

## The effectiveness of catheter aspiration in the treatment of spontaneous pneumothorax

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Catheter aspiration is a simple and minimal invasive method to treat spontaneous pneumothorax. It was recommended by British Thoracic Society in 1993 as the treatment for spontaneous pneumothorax. This study was designed to evaluate the effectiveness of catheter aspiration in the treatment of spontaneous pneumothorax. The protocol involved catheter placement by using Seldinger technique and serial chest X-rays were used to document the degree of lung re-expansion. We report a case series study in which eight patients were recruited into the study. All patients' pneumothorax re-expanded well after the initial attempt of aspiration. However, during the observation period, 5 patients had recurrence of pneumothorax requiring further aspiration. Despite that, these 5 patients finally required chest drain insertion. The remaining 3 patients were discharged after aspiration and were followed up on the following day. Two patients had recurrent pneumothorax and required further intervention. One patient had uneventful recovery. **Conclusion:** catheter aspiration was effective in relieving spontaneous pneumothorax but with a high recurrence rate. (*Hong Kong j.emerg.med.* 2002;9:18-22)

**Keywords:** Catheter aspiration, spontaneous pneumothorax

### Background

Spontaneous pneumothorax is commonly encountered in young, tall, thin subjects without apparent underlying lung disease. Short-term treatment of pneumothorax aims at evacuation of air from the pleural space, thus allowing lung re-expansion. Catheter aspiration and thoracic drainage are the most frequently used methods to serve this purpose. The success rate of treating spontaneous pneumothorax by catheter aspiration ranged from 53% to 84% as shown in different studies.<sup>1-9,12</sup>

Catheter aspiration is simple, less painful and minimally invasive when compared to thoracic drainage.<sup>10</sup> It was recommended by British Thoracic Society in 1993 as the treatment of pneumothorax.<sup>11</sup> However, it may be ineffective if the parenchymal tear is large, which carry a high risk of short-term recurrence because it does not promote pleural symphysis.<sup>12</sup>

This study was designed to evaluate the effectiveness and the recurrence rate of catheter aspiration in the treatment of spontaneous pneumothorax.

### Methods

Primary pneumothorax was defined as pneumothorax occurring in patient without underlying lung disease. The study subjects were recruited in Accident & Emergency (A&E) department of Alice Ho Miu Ling Nethersole Hospital (AHNH). AHNH was an acute regional 500 beds hospital with 24 hours A&E services. Patients between 18-50 years old with this diagnosis were included into the study if they were

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suffering from their first episode or first recurrence of pneumothorax and the size of pneumothorax was between 10% to 50%. The study was conducted from May 1999 to August 1999.

Exclusion criteria were listed as follows: patients with pre-existing lung diseases like chronic obstructive airway disease and asthma, post-trauma cause, iatrogenic cause like surgical intervention, bilateral pneumothorax, three or more episode of ipsilateral pneumothorax and patients with coagulation defects. (Figure 1)

Patients with spontaneous pneumothorax who met the above criteria were arranged to have chest X-ray including posterior-anterior view and lateral view. The size of pneumothorax was determined by calculating the average interpleural distance as shown in Figure 2.<sup>13</sup>

The procedure was done by the senior medical officers or consultants of A&E department. Catheter aspiration was performed under local anaesthesia, using Cook's apparatus to insert the catheter into the fourth or fifth intercostal space, anterior to the mid-

YES	NO	
<input type="checkbox"/>	<input type="checkbox"/>	AGE <18, OR >50
<input type="checkbox"/>	<input type="checkbox"/>	COAD or ASTHMA
<input type="checkbox"/>	<input type="checkbox"/>	TRAUMATIC CAUSE
<input type="checkbox"/>	<input type="checkbox"/>	THREE OR MORE EPISODES OF UNILATERAL PNEUMOTHORAX
<input type="checkbox"/>	<input type="checkbox"/>	BILATERAL PNEUMOTHORAX
<input type="checkbox"/>	<input type="checkbox"/>	CONCURRENT INFECTION (PNEUMONIA, CONSOLIDATION, TEMP >38.5
<input type="checkbox"/>	<input type="checkbox"/>	SUSPECTED OR PROVEN LUNG CARCINOMA
<input type="checkbox"/>	<input type="checkbox"/>	PLEURAL EFFUSION OR HAEMOTHORAX
<input type="checkbox"/>	<input type="checkbox"/>	BLEEDING TENDENCY
<input type="checkbox"/>	<input type="checkbox"/>	PNEUMOTHORAX SIZE <10% OR >50%

Figure 1. Checklists for study.

