Needle aspiration as first-line management of primary spontaneous pneumothorax

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Summary

Background > Initial management of primary spontaneous pneumothorax (PSP) remains a topic of debate. Recent guidelines recommend needle aspiration as the initial strategy for large PSP, but chest tube drainage is still widely used.

Methods > Over a six-year period, we used needle aspiration in all cases of large PSP at our center to assess this technique’s efficacy in real-life clinical practice. Our prospective study in the pulmonary intensive care unit of a 680-bed university hospital included patients with a PSP greater than 20%, as estimated by the Light’s index. Needle aspiration, performed after local anesthesia, used a plastic intravenous catheter. If it failed, we performed thoracic drainage.

Results > The study included 35 patients. The initial success rate of needle aspiration was 69% (n=24/35), the one-week success rate 63% (n=22/35), and the one-year rate 51% (n=18/35). Tolerance of needle aspiration was good except for transient vagal reaction in four patients. No risk factors (age, body mass index, delay before hospitalization, previous pneumothorax, or Light index at inclusion) predicted initial failure of needle aspiration.

Conclusion > Our results confirmed that needle aspiration is an attractive therapeutic option for patients with large PSP: success was observed in approximately two thirds of cases.

Résumé

Exsufflation à l’aiguille, prise en charge initiale du pneumothorax spontané primaire

Introduction > La prise en charge initiale du pneumothorax spontané primaire (PSP) est controversée. Des sociétés savantes ont recommandé l’exsufflation à l’aiguille dans le traitement de première intention du pneumothorax spontané primaire mais dans la pratique courante le drainage est toujours largement utilisé.

Méthodes > À partir de 1996, nous avons utilisé l’exsufflation à l’aiguille en première intention dans tous les cas de PSP de grand volume. Des patients admis en réanimation pour PSP de grand volume ont été inclus. L’exsufflation à l’aiguille a été réalisée après anesthésie locale en utilisant un cathéter intraveineux en plastique. En cas d’échec, un drainage thoracique était réalisé.

Résultats > Trente-cinq patients ont été inclus. Le taux initial de succès de l’exsufflation à l’aiguille a été de 69%, alors que le taux de succès à 1 semaine et à 1 an ont été respectivement de 63% et de 51%. La tolérance de la technique a été bonne mise à part 4 cas de réaction vagale transitoire. Aucun facteur prédictif d’échec de l’exsufflation à l’aiguille n’a été identifié.

Conclusion > L’exsufflation à l’aiguille est une option thérapeutique intéressante chez les patients ayant un PSP de grand volume, un bon résultat étant observé dans environ 2/3 des cas.

See also in this issue:
• the editorial of Sylvie Leroy and Charles-Hugo Marquette, Pneumothorax spontané : peut-on enfin avancer vers une simplification ?, p. 747-8.
Spontaneous pneumothorax is classified as primary when not accompanied by any apparent lung disease. Although the incidence of primary spontaneous pneumothorax (PSP) is high [1], its initial management remains a matter of debate [2]. While observation is generally recommended for small PSP, either needle aspiration or chest tube insertion may be proposed when a large amount of air has accumulated in the pleural space (large PSP). Needle aspiration, reported to have an immediate success rate of approximately 65% as first-line treatment of PSP [3, 4], is a low-morbidity procedure associated with shorter hospitalization than chest tube drainage. On the other hand, the initial failure rate after needle aspiration may be higher than after chest tube drainage [3]. Some authors advocate needle aspiration as the initial strategy for large PSP [3-6], and the British Thoracic Society guidelines recommend it [1]. Nevertheless, chest tube drainage (or small bore catheter insertion) is widely used and was recommended in a consensus statement by the American College of Chest Physicians [7]. In 1996, we began to use needle aspiration for all the cases of large PSP at our center to verify that its efficacy was the same in real-life clinical settings as in randomized controlled studies.

### Methods

This prospective study was conducted from 1996 through 2002 in the pulmonary intensive care unit of a 680-bed university hospital.

