Persistent air-leak in spontaneous pneumothorax – clinical course and outcome


Department of Respiratory Medicine, Tan Tock Seng Hospital, Singapore

Persistent air-leak in patients with spontaneous pneumothorax (SP) is not uncommon and may present a management dilemma in those who are unfit or unwilling for surgery. Video-assisted thoracoscopic surgery (VATS) has been advocated in the management of patients with broncho-pleural fistulae (air-leak persisting beyond 7 days): however the optimum time for surgical intervention remains unclear.

We reviewed the records of 130 episodes of SP in 115 patients over a 2-year period to determine clinical course and outcome, particularly with respect to duration of air-leak.

There were 90 first episodes and 40 recurrent episodes. Eighty-one episodes (62%) occurred in patients with underlying lung disease (secondary pneumothorax). Initial management consisted of chest-tube drainage in 104 episodes (80%) occurring in 90 patients, percutaneous needle aspiration in five patients (4%) and observation in 21 episodes (16%) in 20 patients. In the group treated with chest-tube drainage, there was spontaneous resolution of air leak and lung re-expansion in 90 episodes (87%). The overall incidence of broncho-pleural fistula was 34.6%. In the primary SP group, 75% of air-leaks ceased by 7 days and 100% by 15 days. In the secondary SP group, 61% of air-leaks resolved by 7 days and 79% by 14 days, after which time resolution of air-leak proceeded at a much slower rate. Five patients underwent surgery while nine patients were discharged with residual pneumothoraces. There were no major complications or mortality.

Based on our findings, we advocate surgery for patients with air-leak persisting beyond 14 days, while favouring a conservative approach before this time, as the majority of air-leaks (especially in patients with primary pneumothorax) would resolve by 14 days.

Introduction

The optimal management of spontaneous pneumothorax (SP), a condition commonly encountered in hospital practice, remains the subject of debate. While there has been a shift towards outpatient management with percutaneous needle aspiration, especially for the first episode of primary pneumothorax (1-4), others advocate early surgery and pleurodesis with video-assisted thoracoscopic surgery (VATS) (5,6). Indeed, surgical intervention, whether open thoracotomy or more recently, VATS, is the current recommended practice for air-leak persisting for 7 days (7,8). To our knowledge, this 'cut-off' point of 7 days is not supported by the literature. Moreover, the rate of recurrence of pneumothorax ranges between 10 and 40%, depending on whether pleurodesis was carried out, and on the sclerosing agent used (7,9-12). Therefore, the majority of patients may not experience a recurrence and, in our view, subjecting them to surgery after only 7 days of persistent air-leak may not be justified, especially in those with borderline pulmonary function or concomitant medical problems which may pose a risk for anaesthesia. It has also been our experience that many patients with a first episode of SP are reluctant to undergo surgery.

We examined the time taken for air-leak to resolve in our patients with SP who were treated with chest tube drainage during the period 1990-1991, at which time VATS was not yet commonly practised in our hospital. We hoped to identify a 'cut-off' time limit for resolution of air-leak after which surgery may be advisable.

Methods

Our study population comprised adult patients admitted with SP to the medical departments of Tan Tock Seng Hospital, a 1000 bed general hospital in Singapore, over a 2-year period from January 1990 to January 1992. There were 130 episodes of SP altogether, occurring in 115 patients. The case records of these episodes were reviewed retrospectively for data pertaining to patient age, gender.
and smoking status, duration of symptoms, side and type of pneumothorax (primary or secondary; initial or recurrent) and degree of lung collapse. The degree of lung collapse was assessed radiologically by the same chest physician according to the method described by Rhea and DeLuca (13). For patients in whom chest tubes were inserted, the time taken for the air-leak to resolve, duration of chest tube, local and systemic complications, and the outcome of the SP episode were documented.

Results

PATIENT CHARACTERISTICS

The various patient characteristics are shown in Table 1. The mean age of the patients was 48.4 years. There were 110 male (96%) and five female patients and 83% were smokers. The mean duration of symptoms prior to admission was 3.8 days. Sixty-two per cent of the episodes occurred on the right side. The mean size of the SP was 47% collapse of the lung. Seventy per cent (n=73) of the episodes were secondary pneumothoraces. The patient characteristics of the patients with primary SP as compared with the secondary SP group are shown in Table 3. The patients with primary SP were significantly younger than those with secondary SP (mean age 24.1 years vs. 64.1 years). All but one of the patients with secondary SP were smokers, while 36% (10/28) of the patients with primary SP were non-smokers.

