Original Article

Conservative versus invasive management of secondary spontaneous pneumothorax: a retrospective cohort study

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Aim: Hospitalization, often with intervention, is the recommended management algorithm by multiple international respiratory societies for management of a secondary spontaneous pneumothorax (SSP). Over recent years we adopted a conservative approach to SSPs. We undertook a retrospective cohort study of SSP to establish the safety profile of a conservative approach for these previously unstudied patients.

Methods: We reviewed all cases of SSP presenting to our institution from 2012 to 2019 using the 2010 British Thoracic Society definition of an SSP. Age, gender, smoking status, underlying lung disease, pneumothorax size estimate (using the Collins method), nature of intervention, inpatient duration, and any additional complications were recorded. The χ^2-test and Mann–Whitney *U*-test were used for comparison of categorical variables and categorical/continuous variables, respectively.

Results: Eighty-two cases were included in the final analysis. Of them, 64 had an interpleural distance at the hilum of 1cm or greater, meeting British Thoracic Society criteria for a pleural intervention. Of these 64 patients, 25 (39%) were managed conservatively. No patient managed conservatively required a subsequent intervention. When stratified for conservative or invasive management, there was no significant difference in age, gender, smoking status, or presence of underlying lung disease between the groups. There was a significant difference in size of the pneumothorax with conservative management having smaller pneumothoraces (37% versus 54%, $P < 0.001$) and a shorter inpatient stay (conservative, 7.9 days; intercostal catheter, 9 days; $P = 0.004$).

Conclusion: We have demonstrated success with conservative management of SSPs where a significant proportion of them met accepted criteria for a pleural intervention.

Key words: Catheter, conservative, intercostal, management, pneumothorax

INTRODUCTION

SPONTANEOUS PNEUMOTHORACES HAVE been traditionally divided into primary spontaneous pneumothorax (PSP) and secondary spontaneous pneumothorax (SSP). The British Thoracic Society (BTS) define an SSP as a spontaneous pneumothorax occurring in a patient greater than 50 years of age with a significant smoking history or evidence of underlying lung disease on chest X-ray or clinical examination.[1] There has been a recent shift in the accepted management of PSP from intervention based purely on size criteria/subjective breathlessness to conservative management in all patients apart from those with significant pain or hemodynamic compromise.[2] However, there are no prospective data guiding management of SSP. British and American guidelines dictate admission to hospital for at least 24 h for all patients with an SSP and intervention for anything greater than a 1 cm pneumothorax at the hilum or 2 cm at the apex[1,3], and a recent *New England Journal of Medicine* editorial described an interventional approach being warranted for any SSP[4]—recommendations made based on eminence, not evidence.

Our institution has traditionally practiced a conservative approach to primary and secondary pneumothoraces. Given the strength of evidence behind conservative management of PSP, we undertook a first-in-class retrospective cohort study of SSP to establish the safety profile of a conservative management approach for these patients, believing it would show a shorter length of inpatient stay compared to the traditional invasive approach.

METHODS

WE REVIEWED THE management of all secondary pneumothoraces (using the 2010 BTS guideline

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definition described above) that presented to a tertiary public hospital in Far North Queensland, Australia, from 2012 to 2019. Given the generally endorsed management strategy for an SSP is a pleural intervention, these patients were designated as the unexposed group and those managed without pleural intervention were designated the exposed group. As this is (to the best of the authors' knowledge) a first-in-class, albeit retrospective, study an anticipated failure rate in the exposure group was unknown from previous reports so no power calculation was carried out. However, we hypothesized that the exposed group (i.e., no pleural intervention) would have a shorter length of stay than the unexposed (pleural intervention) group. Additionally, we hypothesized that there would be a demonstrable safety signal, manifesting as few patients needing a delayed pleural intervention, in the exposed group.

All of the following inclusion criteria needed to be met to be included in the final analysis: meeting the study definition of secondary pneumothorax, having an erect chest X-ray demonstrating the pneumothorax, having sufficient information available through our electronic medical record to assess the individual case, and having the primary management decision made at our institution. Patients who received an intercostal catheter (ICC) at a peripheral hospital and were transferred to the tertiary center for ongoing care were excluded from this study. Traumatic and iatrogenic pneumothoraces were also excluded.