### Patients

All patients older than 15 years were considered eligible for inclusion if they were admitted for a first or second episode of spontaneous pneumothorax, with no evidence of underlying lung disease at admission (thereby defining the pneumothorax as primary) and the size of the pneumothorax was greater than 20%, as estimated by Light's index: estimated percentage of pneumothorax = (1 - L/L') x 100 (L = diameter of the collapsed lung and H = diameter of the hemithorax) [5]. The study did not include patients with posttraumatic, iatrogenic, bilateral, or tension pneumothorax.

### Evaluation of therapy

We evaluated the efficacy of needle aspiration by analyzing the success rate in the first hours after aspiration, at one week, three months and one year after aspiration. Initial success was defined by complete or nearly complete lung re-expansion after manual needle aspiration, according to the chest radiograph taken within hours of aspiration. The one-week success rate was defined by complete or nearly complete lung re-expansion according to the chest radiograph taken seven days after the needle aspiration. The success rates at three months and one year after the procedure were defined by the absence of PSP recurrence. We compared patients with initial success and initial failure for sex, age, body mass index (BMI), delay before admission, previous episode of pneumothorax, and Light index at admission. We also assessed tolerance of needle aspiration.

### Statistical analysis

Data are given as means ± SD or median and range. Continuous variables were compared with a two-tailed Student t test or a Mann-Whitney U test when skewness was detected. Categorical variables are reported as counts and percentages and compared with the Fisher exact test. A p value <0.05 was considered significant.

### Results

During the study period, 35 patients were included (table I). Underlying pulmonary disease, not initially suspected, was discovered in four patients after inclusion: moderate asthma for...
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three and moderate chronic obstructive pulmonary disease (FEV1=51%) for one. Chest radiography at inclusion showed the lung contralateral to the pneumothorax to be normal for all four. Of the 35 patients, 89% had a total pneumothorax, defined by air completely surrounding the lung. The mean Light index in the entire cohort was 61 ± 25%.

The initial success rate for needle aspiration was 69% (n=24/35) overall and 67.7% for patients with total pneumothorax (n=21/31). One of the 24 patients with initial success had a recurrent pneumothorax 24 hours after aspiration and one patient was lost to follow-up after discharge and could not be evaluated at one week. The one-week success rate was thus at least 63% (22/35). Two other patients with initial success were lost to follow-up after the first week, and the remaining patients (n=20) were seen again at three months and at one year. Two had a recurrent pneumothorax (at five and twelve months). Bearing in mind that three patients were lost to fol-

low-up, the success rate was at least 57% (20/35) at three months and 51% at one year (18/35), and the recurrence rate at one year in patients with initial success at least 14% (n=3/21). Among the four patients in whom an underlying pulmonary disease was discovered after inclusion, initial success after aspiration was observed for three, one of whom had a recurrence at five months.

Tolerance of needle aspiration was good for almost all patients. The only adverse event was a transient vagal reaction with rapid recovery in four patients.

As expected, the median hospital stay was significantly lower for patients whose needle aspiration succeeded initially: 24 hours (range 7-216) versus 165 hours (range 48-384) for those whose procedure failed, p=0.0001. Atrial fibrillation resulted in a prolonged hospitalization of one patient in the initial success group.

We analyzed several risk factors for initial failure of needle aspiration: age, sex, BMI, delay before hospitalization, previous pneumothorax, and Light index at inclusion (table II). None predicted initial failure.

Discussion

This prospective study examined the efficacy of needle aspiration in initial management of large PSP and found it effective as first-line treatment in more than two thirds of cases. The success rates for this approach were 57% at three months and 51% at one year.

First-line treatment of PSP ranges from simple observation or oxygen therapy to needle aspiration, chest drainage and even surgery. The primary techniques discussed for large PSP are needle aspiration and chest tube drainage but the optimal strategy is still controversial [2]. In the early 1990s, the standard treatment was chest tube drainage, although several authors advocated more widespread use of needle aspiration [5, 8-10]. In 1993, the British Thoracic Society recommended needle aspiration for first-line management of PSP [8], on the basis of a randomized trial [9-10]. In 1995, another randomized study [3] compared needle aspiration and chest tube as first-line treatment of spontaneous pneumothorax (either primary or secon-

