CHEST

Original Research

SPONTANEOUS PNEUMOTHORAX

Outcomes of Emergency Department Patients Treated for Primary Spontaneous Pneumothorax*

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Background: **International guidelines for the management of primary spontaneous pneumothorax (PSP) vary, and there is growing opinion that more patients could be successfully managed with observation alone. There is little published evidence detailing the outcomes of emergency department (ED) patients who have been treated for PSP. The aim of this study was to describe the clinical outcomes for patients with PSP.**

Methods: **This was a retrospective cohort study that was conducted by explicit medical record review that investigated adult patients with PSP who had been treated at two urban teaching hospital EDs from 1996 to 2005. The data collected included demographics, clinical data at presentation, and outcome data. The outcome of interest was the proportion of patients who were successfully treated with the initial management strategy (*ie*, conservative, aspiration, and tube thoracostomy). Data analysis was performed using descriptive statistics.**

Results: **A total of 203 episodes of PSP in 154 patients (70% male; median age, 24 years) was identified. PSP size ranged from 5 to 100%. Ninety-one PSP patients (45%) were treated with outpatient observation, 48 patients (24%) were treated with aspiration, and 64 patients (31%) were treated with tube thoracostomy. In total, the conditions of 79% of patients (82 of 91 patients) who were treated with observation resolved without additional intervention. Aspiration was successful in 50% of cases (24 of 48 cases) where it was attempted; the conditions of 73% of PSP patients who were treated with tube thoracostomy (47 of 64) resolved without additional intervention.**

Conclusion: **These data suggest that observation alone is an effective initial treatment strategy for selected patients with PSP. They support the inclusion of an observation arm in planned prospective studies comparing different management approaches.** ***(CHEST 2008; 134:1033–1036)***

Key words: management; pneumothorax

Abbreviations: CI = confidence interval; ED = emergency department; IQR = interquartile range; PSP = primary spontaneous pneumothorax

Guidelines vary in their recommendations for the treatment of primary spontaneous pneumothorax (PSP),[1–3] and a recent literature review[4] has highlighted the lack of high-quality research studies in this area. Historically, conservative treatment was the mainstay of the management of PSP until the 1940s. It was then largely rejected in favor of tube thoracostomy because it was believed that the latter resulted in a more rapid reexpansion of the lung with the assumption that this yielded a better outcome for patients. This logic has been challenged,[4] and there is now growing opinion that stable patients with PSP could be safely and successfully managed with observation alone. There is a clear need for robust clinical trials to define the optimal management strategy for

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PSP, including the role of observation. The aim of this study was to describe the clinical outcome of a cohort of emergency department (ED) patients with PSP, with particular focus on the subgroup of patients who were managed conservatively, with a view to informing future research study designs.

Materials and Methods

Study Design

This was a retrospective observational cohort study that was conducted by explicit medical record review.[5]

Setting

The study was conducted in two community teaching hospitals in Melbourne, VIC, Australia.

Participants

The participants in the study consisted of a consecutive sample of adult ED patients (age range, 16 to 60 years) with confirmed PSP who were treated from 1996 to 2005 and were identified from an ED administrative database. Patients with secondary iatrogenic and traumatic pneumothoraces were excluded from the study. *Secondary pneumothorax* was defined as a pneumothorax that was related to known underlying lung disease including asthma, cystic fibrosis, neoplasia, pneumonia, or established COPD. Where information establishing a secondary cause was not present in the record, the pneumothorax was assumed to be primary.

Data Collected

Demographics, clinical data, size estimation by the treating doctor, and outcome data were collected. Where data regarding smoking status, previous pneumothorax, or intervention were missing, they were assumed to be absent. Where data regarding age, gender, or PSP size were missing, the case was omitted from analyses related to the missing parameter.

Outcome of Interest

The outcome of interest was the proportion of patients who were successfully treated with the initial management strategy (*ie*, observation, aspiration, and tube thoracostomy). Of note, aspiration following a period of observation was regarded as a treatment failure.

Statistical Analysis

Descriptive statistics were used for analysis, and the χ^2 test was used for the comparison of proportions.

Ethics Approval

This study was approved under the National Health and Medical Research Council (Australia) quality assurance projects guidelines.