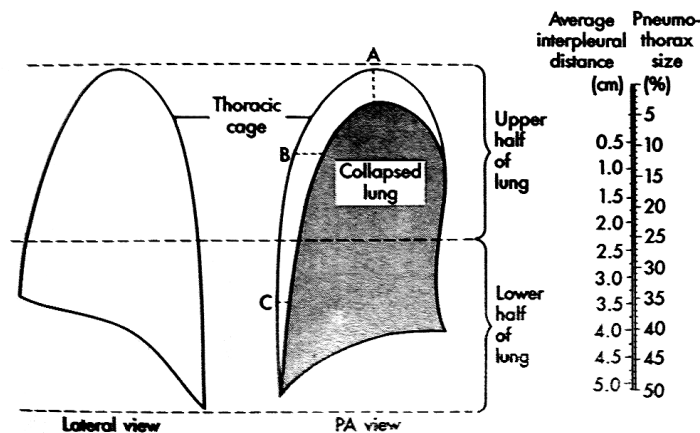


Figure 2. Calculation of average interpleural distance= $(A+B+C)/3$  (in cm) to predict pneumothorax size. (Redrawn with permission from Rhea JT, Deluca SA, Greene RE. Radiology 1982;144:734.)

axillary line by Seldinger technique. 1% lignocaine solution was used for local anaesthesia. Aspiration was performed and stopped when resistance was felt or more than 2.5 litre of air was aspirated or patient had excessive cough. The catheter was left in place after the first aspiration. Chest X-ray was repeated after the first aspiration. If the pneumothorax size was reduced, the patients were sent to observation room for observation. Patients were given 100% oxygen and regular analgesia. Oxygen saturation, respiratory rate, blood pressure and pulse were closely monitored. Chest X-ray was ordered 4 hours after the first attempt of aspiration unless the patients deteriorated and needed earlier intervention. Another aspiration was allowed if pneumothorax reaccumulated and the size was between 10% to 50%. After the second attempt of aspiration, another chest X-ray was performed for documentation. If the pneumothorax size was reduced, the patients were continuously monitored in the observation room for another 8 hours. Another chest X-ray was performed 8 hours after the second attempt of aspiration or 12 hours after the first attempt of first aspiration unless the patients deteriorated and needed earlier intervention.

### Outcome measurement

The outcome measurement of this study would be the successful rate of the initial catheter aspiration and the recurrence rate of pneumothorax. The study was defined as successful if the lung fully expanded (apical pneumothorax also accepted) within 2 attempts of aspiration and no other surgical intervention was required. These patients would be discharged home and was advised to return if they experienced chest pain or dyspnoea. They would be followed up in the follow up clinic on the next day.

### Results

A total of 20 patients with pneumothorax were recruited in a period of 4 months. Twelve patients were excluded from the study based on the inclusion and exclusion criteria.

Eight patients were included into the study, six were male and 2 were female patients. The ages ranged from 18 to 32, with a median of 22. The size of pneumothorax on initial presentation ranged from 15% to 47%, with a median of 26.5%. The amount of air aspirated on first attempt ranged from 300 ml to 1600 ml, with a median of 800 ml. After the first attempt of aspiration, all the patients' pneumothorax size were reduced with a successful rate of 100%. Four patients had residual apical pneumothorax, while the remaining 4 patients had residual pneumothorax with size ranging from 10% to 15% with a median of 11%. (Tables 1 and 2)

All these 8 patients were observed in the observation room and none of them had symptoms which required intervention during the first 4 hours.

Chest X-ray was repeated 4 hours after the initial attempt of aspiration. Three out of 8 patients' pneumothorax size remained the same (apical pneumothorax) (37.5%) and did not require the second attempt of aspiration. Five out of 8 patients' pneumothorax (62.5%) reaccumulated from 20% to 27%, with a median of 25% and required a second attempt of aspiration. The amount of air aspirated on second attempt ranged from 400 to 670 ml, with a median of 500 ml. All these 5 patients pneumothorax size were successfully reduced with a successful rate of 100%. The residual pneumothorax size ranged from 12% to 15%, with a median of 13%. (Tables 1 and 2)

All these 8 patients were observed in the observation room for another 8 hours. None of them had symptoms which required earlier intervention during the observation period. At 8 hours after the second attempt of aspiration or 12 hours after the first attempt of aspiration, chest X-ray was repeated. Three out of these 8 patients' (37.5%) pneumothorax size remained the same (apical pneumothorax) and were discharged home with follow up. Five out of 8 patients' (62.5%) pneumothorax size increased from 20% to 32%, with a median of 25%. These 5 patients required chest drain insertion eventually. (Tables 1 and 2)

