Ambulatory Management of Large Spontaneous Pneumothorax With Pigtail Catheters

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Study objective: There is no consensus about the management of large spontaneous pneumothoraces. Guidelines recommend either needle aspiration or chest tube drainage and most patients are hospitalized. We assess the efficacy of ambulatory management of large spontaneous pneumothoraces with pigtail catheters.

Methods: From February 2007 to January 2011, all primary and secondary large spontaneous pneumothoraces from Lorient’s hospital (France) were managed with pigtail catheters with a 1-way valve. The patients were discharged immediately and then evaluated every 2 days according to a specific algorithm.

Results: Of the 132 consecutive patients (110 primary, 22 secondary), 103 were exclusively managed as outpatients, with full resolution of the pneumothorax by day 2 or 4, which represents an ambulatory success rate of 78%. Mean time (SD) of drainage was 3.4 days (1.8). Seven patients were initially hospitalized but quickly discharged and had full resolution by day 2 or 4, leading to a total success rate of 83%. The use of analgesics was low. The 1-year recurrence rate was 26%. If successful, this outpatient management is potentially cost saving, with a mean cost of $926, assuming up to 2 outpatient visits and 1 chest radiograph, compared with $4,276 if a chest tube was placed and the patient was admitted to the hospital for 4 days.

Conclusion: Ambulatory management with pigtail catheters with 1-way valves could be a reasonable first-line of treatment for large spontaneous pneumothoraces. Compared with that of other studies, our protocol does not require hospitalization and is cost saving. [Ann Emerg Med. 2014;64:222-228.]

See Editorial, P. 229.

INTRODUCTION

Background

Spontaneous pneumothoraces are common; however, there is no consensus about their management. Three major articles contain guidelines for the management of spontaneous pneumothoraces, but they differ both in definition and management of large spontaneous pneumothoraces. Although the American College of Chest Physicians recommends the use of small-bore catheters, the British Thoracic Society and Belgian Society of Pulmonary Diseases recommend needle aspiration as the first step, followed by chest tube drainage in case of at least 1 unsuccessful needle aspiration attempt.

Importance

Pigtail catheters are worth investigating as a treatment procedure for managing pneumothoraces because of their limited invasiveness. Marquette et al published a pilot study in 2006 with a simplified management of primary spontaneous pneumothoraces in hospitalized patients, using a small-caliber indwelling catheter connected to a 1-way Heimlich valve. The same group recently published a study of a series of 48 patients with a first episode of large primary spontaneous pneumothoraces treated with pigtail catheter and 1-way valve, in which 18 (37%) were treated as outpatients, with good efficiency and safety. Other studies with approximately 50 patients each have shown that ambulatory management of primary spontaneous pneumothoraces using small catheters connected to a 1-way valve is possible.
Editor’s Capsule Summary

What is already known on this topic
Patients with large spontaneous pneumothorax have traditionally been managed in hospital with a chest tube. Small studies have described outpatient management with pigtail catheter and 1-way valve.

What question this study addressed
Can patients with large spontaneous pneumothorax be safely managed as outpatients with pigtail catheter and 1-way valve?

What this study adds to our knowledge
In this retrospective single-center series of 132 consecutive patients, approximately 80% were treated successfully without hospital admission.

How this is relevant to clinical practice
If confirmed in randomized trials in other centers, outpatient management of large spontaneous pneumothoraces in this manner may become preferred first-line treatment.

detailed in Figure 1. The pigtail catheters (8.5-French; Cook, Bloomington, IN) were set in aseptic conditions in the second or third intercostal space in the midclavicular line after local anesthesia with 1% lidocaine. This procedure was exclusively performed by a respiratory physician (out of 5 in the study center). A needle aspiration of the catheter confirmed proper placement into the pleural space and the permeability of the system. The catheter was then fitted to a 1-way mini-Heimlich valve (reference C-CASP-A6föd; Cook). Polyurethane transparent adhesive dressing was the sole means for securing the catheter in place, and folded sterile gauze was set as a pillow under the catheter to avoid kinking, as described. No chest radiograph was performed after placement of the catheter, and no complete aspiration of the pneumothorax was performed before the patient’s discharge.

