Spontaneous Hemopneumothorax: Appropriate Surgical Management

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Abstract

Background & Aims: Spontaneous hemopneumothorax (SHP) is a rare condition that can result in shock due to extensive bleeding. However, the optimal timing of surgery remains controversial.

Methods: Twenty-six patients who underwent surgery for SHP between July 1999 and December 2017 at our institution were retrospectively investigated.

Results: Nineteen patients underwent emergent surgery (ES) and 7 underwent sub-emergent surgery (sub-ES). The ES group exhibited significantly higher drainage volume before surgery compared to the sub-ES group (blood loss; 512 ml vs. 258 ml, \( p = 0.019 \)), and higher total hemorrhage volume (1,056 ml vs. 458 ml, \( p = 0.022 \)). One sub-ES group patient, whose preoperative blood loss measured 150 ml, went into shock prior to surgery. His chest roentgenograms did not indicate significant hemorrhage in the thorax; however, his total blood loss measured 1,100 ml.

Conclusions: The optimal timing of surgical intervention for SHP may depend on the extent of preoperative blood loss. However, preoperative drainage volume is not an accurate indicator of total blood loss, and chest radiographic findings are not reliable in some cases. Therefore, patients with SHP must be carefully monitored, and surgical treatment should proceed smoothly from conservative management as necessary.

Introduction

Spontaneous hemopneumothorax (SHP) is a rare condition characterized by simultaneous accumulation of air and blood within the pleural cavity, without evidence of any trauma or obvious etiology. It accounts for 1-12% of all spontaneous pneumothorax cases.¹,² Furthermore, SHP can be life-threatening, due to the associated hemodynamic instability that results from rapid ventilatory collapse and large volumes of concealed and continuous blood loss into the pleural cavity. The initial management of these patients includes close monitoring, oxygen therapy, fluid resuscitation, blood transfusion, and tube thoracostomy. Surgery is also required in at least 60% of cases.¹,² However, no consensus has been reached regarding the optimal timing of surgery, which may be emergent or sub-emergent. Moreover, because there are currently no guidelines for the treatment of SHP, the optimal timing of surgery is a controversial issue.

To investigate the optimal timing of surgical treatment for SHP, we conducted a retrospective study in our institution to identify the most appropriate approach to surgical management of SHP.

Materials and Methods

Patients

Our study cohort comprised 26 consecutive patients with SHP who had undergone video-assisted thoracoscopic surgery (VATS) at Japanese Red Cross Maebashi Hospital (Maebashi, Gunma, Japan) between July 1999...
and December 2017. The inclusion criteria were as follows: (i) an otherwise healthy individual without related history or underlying conditions; (ii) chest roentgenogram indicating spontaneous pneumothorax associated with fluid accumulation; (iii) the absence of endogenous or iatrogenic trauma to the lung or pleural space within 48 hours of tube thoracostomy. All SHP patients underwent tube thoracostomy insertion as part of the initial management procedure. Following tube insertion, bloody drainage was investigated for definitive diagnosis of SHP. Blood transfusion was administered according to clinical signs, drain output and hemoglobin (Hb) levels. At our institution, surgical treatment for SHP is performed routinely in all cases, owing to the potential difficulties associated with achieving hemostasis due to collapsed and abnormal vessels.

**Surgical procedures**

General anesthesia was administered using a single-lung ventilation technique with a double-lumen endotracheal tube. The patient was placed in a lateral decubitus position. The VATS with three ports was applied in all patients for whom intrapleural blood clots were removed; hemostasis of bleeding vessels was achieved by electrocautery or clipping, and resection of the bullae. At the end of the procedure, a chest tube (24 Fr) was inserted and its appropriate placement ensured by resection of the bullae. The patient was placed in a lateral decubitus position. The VATS with three ports was performed in 19 patients (ES group), with sub-ES being performed in the remaining 7 patients (sub-ES group). No patient required conversion from VATS to thoracotomy.

