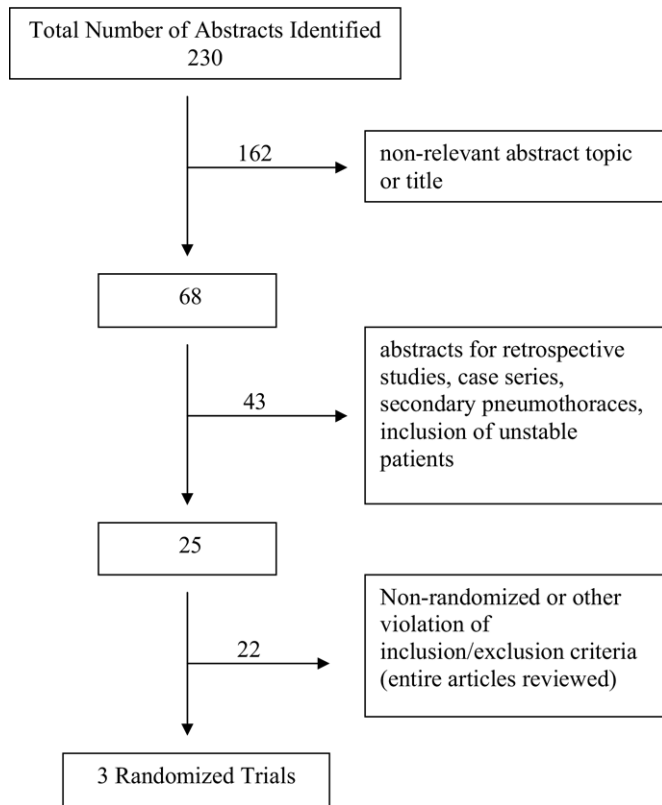


Figure 1. Process of selecting trials suitable for inclusion in the final review.

by Noppen et al,⁸ which was included in our review as well. The authors of this Cochrane review excluded the study by Harvey and Prescott⁷ because the randomized participants included those with previous pneumothoraces. The systematic review by Devanand et al,¹¹ published in 2004, did not include any reference that was not identified in our literature search. This systematic review included the study by Andrivet et al,¹² which was excluded in our review because it included hemodynamically unstable patients and delayed the needle aspiration in stable patients for 3 days. We did not identify any additional eligible trials from a review of the bibliographies of these articles.

DESCRIPTION OF THE TRIALS

Table 1 summarizes the key features of the 3 trials that compared the use of needle aspiration to tube thoracostomy in patients with primary spontaneous pneumothorax. Two of the trials presented data from European countries (multicenter)^{7,8} and 1 from a tertiary care center in Kuwait.⁶ All were published in English and were limited to adults. None of the studies clearly state who performed the procedures or explicitly affirm that emergency physicians were included in the intervention. All 3 trials used plain chest radiographs as the criterion standard for identifying clinically significant pneumothorax. These studies excluded pneumothoraces in unstable patients and in those with

underlying lung disease. All trials allowed a second aspiration if the first attempt failed, before moving to tube thoracostomy. Two studies were restricted to patients with first episode of primary spontaneous pneumothorax.^{6,8} Harvey and Prescott⁷ did not make this distinction, but only 14 of 74 (19%) of the enrolled patients in this trial had previous pneumothoraces. The published data did not allow for our planned subgroup analysis based on direct comparison of outcomes between patients with first episodes to those with recurrence.

All 3 trials included success rate (immediate and also at various periods after the procedure), length of hospital stay, and 1- to 4-week recurrence rates. Patients' discomfort was measured by analgesia requirement during the procedure and in the first 24 hours by Ayed et al,⁶ whereas Harvey and Prescott⁷ presented pain score during the procedure, daily pain score for the duration of hospitalization, and total pain scores. Issue of pain or analgesia was not addressed by Noppen et al.⁸ None of the studies used dyspnea score as a measure of comfort level during or after the procedure. The follow-up rates for all 3 trials were 100%. The follow-up period was 2 years for the study by Ayed et al⁶ and up to 1 year for the other 2 trials.^{7,8}

The methodological quality of the 3 selected trials was fair. Table 2 summarizes our assessment of the likelihood of bias in the 3 trials using published criteria.^{13,14} All 3 studies appear to be randomized. Only Noppen et al⁸ clearly took adequate measures to conceal allocation. Harvey and Prescott⁷ did not provide any details about their randomization protocol. The nature of the interventions was such that patient or practitioner blinding was not feasible in these studies. The potential for measurement bias could have been minimized if assessors evaluating the subjective outcomes such as pain score or analgesia requirements had been blinded, but this approach was not reported in any of the trials.