Patients were all discharged on day 0 (except 11, detailed in the “Results” section) after fewer than 2 hours of observation (pain, anxiety, dyspnea), during which instructions about the catheter and valve were given. Patients were assessed by a pulmonologist every 2 days at the hospital’s outpatient clinic. Analgesics consumption and complications were inquired about at each appointment. Step 2 analgesics were tramadol or codeine/acetaminophen, and step 3 analgesics were immediate-release morphine sulfate. Only oral analgesics were used for outpatients. Success was defined as previously reported5: complete lung expansion or nearly complete lung re-expansion (only a very small rim of apical air) on the chest radiograph before catheter withdrawal. Ambulatory success was defined as resolution at 4 days or fewer. No chest radiograph was performed after catheter withdrawal. Surgical pleurodesis was performed by video-assisted thoracoscopy with metallic scrubber and bullectomy.

Of the 132 patients, 121 were contacted by telephone between May and October 2012 and were asked about pneumothorax 1-year recurrences. Eleven patients (8%), 2 with secondary spontaneous pneumothoraces and 9 with primary spontaneous pneumothoraces, could not be contacted during follow-up.

Crude costs were estimated with the French health payer’s perspective and were limited to direct medical costs. Costs, expressed in US dollars and in euros, were based on the national health insurance provider’s tariffs for diagnosis-related groups and national fees for ambulatory care, provided by the French Ministry of Health and the national health insurance provider.12,13

Primary Data Analysis
Demographic and descriptive data are given as means with SD. Rates are given with 95% confidence interval (CI). Categorical variables are compared with \( \chi^2 \) or Fisher exact test, when appropriate. Recurrence-free survival was calculated from the date of the first episode of pneumothorax included in this study to the date of recurrence or the last day of follow-up with censored data at 1 year. The Kaplan-Meier method with log-rank test was used. The 11 patients with loss of follow-up were included in recurrence-free survival analysis and censored at the day of last appointment. We also provided results of the 1-year recurrence rate
without and with the 11 patients lost to follow-up (worst case). Statistical significance was considered when $P<0.05$. Statistical software used was R (version 2.15.2; R Core Team, Vienna, Austria).

RESULTS

Characteristics of Study Subjects

We included all 132 consecutive large spontaneous pneumothoraces, detailed in Figure 2. No pneumothoraces were missed because pulmonologists were on call and could be contacted day and night if a patient presented with a large spontaneous pneumothorax. The clinical characteristics of the patients are detailed in Table 1. The mean age of our patients was 32 years (SD 15; range 16 to 82 years). The mean duration of pigtail drainage was 3.4 days (SD 1.8; range 1 to 12 days).

Main Results

The 22 secondary spontaneous pneumothoraces concerning 18 patients (4 patients with a first episode of secondary spontaneous pneumothorax displayed 1 recurrence during the study period) managed in our center were divided as follows: 16 patients with emphysema (including only 1 patient who had received a diagnosis before the pneumothorax), 1 patient with bilateral community-acquired pneumonia and positive pneumococcal urinary antigen, and 1 patient with breast cancer and pulmonary metastases.

Of the 132 patients managed with a pigtail catheter, 103 were managed exclusively as outpatients, with full resolution of the pneumothorax by day 2 or 4, which represents an ambulatory success rate of 78% (95% CI 71% to 85%) (Figure 3).

A total of 121 patients with spontaneous pneumothoraces were initially managed as outpatients and the other 11 with pneumothoraces were hospitalized (Figure 3). Seven of the hospitalized patients were discharged at day 2, with full resolution by day 2 or 4, which represents a total success rate of pigtail catheter with 1-way valve at day 4 of 83% (95% CI 77% to 89%; Table 2).

Of these 7 patients, 2 were observed for 48 hours because they were the first patients to be treated with a pigtail catheter in our center. The treatment was successful, and they were
discharged after 48 hours without the catheter. One patient had severe dyspnea and chronic obstructive pulmonary disease and was able to go home after a day of observation. Another patient was initially admitted during the first 24 hours because of chest pain but was discharged the following day. Three patients were unnecessarily admitted and should have been managed with ambulatory care. They were discharged the following day. The 4 other hospitalized patients with pneumothoraces remained hospitalized until day 6 or after and were considered to have failed treatment. One patient was hospitalized because of chemotherapy for pancreatic cancer, and another had severe bilateral community-acquired pneumonia. The third patient wanted immediate surgery and was therefore admitted on day 0. The final patient had severe anxiety and therefore did not want to go home.

The success rates of ambulatory management with pigtail catheters in primary and secondary spontaneous pneumothoraces were not different at day 4 (85% [95% CI 78% to 92%] versus 73% [95% CI 54% to 92%]; Table 2). Success rates of primary and secondary spontaneous pneumothoraces were similar for the first episode (84% [95% CI 76% to 92%] versus 67% [95% CI 43% to 91%]) and for recurrences (89% [95% CI 79% to 99%] versus 86% [95% CI 60% to 100%]).