DURATION OF AIR-LEAK

The duration of air leak, taken as the presence of ‘bubbling’ of the fluid in the bottle attached to the chest tube, was analysed for the 104 episodes of SP treated with chest-tube insertion (Table 4). In the 11 cases in which this was not documented, the duration of air-leak was taken as the duration of the chest tube: 7 days or less in four instances;
TABLE 3. Characteristics of patients treated with chest-tube drainage (104 episodes in 90 patients)

<table>
<thead>
<tr>
<th>Patient characteristics</th>
<th>Primary SP (31 episodes in 28 patients)</th>
<th>Secondary SP (73 episodes in 62 patients)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (SD)</td>
<td>24.1 years (5.8)</td>
<td>64.4 years (12.6)</td>
</tr>
<tr>
<td>No. of males (%)</td>
<td>28 (100)</td>
<td>61 (98.4)</td>
</tr>
<tr>
<td>No. of smokers (%)</td>
<td>18 (64.3)</td>
<td>61 (98.4)</td>
</tr>
<tr>
<td>Mean % collapse of lung (SD)</td>
<td>64.0% (25.0)</td>
<td>46.2% (20.3)</td>
</tr>
</tbody>
</table>

TABLE 4. Duration and resolution of air-leak in patients treated with chest tube drainage (n=104 episodes in 90 patients)

<table>
<thead>
<tr>
<th>Duration of air-leak</th>
<th>Primary SP (n=31)</th>
<th>Secondary SP (n=73)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (SD)</td>
<td>5.19 days (3.50)</td>
<td>9.90 days (11.54)</td>
</tr>
<tr>
<td>Median</td>
<td>4 days</td>
<td>6 days</td>
</tr>
<tr>
<td>No. of air-leaks resolved by 7 days (%)</td>
<td>23 (75%)</td>
<td>45 (61%)</td>
</tr>
<tr>
<td>No. of air-leaks resolved by 14 days (%)</td>
<td>30 (97%)</td>
<td>59 (79%)</td>
</tr>
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</table>

Longer than 14 days in four instances; and between 8 and 14 days in three instances. The incidence of broncho-pleural fistula (BPF), conventionally defined as air-leak persisting beyond 7 days, was 26% (8/31) in the primary pneumothorax group and 39% (28/73) in the secondary pneumothorax group, giving an overall incidence of 34.6%. The time taken for resolution of air-leak in the primary and secondary pneumothorax groups is shown in Table 4 and plotted graphically in Fig. 1. In the primary pneumothorax group, 75% (23/31) of air-leaks had ceased by 7 days, 97% (all but one) by 14 days and 100% by 15 days. In the secondary pneumothorax group, 61% (45/73) had resolution of air-leak by 7 days and 79% (59/73) by 14 days. The remaining 14 episodes took up to 71 days to resolve. It may be shown graphically (Fig. 1) that all our patients with primary SP, and a large number with secondary SP, had closure of BPF up to 15 days, after which closure of BPF proceeded at a much slower rate. The plot for patients with secondary SP appeared to demonstrate two infection points at 7 days and 14 days, representing points at which the rate of cessation of air-leak seemed to change and decrease. The duration of air-leak for primary pneumothorax was significantly shorter than that for secondary pneumothorax (Wilcoxon 2-sample test: P=0.04). There was no significant correlation between size of the pneumothorax and time taken for air-leak to resolve (Pearson correlation: −0.10, P=0.13).

COMPLICATIONS

Local complications comprised (in decreasing order of frequency) subcutaneous emphysema, infection, slippage of chest tube, re-expansion pulmonary oedema and haemothorax (Table 5). Three of the episodes of subcutaneous emphysema were severe, one requiring fasciotomy. Six of the seven patients in whom infection occurred had chest tubes inserted for longer than 15 days. Four developed pneumonia, one developed infection at the chest-tube site, while two patients had both pneumonia and infection at the

Fig. 1. Time course of resolution of air-leak in primary (— — — , n=31) and secondary (— — , n=73) SP.
chest-tube site. There were no episodes of empyema. None of the episodes of re-expansion pulmonary oedema resulted in systemic hypotension. Apart from the above six episodes of pneumonia, there were no other systemic complications associated with prolonged hospitalization and immobility, such as pressure sores or acute retention of urine. There was no mortality in our group of patients. However, one patient suffered cardiovascular collapse at the time of chemical pleurodesis with dextrose 50% in the presence of an air-leak (14). It was postulated that the reflux of the concentrated dextrose solution caused dextrose pneumonitis and increased permeability pulmonary oedema. He was successfully resuscitated and discharged from hospital.