All 3 trials presented the data for baseline comparisons of the study groups. According to the reported data, subjects enrolled in needle aspiration and tube thoracostomy groups were not significantly different when compared for age, sex, weight, or smoking history. None of the trials reported the influence of these factors on the outcomes.

RESULTS OF THE TRIALS

We reported the results as relative risk (RR), with 95% confidence intervals (CIs). The number needed to treat was reported only when the RR was statistically significant (ie, when 95% CI did not cross 1.0). As shown in Table 3, needle aspiration reduced the need for admission dramatically in the 2 trials that reported this outcome.^{6,8} Among patients who were hospitalized, needle aspiration resulted in a shorter hospital stay than tube thoracostomy (Table 4). Length of ED observation before discharge or admission was not mentioned in any of the trials.

The failure rates for needle aspiration were comparable to the ones for tube thoracostomy. Only 2 studies reported 1-week failure rates.^{6,8} One-year recurrence rate was measured in all 3 trials (Figure 2); no significant difference was observed between

Table 1. Summary description of 3 included trials.

First Author	Patients	Intervention	Comparison	Outcomes
Ayed ⁶ (2006)	137 Patients with first episode of PSP in a tertiary care center in Kuwait.* Inclusion: Any size PSP if symptomatic (dyspnea or chest pain), or PSP >20% of hemithorax regardless of symptoms. Exclusion: recurrent, secondary, tension, bilateral, iatrogenic, or asymptomatic <20% pneumothoraces; and hemopneumothorax.	Needle aspiration. Up to 2 attempts until complete lung expansion or only a small rim remaining. Chest tube if second attempt failed.	Chest tube insertion. Removed after 24 h of complete lung expansion or after air bubbling stopped. Drainage continued if air leak persisted or incomplete lung expansion after 7 days.	Immediate success rate, defined by complete or near-complete lung expansion immediately after the procedure for needle aspiration and absence of air leak, complete lung expansion, and tube removal within 3 days of insertion for chest tube. Immediate success rate and recurrence rate at 1 week and 3, 12, and 24 mo, all by CXR; hospitalization rate, length of hospital stay, analgesia requirement, quantity of analgesia in first 24 h, complication rate, and inability to work.
Noppen ⁸ (2002)	60 Patients with first episode of PSP. Multicenter (Belgium), 1 tertiary academic center, and 4 general hospitals.* Inclusion: symptomatic PSP (chest pain or dyspnea) of any size or size >20% regardless of symptoms. Exclusion: Secondary, recurrent, and tension pneumothoraces.	Manual (needle) aspiration up to 2 attempts by left-in catheter or reinsertion of second catheter. Chest tube if failed second attempt or air aspiration >4 L, without signs of reexpansion.	Chest tube insertion. Chest tube removed 24 h after stoppage of air leak and CXR-confirmed full reexpansion. Drainage prolonged if air leakage persisted or no complete expansion after 7 days.	Immediate success rate. For needle aspiration defined as complete or near-complete lung expansion immediately after the procedure. For chest tube, defined as complete lung expansion, absence of air leak, and chest tube removal within 3 days of insertion. Immediate success rate and recurrence rate at 1 week and 1 year by CXR; rate of hospitalization, length of hospital stay, safety, and complications.
Harvey ⁷ (1994)	73 Patients with PSP in UK (several tertiary care centers and general hospitals).* Excluded patients with tension or secondary pneumothoraces but included recurrent episodes.	Needle aspiration (continued until no more air could be aspirated, patient became uncomfortable, or 3 L of air removed). Repeated attempts allowed.	Chest tube insertion according to the participating physicians' usual practice.	Immediate success rate, risk of subsequent pleuroctomy and recurrence rate at 1 and 12 mo, pain score during procedure, average daily pain score, total pain score, and length of hospital stay.

