

Risk Factor in Symptomatic Re-expansion Pulmonary Edema Needed any Treatment after Chest Drainage for Pneumothorax

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Abstract:

Background

We previously reported that re-expansion pulmonary edema (RPE) occurred in 7.1% of patients after chest drainage of a spontaneous pneumothorax. Symptomatic patients with RPE require treatment. Therefore, we determined the risk factors for symptomatic RPE.

Methods

The clinical records of patients treated for a spontaneous pneumothorax from April 2012 to December 2020 at our institute were retrospectively reviewed. Seven hundred sixty three chest tubes were placed for spontaneous pneumothorax patients. RPE was diagnosed by chest x-ray or chest computed tomography within 0-48 hours after drainage. We defined the symptomatic RPE when patient needed oxygen or the oxygen flow was increased in patient who had oxygen therapy. We investigated a risk factor between the symptomatic and asymptomatic RPE groups.

Results

Fifty-seven of 763 (7.5%) treated patients were diagnosed with RPE. Nineteen of 57 (33%) patients with RPE had symptomatic RPE. Tension pneumothorax and sever cough after drainage were significantly different between two groups on multivariate analysis.

Conclusions

Symptomatic RPE developed in 2.5% of patients after chest drainage for a pneumothorax. When tension pneumothorax and sever cough after drainage exist, in addition to the past risk factor of RPE, an attention for symptomatic RPE is particularly necessary.

Key Words: Re-expansion pulmonary edema Primary spontaneous pneumothorax Chest tube drainage

Abbreviations: RPE, Re-expansion pulmonary edema

1. INTRODUCTION

Re-expansion pulmonary edema (RPE) is a complication of chest drainage for pneumothoraces and massive pleural effusions. Generally, the incidence of RPE after treatment of a spontaneous pneumothorax ranges from 0.9%-29.8% [1,2]. We previously reported that RPE occurs in 7.1% of patients after chest drainage for a spontaneous pneumothorax [3]. Although most patients with RPE recover without treatment, in severe cases supplemental oxygen and ventilator support are necessary. Herein we describe the risk factors for symptomatic RPE in all cases that had

diagnosis of RPE at our institution.

2. PATIENTS AND METHODS

We analyzed the medical records of all patients treated for a spontaneous pneumothorax between April 2012 and December 2020 at the Sapporo City General Hospital Pneumothorax Center. Seven hundred sixty three chest tubes were placed for drainage with spontaneous pneumothorax. Cases complicated by hemopneumothoraces, traumatic pneumothoraces, and iatrogenic pneumothoraces were excluded. RPE was diagnosed by chest x-ray or chest computed

tomography within 0-48 hours of drainage. We defined symptomatic RPE when patient had either in following two situation after chest tube drainage. 1) The patient needed supplemental oxygen. 2) Oxygen flow increased in patients who require oxygen therapy. Based on our experience, patients with a pneumothorax that increased in size > 40% during more than 24 hours were treated with steroids intravenously before chest drainage and continuous suction was not performed. Age, gender, cigarette smoking, time from pneumothorax onset-to-drainage, presence of a tension pneumothorax, presence of atelectasis, sever cough just after treatment, and drainage tube size were compared between symptomatic RPE group and asymptomatic RPE group. A 20-Fr trocar catheter or 12-Fr aspiration kit was used for chest drainage.

3. ANALYSIS

All analyses were performed using IBM SPSS Statistics for Windows (version 22.0; IBM Corp., Armonk, NY, USA). Continuous variables were analyzed using the Wilcoxon test. Categorical variables were analyzed using a χ^2 test or Fisher’s exact probability test, as appropriate. Statistical significance was set at $p < 0.05$. To determine risk factors for RPE, variables with a $p < 0.05$ on univariate analysis were used in multiple logistic regression.

4. RESULTS

Fifty-seven of 763 (7.5%) patients were diagnosed with RPE. Nineteen patients had symptomatic RPE and 38 patients were asymptomatic. The characteristics of the patients are shown in Table 1.

Tale1. Patient characteristics with re-expansion pulmonary edema

		symptomatic RPE n=19	asymptomatic RPE n=38
Age	(mean)	13- 93(36.6)	16- 82(45.2)
Gender	Male:Female	19:0	30:8
Smoking	Yes : No	9:10	27:11
Classification of spontaneous pneumothorax	Primary:Secondary	12:7	15:23
Lung collapse classificaton	I,II:III	0:19	4:34
Tension pneumpthorax	Yes : No	16:3	16:22
Time from pneumothorax onset to drainage (day)	(mean)	1- 21(5.9)	1- 15(4.4)
Atelectasis	Yes : No	19:0	29:9
Cough after drainage	Yes : No	14:5	8:30
Steroid	Yes : No	19:0	25:13
Drainage tube	20Fr:12Fr	19:0	34:4
Contineous suction	Yes : No	5:14	18:20

Age, gender, time from pneumothorax onset-to-drainage, presence of a tension pneumothorax, presence of atelectasis, steroid usage and the presence of a sever cough after chest drainage were significantly different between the two groups ($p < 0.05$; Table 2) based on univariate

analysis. Tension pneumothorax and the presence of a sever cough after chest drainage was significantly different between the two groups based on multivariate analysis ($p < 0.05$; Table 2).