OUTCOME OF SP

There was resolution of pneumothorax in 90/104 episodes (87%). Chemical pleurodesis was carried out in 32 instances at the discretion of the attending physician. The majority of the chemical pleurodesis was carried out in those with secondary SP (26/32 or 81%) and those with recurrent SP (21/32 or 66%). In the remaining 14 patients without full resolution of SP, nine were discharged with small, residual pneumothorax as they were clinically well, while five patients underwent surgery. The indications for surgery were prolonged air-leak in two patients (47 days and 16 days), a third episode of recurrent secondary pneumothorax in one patient and a history of recurrent bilateral primary pneumothorax in another patient. The indication for surgery in the remaining patient (who had a secondary SP) was not documented.

In total, there were 15 patients with air-leak exceeding 14 days. Of these, only one was a primary pneumothorax and the air-leak in this patient ceased at 15 days. Of the 14 secondary SP patients with air-leak exceeding 14 days, two underwent chemical pleurodesis in the presence of air-leak, two underwent surgery and the rest had spontaneous resolution of air-leak.

The median duration of chest-tube was 8 days (range 3-71 days) and the median duration of hospital stay was 9.5 days (range 4-80 days).

Discussion

The majority of SP in our study occurred in male smokers, a finding consistent with that of other studies. As expected, patients with primary SP were much younger than those with secondary SP. Eighty per cent (104/130) of the episodes of SP were treated with chest-tube drainage, while only 4% (5/130) were treated by needle aspiration, reflecting our practice at that time. Only five patients underwent surgery as VATS was not widely practised in our institution before 1992.

There was spontaneous resolution of air-leak in the majority of our patients (100% for primary pneumothorax and 79% for secondary pneumothorax) up to 15 days, after which air-leak closure proceeded at a much slower and more unpredictable rate (Fig. 1). This was in contrast to the results of Mather et al. (15) who found that the rate of resolution of air-leak in his group of patients appeared to change little after 9 days. There was no mortality in our patients, and no significant morbidity associated with chest tube durations under 15 days. Six of the seven patients with nosocomial infection (pneumonia and/or wound infection) had chest-tube durations of longer than 15 days.

Our data in the primary pneumothorax group showed that 75% of the air-leaks resolved by 7 days, and the remaining 25% resolved by 15 days. We believe, therefore, that surgery for persistent air-leak at 7 days in patients with primary pneumothorax may be premature, in view of the high incidence of air-leak closure by 15 days. Surgery (open thoracotomy or VATS) is not without its hazards, especially in older patients with underlying lung disease, poor pulmonary reserve, and concomitant medical problems. Of the air-leaks in our patients with secondary SP, 61% resolved by 7 days and a further 14 out of 28 patients had cessation of air-leak between day 7 and day 14, i.e. after day 7 there was still a 50% chance of the air-leak resolving by day 14. This outcome was achieved at not the expense of any of the anticipated complications of prolonged chest-tube insertion or hospitalization. The financial cost of a longer hospital stay versus that of surgery was not analysed, but we feel that the surgical option may not necessarily be the more economical one. The cost comparison of a prolonged hospital stay with that of early surgery should also take into account the economic burden imposed by days off from work, which would presumably be greater for patients who undergo surgery. The surgical option would enable definitive treatment (i.e. ligation or resection of pleural blebs) and the application of a sclerosing agent to prevent recurrence of SP. However, as the recurrence rate of SP is estimated to range from 10 to 40% in the absence of pleurodesis, more than half of these patients may never experience a recurrence. Application of a sclerosing agent such as talc may also render future thoracic surgery difficult and risky, due to the very fact that it is so effective in inducing adhesions and fibrosis. Subjeacting a patient to surgery and pleurodesis after the first episode of SP (especially primary SP) may not be entirely advantageous to the patient.

In summary, our data demonstrate that 97% of persistent air-leaks in primary SP resolved by 14 days (100% by 15 days), and 79% in secondary SP by 14 days, with a fair proportion (22% in the primary SP group and 18% in the secondary SP group) resolving between 7 and 14 days. We therefore advocate a more conservative approach, deferring surgery beyond 7 days and up to 14 days of air-leak, in patients with primary and secondary SP.

Acknowledgements

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References