The discharged patients were followed up the next day. Two out of these 3 patients had reaccumulation

**Table 1.** Overall-results of catheter aspiration in the treatment of spontaneous pneumothorax.

Patient no.	1	2	3	4	5	6	7	8
Sex	M	F	F	M	M	M	M	M
Age	20	32	30	22	24	18	22	18
Initial size of pneumothorax	30%	15%	19%	28%	25%	34%	20%	47%
Amount of air aspirated on 1 <sup>st</sup> aspiration (in ml)	600	370	300	1335	1000	1400	590	1600
Residual size of pneumothorax (after 1 <sup>st</sup> aspiration)	Apical	Apical	Apical	12%	15%	Apical	10%	10%
4 hours post aspiration pneumothorax size	Apical	Apical	Apical	25%	24%	27%	20%	25%
Amount of air aspirated on 2 <sup>nd</sup> aspiration (in ml)	Not required	Not required	Not required	500	670	570	400	500
Residual size of pneumothorax (after 2 <sup>nd</sup> aspiration)				13%	12%	14%	12%	15%
8 hours post 2 <sup>nd</sup> aspiration or 12 hours post 1 <sup>st</sup> aspiration pneumothorax size	Apical	Apical	Apical	27%	21%	32%	20%	25%
Destination	Discharge	Discharge	Discharge	Admit	Admit	Admit	Admit	Admit

**Table 2.** Results of time sequence of catheter aspiration in the treatment of spontaneous pneumothorax.

	Remarks	Range	Median
Age		18 to 32	22
Initial size of pneumothorax		15%-47%	26.5%
Amount of air aspirated on 1 <sup>st</sup> aspiration		300 ml-1600 ml	800 ml
Residual size of pneumothorax (after 1 <sup>st</sup> aspiration)	4 patients had residual apical pneumothorax	4 patients had residual pneumothorax from 10% to 15%	11%
4 hours post aspiration pneumothorax size	3 patients had residual apical pneumothorax	5 patients had residual pneumothorax from 20% to 27%	25%
Amount of air aspirated on 2 <sup>nd</sup> aspiration	5 patients required 2 <sup>nd</sup> aspiration	400 ml-670 ml	500 ml
Residual size of pneumothorax (after 2 <sup>nd</sup> aspiration)		12%-15%	13%
8 hours post 2 <sup>nd</sup> aspiration or 12 hours post 1 <sup>st</sup> aspiration pneumothorax size	3 patients required one aspiration only and their residual pneumothorax are apical pneumothorax. 5 patients required 2 aspirations.	5 patients had residual pneumothorax from 20% to 32%	25%

of pneumothorax and the size were 20% and 27% respectively. Chest drains were inserted for these 2 patients. The remaining patient's apical pneumothorax resolved in subsequent follow up.

## Conclusion

Although British Thoracic Society has recommended using catheter aspiration to treat spontaneous pneumothorax since 1993, the methods and protocols used for treating spontaneous pneumothorax vary in different centers.<sup>14,15</sup> This study demonstrated that catheter aspiration was very effective in the initial treatment of spontaneous pneumothorax but with high recurrence rate. The high recurrence rate shown in our study matched with the results published by Andrivet et al in France.<sup>12</sup> Within the two attempts of aspiration, the successful rate in reducing the pneumothorax size was 100%. Moreover, none of these patients deteriorated and required earlier intervention during the observation period. However, the reaccumulation rate was high. At 4 hours after the first attempt of aspiration, 5 out of 8 patients' (62.5%) pneumothorax reaccumulated and required another aspiration. At 8 hours after the second aspiration, 5 out of 8 patients' (62.5%) pneumothorax reaccumulated and required chest drain insertion eventually. Three out of these 8 patients (37.5%) in this study were discharged home and followed up on the next day. During the follow up, 2 out of 3 patients (66.7%) had recurrence and required chest drain insertion. This study showed a high short-term recurrence rate. The authors postulated that insufficient time for the parenchymal tear to heal could be one of the major factors for the high recurrence rate.<sup>12</sup> Other possible factor included insufficient attempts of aspiration. The limitation of this study was the small sample size as the number of the study subjects was not high. Nevertheless, based on the above findings, the authors suggested some modifications in the protocol such as increase the number of

aspirations and a longer period of observation would be required.

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