PSP, Primary spontaneous pneumothorax; CXR, chest radiograph; UK, United Kingdom.

*Not specified who performed the procedures.

tube thoracostomy and needle aspiration when this outcome was considered (Table 3). One trial⁶ assessed the 2-year recurrence rate. This analysis showed an RR of 1.23 (95% CI 0.72 to 2.11) for 2-year recurrence rate of needle aspiration compared with tube thoracostomy.

Finally, Ayed et al⁶ report that the number of days lost from work was almost half in patients treated with needle aspiration compared with tube thoracostomy (3.6 ± 0.7 days in the needle aspiration group versus 6.04 ± 1.3 days in the tube thoracostomy

group; mean difference -2.44 days; 95% CI -2.81 to -2.08 days).

Complications of either procedure were not discussed in detail in any of the trials. Harvey and Prescott⁷ did not mention complications in the results. Noppen et al⁸ reported no complications for needle aspiration but did not comment on tube thoracostomy. Ayed et al⁶ reported complications in 6 subjects: 5 in the tube thoracostomy group and 1 in the needle aspiration group. The complications related to tube

Table 2. Quality assessment of the included trials.

Study Characteristic	Ayed et al ⁶	Noppen et al ⁸	Harvey and Prescott ⁷
Randomization	Randomized by self-selecting a sealed envelope that indicated the respective treatment.	Stratified randomization (using separate random number lists at each participating center)	Yes
Concealment	Probable. Envelopes not stated to be opaque.	Definitely concealed	Unclear. Randomization method not reported.
Intention to treat	Yes	Yes	Number of patients initially allocated to each group not reported. No obvious violation. The success rate for the chest tube group was not reported.
Comparability at baseline	Yes. No significant differences in age, sex, weight, body mass index, smoking status, or radiographic appearance of pneumothorax between the 2 groups.	Yes. No significant differences between the groups in regard to age, sex, % total pneumothorax, side of pneumothorax, body mass index, and smoking status.	Yes. Both groups were similar with respect to age, sex, height, weight, smoking history, lung function, and history of pneumothorax.
Blinding	Not blinded	Not blinded	Not blinded
Follow-up	100% 2-y Follow-up	100% 1-y Follow-up	100% 1-y Follow-up
Cointervention	None	None	None

thoracostomy included subcutaneous emphysema (n=2), tube blockage (n=2), and site infection (n=1). One patient in the needle aspiration group experienced subcutaneous emphysema.⁶

The reviewed trials did not discuss the issues of patient comfort and analgesia requirement in a similar fashion. None of the studies reported using procedural sedation. Harvey and Prescott⁷ used a scoring system for pain assessment during and after the procedures, as well as a total pain score throughout the patients' hospitalization. No significant difference was observed in pain score during the procedure (mean difference 0.2; 95% CI -0.6 to 0.2), whereas the daily pain scores (mean difference 0.8; 95% CI 0.5 to 1.1) and total pain scores (mean difference 4.0; 95% CI 2.4 to 5.6) were greater in the tube thoracostomy group.⁷ Ayed et al⁶ measured patient discomfort by comparing the need for analgesia (intramuscular meperidine) and the amount of analgesic used in each group. According to this study, fewer patients in the needle aspiration group required analgesia (34% [95% CI 24% to 46%] versus 56% [95% CI 44% to 66%]), but the amount of analgesic given to patients in each group was not significantly different (mean difference 3.8 mg/day; 95% CI -10 to 2.4 mg/day).⁶

According to the study by Harvey and Prescott,⁷ more patients in the tube thoracostomy group required pleurectomy (0% versus 18%; absolute risk reduction 18%; 95% CI 5% to 36%). Noppen et al⁸ reported the number of patients who were treated with thoracoscopic talc poudrage, axillary thoracotomy, and drainage after recurrence of pneumothorax after 1 year but did not report the interventions with which these patients were treated initially. In the study by Ayed et al,⁶ all patients experiencing recurrence of pneumothorax up to 2 years after the initial intervention were treated with video-assisted

thoracoscopy surgery. The RR of video-assisted thoracoscopy surgery requirement for patients treated with needle aspiration compared with tube thoracostomy was 1.23 (95% CI 0.72 to 2.11).⁶