Data extracted from each case included age, gender, smoking status, presence and nature of any underlying lung disease, estimated size of pneumothorax as per the Collins method,[5] nature of any intervention, length of inpatient stay, time to re-expansion (if known), and any additional complications. The χ^2-test and Mann–Whitney *U*-test were used for comparison of two categorical variables and categorical/continuous variables, respectively.

Given the retrospective nature of this study, it has been assumed that all hospital admissions and discharges occurred due to clinical need and medical suitability for discharge, respectively.

This research was prospectively approved by the local hospital ethics review committee (reference LNR/2020/QCH/63269-1440QA).

RESULTS

AFTER SCREENING 285 individual episodes coded as secondary pneumothorax, 82 were included in the final analysis. The cohort breakdown, including reasons for exclusion, is listed in Figure 1.

In total, 64 of 82 patients had an interpleural distance at the hilum of ≥1 cm, meaning they met BTS guideline-derived criteria for a pleural intervention.[1] Of these 64 patients, we undertook conservative management in 25 (39%) (Table 1). If both BTS and American guidelines (which recommend pleural intervention if apex–cupola distance is ≥2 cm)[3] are applied then 74 patients would meet the criteria for pleural intervention, of which we managed 30 conservatively (41%). No conservatively managed patient in our cohort required a delayed or subsequent intervention.

Table 2 presents the characteristics of all patients included in the final analysis, grouped by conservative or invasive management. There was no significant difference between age, gender, smoking status, or presence of underlying lung disease between the two groups. There was a significant difference in size of the pneumothorax, with conservative management having smaller pneumothoraces (37% versus 54%, $P < 0.001$) and a shorter inpatient stay (conservative 7.9 days versus ICC 9 days, $P = 0.004$). There were two and five in-hospital deaths in the conservative and ICC groups, respectively.

Table 3 shows the characteristics of patients with a previously diagnosed underlying lung disease ($n = 62$). These groups were also similarly matched, with the conservative group having a smaller pneumothorax (38% versus 58%, $P < 0.001$). Of this subpopulation, there was a small but statistically significant longer inpatient stay (7.8 days versus 7.5 days, $P = 0.01$), the inverse to that found when the entire population was considered.

Reason for ICC insertion was documented in 25 of 42 cases (60%). The most common reason cited was dyspnea with or without hypoxia (8/28, 29%), need for invasive ventilation (8/28, 29%), size (without pain, dyspnea, or cardiopulmonary compromise) in 4/28 (24%), and pain in 2/28 (7%).

Complications were uncommon, with only one patient in the intervention group developing an insertion site infection. Seven patients developed subcutaneous emphysema that was documented in contemporaneous notes as significant but did not require directed intervention. Time to re-expansion was only documented or able to be identified in 10/36 conservatively managed patients (median, 15 days; interquartile range, 16.5 days) versus 35/46 ICC patients (median, 2 days; interquartile range, 2 days).

DISCUSSION

THIS CASE SERIES reveals success, defined as a reduced length of stay without need for a delayed pleural intervention, with conservative management of SSPs where a large proportion of them met accepted criteria for a pleural intervention.