Results

There were 203 episodes of PSP in 154 patients. Patient characteristics are shown in Table 1. Fifty-five percent of patients were documented as being current smokers. PSP size ranged from 5 to 100%, with 57% occurring on the left side. In 38% of episodes (78 of 203 episodes), patients reported having experienced a previous PSP; 67% of episodes (51 episodes) occurred on the same side, and a further 12% of episodes (9 episodes) occurred on both sides. It was not possible to calculate the means/medians for PSP size because treating doctors used both numerical estimations of size and descriptors such as "small," "moderate," or "large." That said, the proportion of PSP classified as large or estimated as being $\geq 50\%$ was 32%.

The vast majority of patients were in good clinical condition with a median pulse rate of 80 beats/min (interquartile range [IQR], 71 to 94 beats/min), a systolic BP of 120 mm Hg (IQR, 110 to 133 mm Hg), a respiratory rate of 20 breaths/min (IQR, 18 to 22 breaths/min), and oxygen saturation of 98% (IQR, 96 to 99%). No patient had a systolic BP < 90 mm Hg, 4 patients had a respiratory rate > 30 breaths/min, and 10 patients had oxygen saturation $< 94\%$. There were no cases of clinical tension pneumothorax.

Table 1—*Patient Characteristics and Outcome

Parameters	Group Overall (n = 203)	Observation Group (n = 91)	Aspiration Group (n = 48)	Thoracostomy Group (n = 64)	p Value
Age, yr	24 (20–35)	21 (18–25)	26.5 (22–37)	33 (23–42)	< 0.001 (Mann-Whitney test)
Male gender, %	68	65	69	73	NS (omnibus χ^2 test)
Previous pneumothorax,† %	38	40	31	44	NS (omnibus χ^2 test)
Large pneumothorax,‡ %	32	5	60	73	< 0.0001 (omnibus χ^2 test)
Treatment success rate§	70 (64–77)	79 (69–87)	50 (35–65)	73 (61–83)	0.014 (omnibusf χ^2 test)

*Values are given as the median (IQR), unless otherwise indicated. NS = not significant.
†Data for 22 patients were missing.
‡Defined as > 50% or verbal descriptor of "large." Missing data for 47 patients were excluded.
§Defined as successful resolution of the episode with the primary treatment modality (*ie*, without further intervention). Values are given as % (95% CI).

Ninety-one patients (45%) were treated with observation alone, 48 patients (24%) were treated with attempted aspiration, and 64 patients (31%) were treated with tube thoracostomy. The treatment groups were not matched for size, with the tube thoracostomy and aspiration groups having a higher proportion of large PSPs (*ie*, those using the descriptor "large" or ≥ 50%) than the other groups (observation group, 5%; aspiration group, 60%; tube thoracostomy group, 73%; $p < 0.001$ [by omnibus χ^2 test]). The observation group was also significantly younger than the other treatment groups ($p < 0.001$ [Mann-Whitney test]).

The PSP size in the observation group varied from 5 to 60%. Seventy-two episodes resolved without further intervention (clinical success rate, 79%; 95% confidence interval [CI], 69 to 87%). In 19 episodes, there was an intervention in the follow-up phase (13 thoracostomy tube insertions; 4 successful aspirations; and 2 episodes of video-assisted thorascopic surgery without preoperative drainage for persistent PSP). The clinical reasons for intervention were unclear in most cases. There were no emergency interventions. The aspiration group (n = 48) varied in size from 10 to 100%. Aspiration was successful in 50% of cases in which it was attempted (24 of 48 cases; 95% CI, 35 to 65%). Numbers were too small to meaningfully compare success rates by PSP size. The group treated by thoracostomy tube (n = 64) ranged in size from 10 to 100%. Forty-seven episodes (73%; 95% CI, 61 to 83%) resolved without further intervention. Seventeen patients underwent surgery during the index hospital admission. The success rate with aspiration was significantly lower than those with the other methods ($p < 0.001$ [by omnibus χ^2 test]).

Discussion

The optimal management strategy for clinically well patients with PSP remains to be defined. Guidelines vary in their recommendations (Table 2), and a robust evidence base to inform practice is lacking.