APPLYING THE EVIDENCE

In the preceding clinical scenario, the clinician wondered whether needle aspiration was a practical approach to management of primary spontaneous pneumothorax. Review of the evidence reveals that needle aspiration is a reasonable alternative to tube thoracostomy, given that the outcomes of interest are equal to or better than those of tube thoracostomy.

Both needle aspiration and tube thoracostomy are relatively simple procedures and can be performed by emergency physicians. Some authors have advocated for the use of needle aspiration techniques performed by emergency physicians for treatment of primary spontaneous pneumothorax.¹⁵⁻¹⁷ A survey of 101 clinicians in a European country revealed that 80% of emergency physicians felt comfortable with the choice of simple aspiration for treatment of spontaneous pneumothorax in an imaginary young patient.¹⁸

The differences in management of "first episode" versus "recurrent episode" of primary spontaneous pneumothorax have not been adequately addressed in clinical trials; thus, controversies about the management of recurrent episodes of pneumothorax persist.¹⁹ In general, the literature advocates use of more aggressive and definitive strategies to treat recurrent episodes (eg, video-assisted thoracoscopic surgery).¹ Although the recurrence rate of pneumothorax is thought to be higher after the first episode of primary spontaneous

Table 3. Relative risks for various outcomes for the 3 included trials (needle aspiration compared with tube thoracostomy).

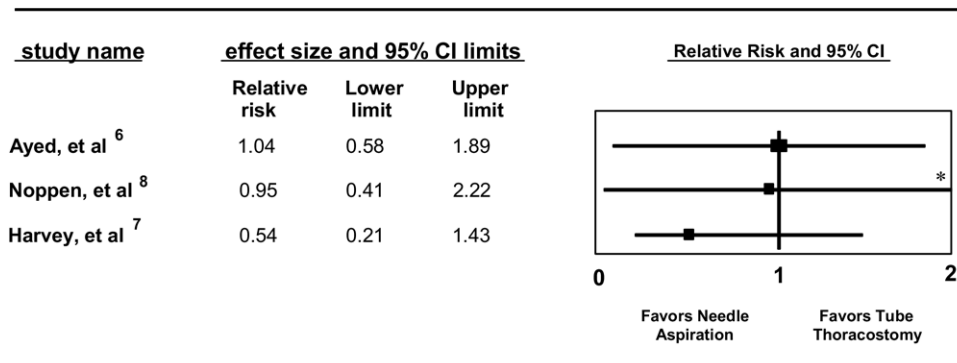
Outcome	Needle Aspiration % (n/N)	Endotracheal Tube Thoracostomy % (n/N)	RR (95% CI)	NNT (95% CI)
Hospitalization rate				
Ayed et al ⁶	26 (17/65)	100 (72/72)	0.26 (0.17–0.39)	1.3 (1.2–1.6)
Noppen et al ⁸	52 (14/27)	100 (33/33)	0.51 (0.36–0.74)	2 (2.0–4.0)
Harvey and Prescott ^{7*}	—	—	—	—
Immediate failure rate				
Ayed et al	38 (25/65)	32 (23/72)	1.12 (0.76–1.90)	—
Noppen et al	41 (11/27)	36 (12/33)	1.12 (0.59–2.13)	—
Harvey and Prescott	20 (7/35)	—	—	—
One-week failure rate				
Ayed et al	11 (7/65)	13 (9/72)	0.86 (0.34–2.18)	—
Noppen et al	7 (2/27)	15 (5/33)	0.49 (0.10–2.33)	—
Harvey and Prescott	—	—	—	—
One-year recurrence rate				
Ayed et al	25 (16/65)	24 (17/72)	1.04 (0.58–1.89)	—
Noppen et al	26 (7/27)	27 (9/33)	0.95 (0.41–2.22)	—
Harvey and Prescott	14 (5/35)	26 (10/38)	0.54 (0.21–1.43)	—

RR, Relative risk; CI, confidence interval; NNT, number to treat.