### Table I

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<th>Patients’ characteristics</th>
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<tr>
<td>Age in years (mean, range)</td>
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<td>Sex (M): n (%)</td>
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<tr>
<td>Body mass index: mean, range</td>
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<tr>
<td>Smokers: n (%)</td>
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<tr>
<td>Underlying pulmonary disease: n (%)</td>
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<td>Previous pneumothorax: n (%)</td>
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<td>Delay before admission in hours: median, range</td>
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<td>Pain: n (%)</td>
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<td>Dyspnea: n (%)</td>
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<td>Light index at inclusion in %: mean, range</td>
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<tr>
<td>Right/left sided pneumothorax: n (%)</td>
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<tr>
<td>Total pneumothorax: n (%)</td>
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<tr>
<td>Hospital stay in hours: median, range</td>
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### Table II

<table>
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<tr>
<th>Factors predictive of immediate failure of needle aspiration</th>
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<tr>
<td>Initial success</td>
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<tr>
<td>Gender, Male: n, (%)</td>
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<tr>
<td>Age (in years) (mean, range)</td>
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<tr>
<td>Body mass index (mean, range)</td>
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<td>Delay before admission in hours (median, range)</td>
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<tr>
<td>Previous pneumothorax: n (%)</td>
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<td>Light index at admission in % (mean, range)</td>
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* Data available for 27 patients
These recommendations, however, conflict with those of the recently published guidelines of the British Thoracic Society [1], which probably take these results into account, recommend use of manual needle aspiration [4]: in this multicenter study, 60 patients with a first episode of large PSP were randomized to either manual needle aspiration (27 patients) or chest tube drainage (33 patients). Immediate success rates were similar for the two methods (59% for needle aspiration and 63% for the chest tube) as were one-year recurrence rates (roughly 25%). Most patients treated successfully initially by manual aspiration were not hospitalized. The most recently published guidelines of the British Thoracic Society [1], which probably take these results into account, recommend use of manual aspiration as first-line treatment of large-size PSP. These recommendations, however, conflict with those of the American College of Chest Physicians [7], which suggest use of a small-bore catheter or a chest tube for large PSP.

Initial management of PSP at our center has varied over the last decade. Until the mid-1990s, our policy was to propose simple observation for small PSP and chest drainage for large PSP. The results of the study by Andrivet et al prompted us to reconsider the use of needle aspiration and led us in 1996 to design a prospective study to assess the efficacy of needle aspiration as first-line treatment of large PSP. Despite the large number of physicians in our unit during the study period and their varying degrees of technical skill, our results were consistent with those of earlier randomized trials [3, 4, 10] and indicate that even in every-day conditions (that is, outside the rigid framework of a randomized study comparing two strategies), needle aspiration yields immediate success in approximately two thirds of patients presenting with large PSP. We conclude, based on our results and previously published series, that needle aspiration is an attractive therapeutic option for patients with large PSP. Although the initial success rate for needle aspiration is probably lower than that of chest tube insertion [3], the policy at our center is now to favor needle aspiration in these patients because:

- initial success of needle aspiration allows a significantly shorter hospitalization [10] (or may even avoid it, as in the study by Noppen et al. [5]);
- aspiration is better tolerated than chest tube insertion [10];
- chest tube insertion carries a risk of morbidity [1, 2].

Needle aspiration techniques are not yet standardized. Some authors advocate connection of the catheter to a water-seal device, while others recommend manual aspiration via a 3-way tap connected to a syringe. Our data did not allow us to determine which technique was more effective or better tolerated. Further studies should be designed to address that issue.

Our results confirm that needle aspiration is an effective therapeutic option for patients with large PSP; successful in approximately two thirds of cases. Given its potential advantages (low morbidity, short duration of hospitalization or even discharge after several hours of observation in cases of initial success), we consider that needle aspiration is the treatment of choice for large PSP.

Conflict of interests: none

References

1 Henry M, Arnold T, Harvey J, on behalf of the BTS Pleural Diseases Group, a subgroup of the BTS Standards of Care Committee. BTS guidelines for the management of spontaneous pneumothorax. Thorax. 2003; 58 (suppl II):i39–i52.