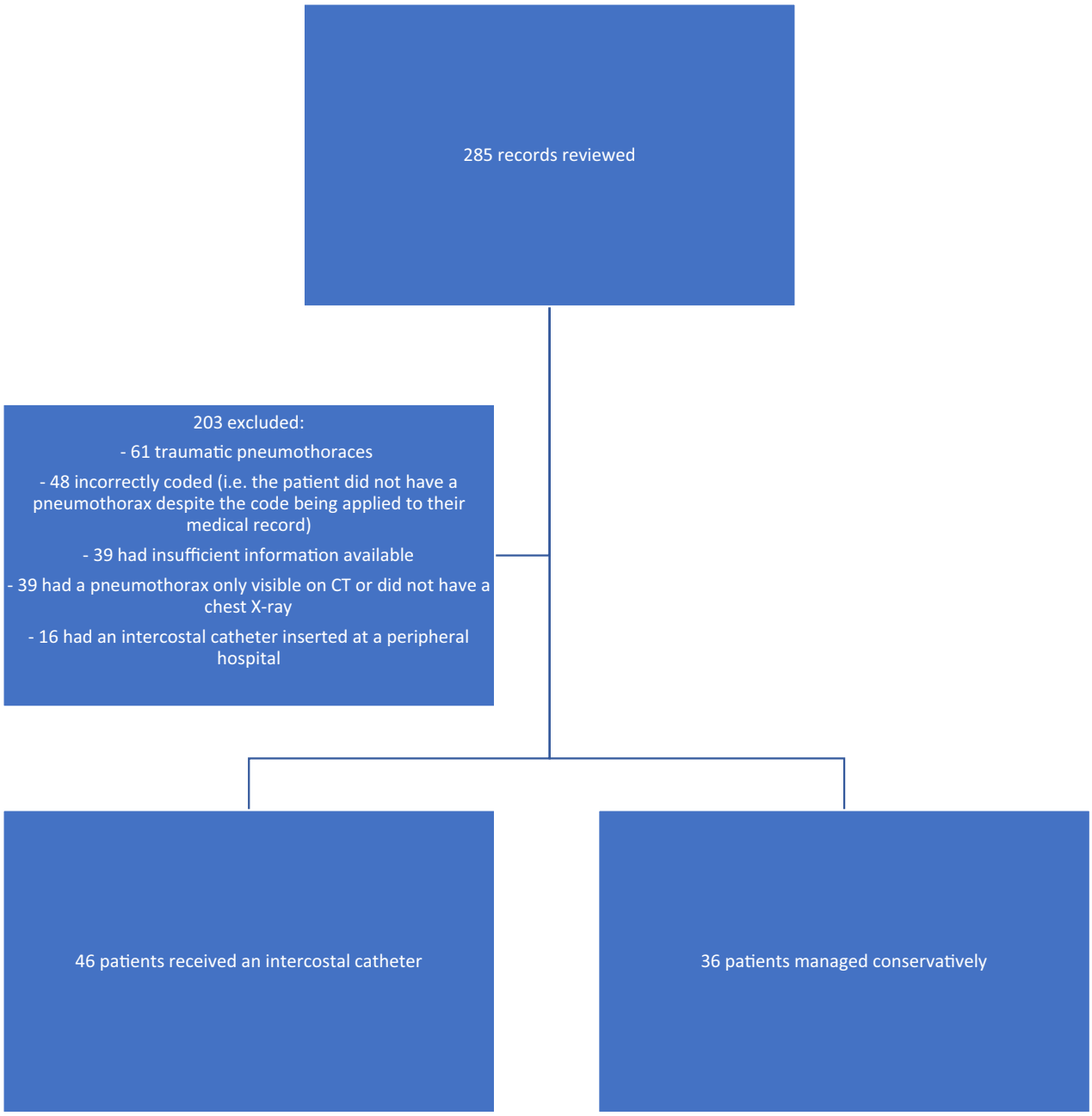

Fig. 1. Flowchart of case analysis of management of secondary spontaneous pneumothorax and reasons for exclusion from the study.

The majority of patients (62/82, 76%) had a documented history of underlying lung disease. The remainder met inclusion criteria either through having a documented minimum 20 pack-year tobacco history or radiological change consistent with significant underlying lung disease.

A postulated mechanism for success with a conservative approach is that, by allowing the lung to stay collapsed for a period of time, the visceral pleural defect can appose and heal.

The conservatively managed group had a statistically and clinically significant reduction in in-hospital bed days. When

Table 1. Comparison of our practice and British Thoracic Society (BTS) guidelines for the management of secondary spontaneous pneumothorax

	Total cohort (n = 82)
≥1 cm at the hilum (BTS recommend pleural intervention)	64
Of these:	
Managed conservatively in our cohort	25
Managed invasively in our cohort	39
<1 cm at the hilum (BTS recommend conservative management)	18
Of these:	
Managed conservatively in our cohort	11
Managed invasively in our cohort	7

BTS guidelines recommend conservative management where interpleural distance is measured as ≥1 cm at the hilum.