*Harvey and Prescott⁷ did not report the outcomes of hospitalization rate and immediate/1-week failure rates for all patients.

Table 4. Length of hospital stay (days) in the 3 included trials (needle aspiration compared with tube thoracostomy).

Study	Needle Aspiration	Tube Thoracostomy	Mean Difference (95% CI)
Ayed et al ⁶ (n=137)	1.85±3.9 (n=65)	4.0±2.9 (n=72)	-2.15 (-3.30 to -0.99)
Noppen et al ⁸ (n=60)	3.4±1.6 (n=27)	4.5±2.7 (n=33)	-1.10 (-2.28 to 0.08)
Harvey and Prescott ⁷ (n=73)	3.2±2.9 (n=35)	5.3±3.6 (n=38)	-2.10 (-3.63 to -0.57)



* The extension of the confidence interval goes beyond the scale

Figure 2. Forest plot representing the 1-year recurrence rates of primary spontaneous pneumothorax, comparing needle aspiration to tube thoracostomy.

pneumothorax,²⁰ the impact of management modality (needle aspiration versus tube thoracostomy) on the course of recurrent pneumothorax is uncertain.^{17,21} Two of the trials selected for this review included only first episodes of pneumothorax. The third study⁷ included patients with recurrent episodes (approximately 20% of the patients) but did not provide the data for this subgroup separately. Therefore, we were not able to compare the outcomes in the subgroups of first time versus recurrent episodes. Until

further research is performed on the differences of these 2 types of primary spontaneous pneumothorax, a definitive assertion about the relative efficacy of needle aspiration for patients with first episodes compared with those experiencing a recurrence is not possible according to the evidence from randomized trials.

The reviewed trials included only adult subjects; therefore, the evidence provided in this review may not apply to the pediatric population. Additionally, the impact of body habitus

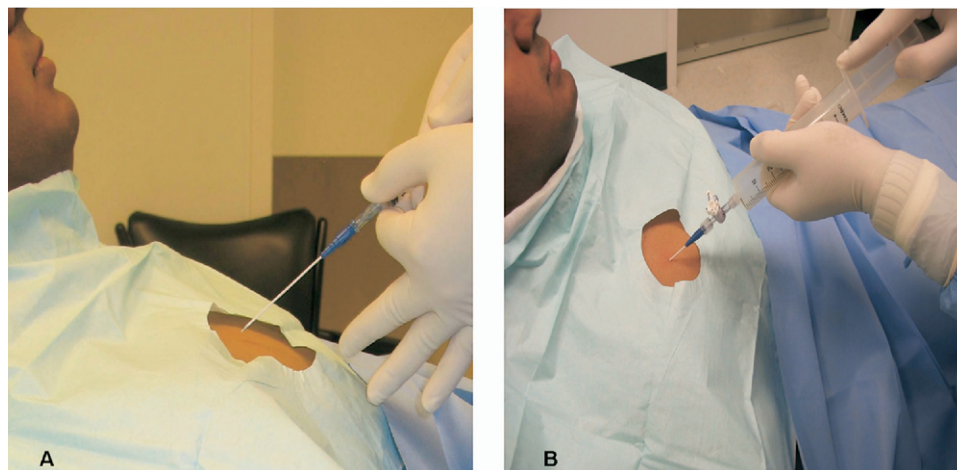


Figure 3. Needle aspiration technique. *A*, After skin preparation and infiltration of a local anesthetic, and while the patient is in a semisupine position (45 degrees), a 16-gauge over-the-needle catheter is inserted into the second anterior intercostal space at the midclavicular line. *B*, After entering the pleural space (aspiration of air), the needle is extracted and the catheter is connected to a 3-way stopcock and a 60-mL syringe. Manual aspiration is continued until no more air can be aspirated.

on success rate of either procedure was not addressed in any of the trials.