Following the algorithm, 18 patients were hospitalized on day 4 for suction on the catheter because of the persistence of the pneumothorax (Figure 3). Among these patients, 10 were finally referred for surgical pleurodesis (1 additional patient was admitted on day 0 for immediate surgery). Three patients had complete re-expansion at day 5 or 6; thus, the catheter was withdrawn. For 5 patients, the persistent air rim was small. Simple succion was applied and the catheter was withdrawn at day 7 (n=2), day 10 (n=2), or day 12 (n=1). The mean duration of suction time in these 8 hospitalized nonsurgically managed patients was 3.6 days (from day 4).

Complications and analgesics use were assessed at each outpatient appointment and daily when patients were hospitalized. Two patients had kinked catheters: 1 patient had stuck the catheter in her bra for 48 hours; for another patient, the catheter was angled in the bandage. These 2 events were corrected on day 2. Notably, no vasovagal reaction was reported during the catheter insertion. Use of analgesics was minimal, with only 6% using step 2 and 6% step 3 analgesics.

The recurrence rate at 1 year was 26% (95% CI 19% to 33%), with no significant difference between primary spontaneous pneumothoraces (25%; 95% CI 17% to 33%) and secondary spontaneous pneumothoraces (35%; 95% CI 15% to 55%) (Figure 4). The recurrence rate between first-episode and recurrent spontaneous pneumothoraces for primary

**Table 1.** Patient characteristics.

<table>
<thead>
<tr>
<th>Variables</th>
<th>All PTX (n=132)</th>
<th>PSP (n=110)</th>
<th>SSP (n=22)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>32 (15)</td>
<td>28 (12)</td>
<td>52 (16)</td>
</tr>
<tr>
<td>Sex ratio, % male</td>
<td>78</td>
<td>77</td>
<td>86</td>
</tr>
<tr>
<td>Smoking history, %</td>
<td>80</td>
<td>81</td>
<td>77</td>
</tr>
<tr>
<td>Mean time of drainage, days</td>
<td>3.4 (1.8)</td>
<td>3.3 (1.7)</td>
<td>3.4 (1.9)</td>
</tr>
</tbody>
</table>

PSP, Primary spontaneous pneumothorax; SSP, secondary spontaneous pneumothorax.

Data are presented as means (SD).
spontaneous pneumothorax (22% [95% CI 13% to 31%] versus 30% [95% CI 15% to 45%]) and secondary spontaneous pneumothoraces (38% [95% CI 13% to 63%] versus 25% [95% CI 0% to 57%]) was also not different. If we consider that the 11 patients who did not answer telephone calls had recurrence (worst scenario), the recurrence rate at 1 year would be 33% (95% CI 25% to 41%).

The result of the economic analysis showed that the estimated mean cost per patient was $926.00 (£686.00) with our ambulatory management compared with $3,276.00 (£3,167.00) with our previous management (traditional management). In our previous management, patients were hospitalized for the pneumothorax in the respiratory medicine ward, with chest tube drainage connected to a water seal device; the cost was $4,276.00 for each patient. In our study, the catheter was inserted in the emergency unit, and the cost was $820.00, including catheter, valve, local anesthesia, and nurse assistance. If we add 2 outpatient appointments ($38.00 each) and 1 chest radiograph ($30.00) at the withdrawal of the catheter, total cost of ambulatory management of spontaneous pneumothorax for each patient was $926.00.

LIMITATIONS

Our retrospective study has some limitations, such as its monocentric setting, the loss of patients during follow-up, that the recurrence data for 1 year relied on retrospective recall of pneumothorax from patients, the absence of a control group, success rate by provider, and standardized pain evaluation scales. Also, the number of patients with secondary spontaneous pneumothorax was small; it is therefore difficult to draw conclusions from this group. The same limitation (underpowered study) applies to the comparison between first-episode and recurrent spontaneous pneumothoraces. The wide ranges of 95% CIs for these items illustrate this fact. Although “clinical confirmation” of the proper placement of the catheter was obtained (bubbles in syringe and valve movement during inspiration), the lack of radiographic confirmation of complete expansion (followed by discharge home) was an additional limitation. Therefore, because of differences between countries’ procedures or legal issues, adaptations of our protocol could be needed such as a chest radiograph after catheter insertion and after catheter removal, which could be customary.

DISCUSSION

To our knowledge, this is the largest case series of ambulatory management for spontaneous pneumothoraces managed with pigtail catheters with 1-way valves. The success rate was 78% of patients managed exclusively as outpatients, reaching 84% in patients with first episode of primary spontaneous pneumothorax, and the total success rate in the entire series was 83%. In addition, analgesic use was low. This protocol was less expensive than our previous traditional chest tube drainage management with hospitalization.