Table 2. Conservative versus invasive management of secondary spontaneous pneumothorax (n = 82)

	Conservative (n = 36)	Invasive (n = 46)	P-value
Median age, years (interquartile range)	73.5 (18.5)	74 (15.75)	0.250
Male sex	23	34	0.410
Current smoker	4	11	0.092
Non-smoker	12	7	N/A
Ex-smoker	20	28	N/A
Previously diagnosed underlying lung disease	25	37	0.250
Mean size using Collins method	37.2	55.4	<0.001
Median length of stay, days (interquartile range)	2 (8)	7 (6)	0.004
Time to re-expansion, days	15 (16.5)	2 (2)	<0.001
Deaths during admission	2	5	N/A

N/A, not applicable.

stratified for diagnosed underlying lung disease the intergroup difference reversed statistically; however, there was no pragmatic difference in this circumstance, with the time being 0.3 days.

Additionally, there was a significant difference in the time to re-expansion, with the conservative arm having a longer time to re-expansion (15 days versus 2 days). Unfortunately, time to complete re-expansion was not documented or available in all cases. However, this difference could have implications for a patient, whereby suitability for activities varies with their treatment method. For example, being able to fly, or ideally the requirement for imaging and review on a regular basis until resolution of the pneumothorax has been demonstrated.

Table 3. Characteristics of patients with secondary spontaneous pneumothorax with previously diagnosed underlying lung disease (n = 62)

	Conservative (n = 25)	Invasive (n = 37)	P-value
Median age, years (interquartile range)	73.5 (16)	72.5 (15)	0.580
Male sex	20	29	0.870
Current smoker	4	11	0.360
Non-smoker	4	3	N/A
Ex-smoker	17	23	N/A
Mean size using Collins method	37.9%	59.4%	<0.001
Median length of stay, days (interquartile range)	3 (4)	7 (5.5)	0.010
Deaths during admission	2	4	N/A

N/A, not applicable.

There are limitations of this study. The retrospective nature means there was no randomization or blinding, and as it is from a single center this could limit the generalizability of the results. Presence or absence of lung disease was assessed in a binary fashion, with no stratification across different types or severity gradings of lung disease, thus being a significant potential confounder. A significant minority of patients were excluded due to insufficient data being available through the electronic medical record or only having a computed tomography scan (i.e., no chest X-ray).

Acknowledging the limitations, we have reported a cohort of patients who met criteria for a pleural intervention as management for their SSP but who were successfully managed conservatively. In the same way, a retrospective analysis[6] provided the groundwork for the practice-changing randomized controlled trial for PSP.[2] These data serve as evidence for a similar trial for this pathology.

DISCLOSURE

Approval of the research protocol: This study was granted approval by the relevant local hospital ethics committee. The approval number is LNR/2020/QCH/63269-1440QA.

Informed consent: The need for informed consent was waived via the ethics committee as this was a deidentified cohort study with grouped data.
Registry and the registration no. of the study/trial: This was not an animal study.
Animal studies (if applicable): This study was approved as a retrospective cohort analysis with nothing further required as per our local hospital ethics committee. The approval number is LNR/2020/QCH/63269-1440QA; the ethics committee was that of the Cairns and Hinterland Hospital and Health Service, QLD, Australia.
Conflict of interest: None.

REFERENCES

1 Macduff A, Arnold A, Harvey J, on behalf of the BTS Pleural Disease Guideline Group. Management of spontaneous pneumothorax: British Thoracic Society pleural disease guideline 2010. Thorax 2010; 65(Supp 2): ii18–31.
2 Brown SGA, Ball EL, Perrin K *et al*. Conservative versus interventional treatment for spontaneous pneumothorax. N. Engl. J. Med. 2020; 382: 405–15.
3 Baumann MH, Strange C, Heffner JE *et al*. Management of spontaneous pneumothorax: An American College of Chest Physicians Delphi consensus statement. Chest 2001; 119: 590–602.
4 Courtney BV. Clearing the air – a conservative option for spontaneous pneumothorax. N. Engl. J. Med. 2020; 382: 469–70.
5 Collins CD, Lopez A, Mathie A, Wood V, Jackson JE, Roddie ME. Quantification of pneumothorax size on chest radiographs using interpleural distances: regression analysis based on volume measurements from helical CT. Am. J. Roentgenol. 1995; 165: 1127–30.
6 Chew R, Gerhardy B, Simpson G. Conservative versus invasive treatment of primary spontaneous pneumothorax: a retrospective cohort study. Acute Med. Surg. 2014; 1: 195–9.