Despite the fair quality of the trials mentioned in this review, the study design used by these investigators may not be the ideal approach to study this type of therapeutic intervention. Although conventional randomized controlled trials are widely recognized as the most reliable method to evaluate pharmacologic therapy, there is skepticism about their role in nonpharmacologic interventions such as surgical procedures.²² Because performing certain procedures requires training and skill, the restricted expertise can compromise the validity of conventional randomized controlled trials. For example, if physicians with expertise in intervention A treat 70% of the patients in both groups A and B, and physicians with expertise in intervention B treat 30% of those in both groups A and B, the trial results will be biased toward intervention A. This type of bias is called differential expertise bias. Although certain trials try to reduce this bias by requiring participating physicians to perform a minimum number of both the experimental and control procedures before taking part in the trial, this measure is unlikely to eliminate bias, because outcomes often improve with increased experience with a procedure. An alternative is to use “expertise-based” randomized controlled trials, in which participants are randomized to clinicians with expertise in intervention A or intervention B. Interventions are performed only by clinicians with expertise in the procedure, which reduces both bias and ethical concerns. Expertise-based randomized controlled trials may have greater applicability than conventional trials.²²

Returning to the opening scenario, how do the results of this evidence-based review help the clinician choose the best approach for management of primary spontaneous pneumothorax for the patient in question? From an emergency

physician point of view, needle aspiration is less invasive (Figure 3) and results in similar failure and recurrence rates, less discomfort and pain, and fewer hospital admissions. In addition to the evidence from clinical trials, at least 2 other considerations should contribute to the decisionmaking process about a therapeutic intervention: the clinical circumstances and patient values and preferences.²³

PATIENT COMMUNICATION

Patients are becoming increasingly more informed about medical interventions and frequently ask about issues of safety and benefit. The following is an example of how an emergency physician might convey what is known about the safety and efficacy of needle aspiration for management of primary spontaneous pneumothorax. The details will, of course, be characteristically modified to reflect the actual clinical circumstances.

“We have diagnosed you with a pneumothorax, which simply means a collapsed lung. To help your lungs reexpand, it is necessary to evacuate the air from your pleural space, the space between your lung and your chest wall. The collection of air in this space is causing collapse of your lung. To solve this problem, we can choose between aspirating the air through a needle through your chest wall or draining the air by inserting a tube inside your chest and evacuating the air by suction. The second option requires that you stay in the hospital for a few days. With needle aspiration, you may be discharged home or stay in the hospital for a short period of observation. The available evidence indicates that both techniques have relatively equal success, and they carry virtually the same chance of recurrence of the pneumothorax. Limited research has been done to compare the discomfort and pain from these procedures, but it appears that needle aspiration may require less pain medication during and after the procedure.”

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Critically Appraised Topic (CAT): Needle Aspiration or Tube Thoracostomy?