Compared with that of previous studies on large primary spontaneous pneumothoraces, our success rate at 4 days is similar to the success rate at 1 week in hospitalized patients in the study by Marquette et al (85%) and Massongo et al (79%), in which only 37% of patients had full outpatient management. Both studies included only patients with first episode of primary spontaneous pneumothorax compared with our study, which included both primary and secondary spontaneous pneumothoraces, first episode, and recurrences. Moreover, in a systematic review, Brims and Maskell showed a 78% success rate of outpatient management of spontaneous pneumothoraces.

Needle aspiration is proposed as first-step treatment of primary spontaneous pneumothoraces. However, even if this technique is as efficient as chest tube drainage, eventually 50% of patients from this study were hospitalized in the needle aspiration arm. Three other randomized studies with needle aspiration showed better results. In addition, in our study, patients were discharged immediately after pigtail catheter placement, knowing that its presence avoids any compressive recurrence of pneumothorax at home compared with the unknown safety of sending home a patient with an aspirated pneumothorax.

We demonstrated a 26% recurrence rate at 1 year (33% in the worst scenario), which is similar to that in the literature, from 17% to 49%. Chen et al demonstrated a recurrence rate of 29% in the treatment group (aspiration + minocycline by intrapleural injection) versus 49% in the control group (aspiration alone). Our recurrence rate is similar to that of their treatment group, but our technique is far less painful, with use of step 3 analgesics in 6% of our patients versus 68% in the study by Chen et al, and does not require a 41-hour stay in the hospital. In the literature, the lowest recurrence rates
(17% to 24%)\textsuperscript{5,6} are probably due to the fact that these studies included only the first episode of primary spontaneous pneumothorax.

In our study, patients were discharged less than 2 hours after pigtail catheter insertion, without radiography. An immediate chest radiograph could be proposed, but this would not provide more information because the aspiration of air by the catheter defines its pleural location. A chest radiograph after catheter withdrawal could be discussed to avoid legal issues.

Chen et al\textsuperscript{19} also proposed a control chest radiograph 4 to 6 hours after the procedure, and the mean hospitalization stay was 36 hours in the needle aspiration group. This duration seems incompatible with ambulatory management.

In addition to the direct cost savings, other elements add to the advantages of our technique: hospital beds in the respiratory ward are available for other types of patients, the quality of life of patients is most likely better at home, and we did not investigate the potential savings from indirect costs, such as days off from work and child care.

In some centers in Brittany, we slightly modified this protocol, and the pigtail catheter is set by the emergency physician. Then the pulmonologist follows up with the patient every 2 days at the outpatient clinic.

Despite published guidelines, no consensus exists concerning the management of large spontaneous pneumothoraces. This study confirms that the use of pigtail catheters with 1-way valves in the management of large spontaneous pneumothoraces is safe and requires only limited use of analgesics. We demonstrate that this exclusive outpatient management is cost saving and just as efficient as other methods. In addition, this procedure clearly decreases the number of hospitalization days.

These results need to be confirmed in a multicenter randomized clinical trial. New recommendations for the management of large spontaneous pneumothoraces should include the possibility of ambulatory management with pigtail catheters with 1-way valves, which could become the first line of treatment, especially in first episodes of primary spontaneous pneumothorax.

The authors acknowledge American Journal Experts for their medical editing service, Christos Chonaid, MD, PhD, for his help with the economic analysis, James Norwood for the review of the article, Thomas Gouyet, MD, for his statistical expertise, and the Centre d’études pneumologiques for funding the editing service.

Supervising editor: Allan B. Wolfson, MD

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Author contributions: FV, LS, BD, and SJ were responsible for the literature search. FV, CR, and SJ were responsible for figures. FV, LS, YR, BD, and SJ were responsible for data collection. All authors were responsible for data analysis, data interpretation, and writing and final approval of the article. SJ takes responsibility for the paper as a whole.

Funding and support: By Annals policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article as per ICMJE conflict of interest guidelines (see www.icmje.org). The authors have stated that no such relationships exist. The Centre d’études pneumologiques funded the medical editing service.

Publication dates: Received for publication September 14, 2013. Revisions received November 20, 2013, and December 2, 2013. Accepted for publication December 10, 2013. Available online January 15, 2014.

Presented as a poster at the European Respiratory Society Congress, Barcelona, Spain, in September 2013.

REFERENCES


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