Our data suggest that conservative management is successful in a high proportion of selected patients (79%), including those with larger PSPs. There were no emergent interventions, suggesting that this approach is also safe. This is only the second series of > 50 patients reporting outcomes for PSP patients who were treated conservatively, and its results are similar to those reported in 1966 by Stradling and Poole[6] (n = 111) and in two small case series.[7,8] The combined average success rate in those three reports was 90%.[4] Supporting data, albeit in a mixed primary and secondary pneumothorax cohort, has been provided by O'Rourke and Yee,[9] who reported a success rate of 78%. Taken together, these data support conservative management as a viable initial management strategy. The success rate obtained with aspiration (50%) was toward the lower end of the range of success rates reported by others[4] (50 to 83%) and was about in the middle of the success rate range reported for thoracostomy tube drainage (66 to 97%).[4]

The optimal management strategy for PSP in clinically well patients is far from clear, as evidenced by the variations in guideline recommendations (Table 2). While on face value guidelines and clinicians agree that small PSPs can be managed conservatively, the definitions of what constitutes a large PSP vary considerably (Table 2).[4] Additionally, the evidence base for decision making is weak. A Medline search (1966 to the present) found three randomized trials[10–12] (one reported as a pilot study) of the treatment of PSP. These trials[10–12] compared aspiration to thoracostomy drainage. Patient numbers were fairly small and the end points for each treatment strategy were different, so it is difficult to pool or compare results. The remaining data are from cohort or uncontrolled studies. A number of other randomized trials are cited in the American College of Chest Physicians guidelines[2]; however, these were not confined to the PSP population, with most including mixed primary and secondary pneumothorax groups. Although they provide some important treatment information, their direct relevance to the treatment of PSP is open to question.

Table 2—*Comparison of Guideline Recommendations (Clinically Stable Patients)*

Guidelines	Definition of Large PSP	Small PSP	Large PSP
British Thoracic Society[1]	Presence of a visible rim of 2 cm between lung and chest wall	Conservative outpatient management	Simple aspiration
American College of Chest Physicians[2]	More than 3 cm apical interpleural distance	Observation in ED followed by conservative outpatient management	Pleural catheter insertion (*ie*, tube thoracostomy) and drainage
Belgian Society of Pneumology[3]	Pleural gap along the entire length of the lateral chest wall	Conservative outpatient management	Aspiration or pleural catheter insertion (*ie*, tube thoracostomy) and drainage

Investigating the basis for the change from conservative management, which was the mainstay of treatment until the 1940s, to interventional drainage makes interesting reading. Kircher and Swartzel[13] derived their recommendation that PSPs > 20% in size should be drained using mathematical modeling based on interpleural distances measured on radiographs in a small set of patients. They estimated that PSP treated conservatively reexpanded at an average rate of 1.25% per day with bed rest alone. This was compared with an average hospital stay of 16 days for those patients treated with drainage, and the 20% cutoff represented the point of balance with respect to hospital stay rather than clinical outcome for the two methods of treatment. Although this contrasts with the findings of Stradling and Poole[6] that there was no relationship between the size of a pneumothorax and the number of days to reexpansion during conservative treatment, the concept that pneumothoraces that are not small require intervention has taken hold, as evidenced by the current guideline recommendations (Table 2). There have been no reported studies comparing conservative management with interventional treatment for clinical outcomes. The lack of evidence and current guideline recommendations have made the inclusion of a conservative treatment arm in studies of larger pneumothoraces contentious. Our data suggest that with appropriate information and follow-up, conservative management is a viable and safe initial management strategy, and is appropriate for inclusion in future prospective trials.

This study has some limitations that should be considered when interpreting the results. The data were collected by retrospective medical record review and thus are subject to documentation errors and missing data. Treatment groups were not matched for initial size, so comparisons of success rates between groups should be made with caution. There was a high rate of recurrent PSP in the group that may have influenced decision making regarding surgical intervention. Treatment was at physician discretion, and undocumented patient and clinical factors may have influenced treatment decision making. The study was conducted at a single health service, so generalizability cannot be assumed.

Conclusion

These data suggest that outpatient observation is an effective initial treatment strategy in selected patients with PSP. They support the inclusion of an observation arm in planned prospective studies comparing management approaches.

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