**Results**

The mean age of the patients was 28.8 years (median: 24.5; range: 17–77 years), and only one patient in the entire cohort was female. The patients’ chief complaints were of chest pain (23 patients), respiratory discomfort (12 patients) and cough (1 patient). Of the 26 patients who underwent surgery for SHP, ES was performed in 19 patients (ES group), with sub-ES being performed in the remaining 7 patients (sub-ES group). No patient required conversion from VATS to thoracotomy.

Table 1 presents patient preoperative characteristics by group. There were no significant group differences in age, sex, laterality, preoperative Hb and Hct levels, blood loss before and during surgery, total blood loss, type of hemorrhage (venous or arterial), duration of hospital stay, and duration of postoperative stay. The study protocols were approved by our institutional review board (ID:2020-9).

**Statistical analysis**

A two-sided P-value less than 0.05 was taken to indicate a statistically significant difference. Fisher’s exact test or an independent t test were used for comparing the two groups. Statistical analysis was performed using SPSS for Windows software (ver. 21.0; IBM corp., Armonk, NY, USA).

| Table 1 Preoperative characteristics of the SHP patients according to surgical timing |
|---------------------------------------------------------------|
| **Age (y)** | **ES (n=19)** | **Sub-ES (n=7)** | **P value** |
|--------------|--------------|-----------------|------------|
|               | 29.1         | 28.0            | 0.853      |
| (17–77)      | (21–33)      |                 |            |
| **Sex**      | female/male  |                 |            |
| female       | 1/18         | 0/7             | <0.999     |
| male         | 18/17        |                 |            |
| **Location of surgery, right/left** | 10/9 | 3/4 | <0.999 |
| **Time to surgery (h)** | 5.7 | 89 | 0.002 |
| **Preoperative Hb (g/dl)** | 13.2 | 13.5 | 0.651 |
| **Preoperative Hct (%)** | 39.5 | 39.9 | 0.813 |
| **Drainage volume before surgery (ml)** | 512 | 258 | 0.019 |
| **Shock presence/absence** | 6/13 | 1/6 | 0.629 |

Abbreviations: ES, emergent surgery; SHP, spontaneous hemopneumothorax

| Table 2 Perioperative characteristics of the SHP patients according to surgical timing |
|--------------------------------------------------------------------------------------|
| **Blood transfusion, presence/absence** | 2/17 | 0/7 | <0.999 |
| **Operative time (min)** | 78.8 | 72.4 | 0.598 |
| **Blood loss during surgery (ml)** | 553 | 200 | 0.176 |
| **Type of hemorrhage venous/arterial/unknown** | 9/7/3 | 6/1/0 | 0.196 |
| **Total blood loss (ml)** | 1056 | 458 | 0.022 |
| **Duration of hospital stay (days)** | 5.6 | 7.1 | 0.152 |
| **Postoperative length of stay (days)** | 5.1 | 3.6 | 0.218 |
| **Morbidity (%)** | 0 | 0 | 1.000 |
| **Mortality (%)** | 0 | 0 | 1.000 |

Abbreviations: ES, emergent surgery; SHP, spontaneous hemopneumothorax
sub-ES group (512 vs. 258 ml, \( p = 0.019 \)).

Table 2 presents the perioperative results for both groups. Two patients in the ES group required blood transfusions, versus no patients in the sub-ES group, although there was no significant difference. There were also no significant differences in length of surgery, hemorrhage type, amount of intraoperative blood loss, or duration of pre- or post-operative hospital stay between the ES and sub-ES groups. However, the total hemorrhage volume was significantly higher in the ES group than in the sub-ES group (1,056 vs. 458 ml, \( p = 0.022 \)).

No postoperative morbidity or mortality was observed in either group.