Question	Is needle aspiration superior to, or as effective as, tube thoracostomy for treatment of unilateral primary spontaneous pneumothorax in hemodynamically stable ED patients when outcomes of admission rate, length of hospital stay, failure rate, recurrence rate, patients' comfort, and complications are considered?
Reviewed by	Shahriar Zehtabchi, MD; Claritza L. Rios, MD
Date	April 26, 2007
Expiration date	April 26, 2009
Clinical bottom line	Needle aspiration is at least as safe and as successful as tube thoracostomy in management of spontaneous pneumothorax. The advantages of needle aspiration are its relative simplicity, minimal invasiveness, lower admission rate, shorter hospital stay, and less patient discomfort.
Search strategy	The search for randomized trials included MEDLINE, EMBASE, the Cochrane Library from the date of origin through December 2006, Emergency Medical Abstracts from 1977 to December 2006, and BestBETS from March 2000 through December 2006.
Citations	<ol style="list-style-type: none"> 1. Ayed AK, Chandrasekaran C, Sukumar M. Aspiration versus tube drainage in primary spontaneous pneumothorax: a randomised study. <i>Eur Respir J</i>. 2006;27:477-482. (A) 2. Noppen M, Alexander P, Driesen P, et al. Manual aspiration versus chest tube drainage in first episodes of primary spontaneous pneumothorax: a multicenter, prospective, randomized pilot study. <i>Am J Respir Crit Care Med</i>. 2002;165:1240-1244. (N) 3. Harvey J, Prescott RJ. Simple aspiration versus intercostal tube drainage for spontaneous pneumothorax in patients with normal lungs. British Thoracic Society Research Committee. <i>BMJ</i>. 1994;309:1338-1339. (H)
Primary study characteristics	<p>Study Population</p> <p>270 patients from Europe (2 multicenter studies) and Kuwait (1 tertiary care center) were studied in 3 trials. All trials excluded pneumothoraces in unstable patients and in those with underlying lung disease. Two trials included only primary spontaneous pneumothoraces (A and N), but the third one (H) did not make this distinction.</p> <p>Interventions</p> <p>All 3 trials compared needle aspiration with tube thoracostomy for treatment of primary spontaneous pneumothorax. All trials allowed a second aspiration if the first attempt failed, before moving to tube thoracostomy.</p> <p>Outcome Measures</p> <p>All 3 trials measured the outcomes of admission rate, length of hospital stay, success/failure rate, and recurrence rate. Two trials measured patients' discomfort by way of analgesia requirement (A) or pain score (H).</p>
Critical appraisal	All 3 studies were randomized. Allocation concealment was unclear in one study (H), but the other 2 (A and N) did not violate this principle. None of the trials used blinding. All 3 presented the data for baseline comparisons such as age, sex, and smoking history.

Summary of results

Trial	Needle	Tube	RR (95%CI)
Hospitalization rate			
Ayed et al	26% (17/65)	100% (72/72)	0.26 (0.17 to 0.39)
Noppen et al	52% (14/27)	100% (33/33)	0.51 (0.36 to 0.74)
Harvey and Prescott	—	—	—
Immediate failure rate			
Ayed et al	38% (25/65)	32% (23/72)	1.12 (0.76 to 1.90)
Noppen et al	41% (11/27)	36% (12/33)	1.12 (0.59 to 2.13)
Harvey and Prescott	—	—	—
One-week failure rate			
Ayed et al	11% (7/65)	13% (9/72)	0.86 (0.34 to 2.18)
Noppen et al	7% (2/27)	15% (5/33)	0.49 (0.10 to 2.33)
Harvey and Prescott	—	—	—
One-year recurrence rate			
Ayed et al	25% (16/65)	24% (17/72)	1.04 (0.58 to 1.89)
Noppen et al	26% (7/27)	27% (9/33)	0.95 (0.41 to 2.22)
Harvey and Prescott	14% (5/35)	26% (10/38)	0.54 (0.21 to 1.43)
Length of hospital stay (Days)			
Ayed et al	1.85±3.9 (n=65)	4.0±2.9 (n=72)	-2.15 (-3.30 to -0.99)
Noppen et al	3.4±1.6 (n=27)	4.5±2.7 (n=33)	-1.10 (-2.28 to 0.08)
Harvey and Prescott	3.2±2.9 (n=35)	5.3±3.6 (n=38)	-2.10 (-3.63 to -0.57)

Needle, Needle aspiration; tube, tube thoracostomy; MD, mean difference.

APPENDIX E1.

Detailed MEDLINE search strategy.

#1 Pneumothorax[MeSH]
#2 Spontaneous Pneumothorax[tw]
#3 #1 OR #2
#4 Catheterization[MeSH]
#5 Chest Tubes[MeSH]
#6 Thoracostomy[MeSH]
#7 Drainage[MeSH]
#8 aspirat*[tw]
#9 catheter*[tw]
#10 drain*[tw]
#11 Needles[MeSH]
#12 needle*[tw]
#13 #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10 OR #11
OR #12
#14 #3 AND #13
#15 clinical trial[pt]
#16 randomized[ab]
#17 placebo[ab]
#18 drug therapy[sh]
#19 clinical trials[MeSH]
#20 randomly[ab]
#21 trial[ti]
#22 groups[ab]
#23 #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21
OR #22
#24 animals[MeSH]
#25 humans[MeSH]
#26 #24 AND #25
#27 #24 NOT #26
#28 #23 NOT #27
#29 #14 AND #28