Shock was observed in six of ES group patients prior to surgery, and two of these required blood transfusions; however, all 6 patients were successfully discharged. One patient from the sub-ES group, whose preoperative blood loss was 150 ml, went into shock before surgery. In that case, the interval between admission and surgery was 40 hours, and his initial roentgenograms, and those acquired on the day before surgery, did not indicate significant hemorrhage in the thorax (Fig. 1). His total blood loss volume was 1,100 ml, due to venous hemorrhage at an unknown site, which was unrecorded. Fortunately, no blood transfusion was necessary.

**Discussion**

ShHP is an uncommon clinical disorder that can be life-threatening due to the possibility of rapid ventilatory collapse and significant hemorrhaging into the pleural cavity. It has been speculated that the development of ShHP may involve a torn pleural adhesion between the parietal and visceral pleura, or bleeding as a result of rupture of the vascularized bullae and the underlying lung parenchyma.\(^5\)\(^7\)

Ohmori et al. described the surgical indications for ShHP as follows: (i) continuous bleeding in excess of 100 ml/h; (ii) presence of a large hematoma in the pleural cavity; and (iii) presence of hemodynamic instability.\(^8\)

Inafuku et al. added persistent air leakage to the above indications.\(^3\) Early surgical intervention has also been recommended for conservatively managed ShHP patients, to prevent potential complications including atelectasis, restrictive lung disorders, and infection of residual hematoma.\(^9\)\(^,\)\(^10\) Based on these results demonstrated by previous studies, the majority of patients suffering from ShHP undergo surgical treatment in accordance with our institutional policy. However, no consensus has been reached regarding the optimal timing of surgical intervention for ShHP. In this study, we evaluated the optimal timing of surgery for ShHP, by comparing emergent and sub-emergent. Although no significant difference was detected between the two groups with regard to perioperative characteristics, preoperative blood loss was greater in the ES group than in the sub-ES group. Furthermore, ES was decided on in cases involving significant preoperative hemorrhage; this is considered a reasonable decision given that hemorrhage can have a significant effect on the patient’s vital signs, and vice versa.

Chest roentgenogram remains the most useful tool for diagnosing ShHP. However, Hwong et al. observed that chest roentgenograms performed on admission indicated pneumothorax alone in 10% of ShHP patients, with radiological evidence of hematohrax emerging only after tube thoracostomy.\(^2\) In the case of the sub-ES group patient that went into shock in this study, his roentgenogram did not indicate significant hemothorax. It is speculated that, in that case, the bleeding became active,
leading to large intrathoracic hemorrhage in the 24 hours following thoracic drainage tube insertion. Moreover, our results revealed that total blood loss was approximately double the preoperative drainage volume in both groups, such that we could not evacuate the entire intrathoracic hematoma through a thoracic drainage tube. Based on these results, the disparity between the actual volume of hemorrhage and the drainage volume should be taken into consideration, and patients’ vital signs should be carefully monitored to inform the decision regarding timing of surgery.

The VATS procedure was used in all SHP patients. Previous reports on SHP patients revealed that the postoperative hospital stay following VATS was significantly shorter than that following thoracotomy, and that VATS was associated with significantly fewer complications than thoracotomy.1,11,12 Moreover, Inafuku et al. expressed a preference for VATS over thoracotomy because VATS afforded easier access to the bleeding site.3 No postoperative complications occurred during the present study, confirming that VATS is appropriate for treating SHP.

Our study had several limitations. First, the sample size was relatively small; second, we used a single-center design, which may have caused a degree of bias in the results. However, to the best of our knowledge, this investigation is the first to evaluate the optimal timing of surgery for SHP, by comparing ES and sub-ES. Further studies are warranted to determine the optimal surgical timing.

In conclusion, the optimal timing of surgical intervention for SHP, including both ES and sub-ES, may depend on the degree of preoperative blood loss. However, preoperative drainage volume is not a reliable indicator of total blood loss, and chest radiographic findings are unreliable in some instances. Therefore, patients with SHP should be carefully monitored, particularly with respect to their vital signs and, where necessary, the transition from conservative management to surgical intervention should proceed smoothly.

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Footnote
Conflict of interest
The authors have no conflicts of interest to declare.

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——292——