Table2. Risk factors between symptomatic and asymptomatic re-expansion pulmonary edema in univariate and multivariate analysis

	univariate	multivariate	
	p-value	p-value	OR 95%CI
Age	<0.001	0.58	
Gender	0.042	0.089	
Smoking	0.092		
Classification of spontaneous pneumothorax	0.103		
Lung collapse classificaton	0.142		
Tension pneumpthorax	0.004	0.029	5.393 1.191- 24.422
Time from pneumothorax onset to drainage	<0.001	0.165	
Atelectasis	0.022	0.261	
Cough after drainage	<0.001	0.006	6.804 1.740- 26.606
Steroid	0.013	0.141	
Drainage tube	0.142		
Contineous suction	0.127		

5. DISCUSSION

The previously reported risk factors for RPE include young age [4], large pneumothorax [4,5], pneumothorax for ≥ 3 days [6], rapid pulmonary expansion [5,7,8], and continuous suction [9]. Our previously reported findings were similar except for the presence of a severe cough after drainage [3]. Indeed, all reports included patients with symptomatic and asymptomatic RPE. Kim et al. [2] reported that RPE developed in 29.8% of patients and the incidence of symptomatic RPE was 19% after spontaneous pneumothorax treatment. Because symptomatic RPE is clinically important, the factor to worsen a condition in RPE cases must be analyzed. Therefore we investigated the risk factors in RPE cases including asymptomatic RPE.

The incident rate of RPE was 7.1%, and symptomatic RPE was 2.5% in this study. It was approximately equal to a previous our report [3]. This result is less than prior any reports [1,2,4,10] and may be related to our management protocol for drainage. Based on our experience, after intravenous steroid administration before chest drainage continuous suction was not performed in patients with a pneumothorax that increased $> 40\%$ in size and during more than 24 hours after intravenous steroid administration before chest drainage. In addition, patients were restricted from activity for 1 day.

In the cases that were placed chest tube while being careful about risk factors of RPE, the risk factors of symptomatic RPE were presence of tension pneumothorax and severe cough just after treatment. This result is reasonable. In cases of tension pneumothorax, almost case indicate that the lungs are collapsed totally. By a cough, the lungs are rapidly expanded. Two worst condition let symptomatic RPE occur.

The reported symptoms of RPE include dyspnea (60%-61%), chest pain (36%-52%), and cough (4%-5%) [4,5]. Most patients with asymptomatic RPE do not develop a cough. We are of the opinion that the presence of a severe cough after drainage leads to rapid lung expansion. Although cough is a symptom of RPE, we think that the presence of a severe cough after drainage is a cause for symptomatic RPE. Sherman [5] reported a case in which cough preceded severe RPE, and cough after

chest tube insertion may be a key symptom for detection of RPE [10]. Hasegawa reported that severe cough led to rapidly pulmonary expansion and developed symptomatic RPE [11]. Our result was similar, too. If we can control a severe cough just after drainage, the lungs can expand slowly and symptomatic RPE can be evaded. So we use our management protocol for drainage and prevent symptomatic RPE.

We have evaded a condition to have a severe cough. After chest drainage, we pay attention to the following points. 1) forbid a patient to strain, 2) forbid a patient to stop breath, and to move (especially, when they get up from a bed to change their clothes and to take chest x-ray) 3) forbid a patient to talk in a big voice. These are ways to avoid the expansion of the lungs rapidly.

There were several limitations in our study. First, the study was retrospective involving a single center, whereas a prospective study in a multi-centered study would allow for more generalizable data and analysis. Second, our management protocol for drainage is different from other institutions. We perform preventive treatment including the steroid dosage for the high risk case of RPE beforehand. Third, the diagnostic methods for RPE were not uniform. Nearly all patients with an initial pneumothorax had chest computed tomography the day after chest drainage, but patients with second or more pneumothoraces often had chest x-ray. In these patients, RPE might be overlooked. However, these cases may be asymptomatic RPE. Finally, the retrospective nature of the study limited the information available because some medical records may be lacking details regarding inpatient symptoms, management, or outcomes.

6. CONCLUSION

We must identify patients with the above-mentioned risk factors (young, have a large pneumothorax, and a pneumothorax for ≥ 3 or 4 days). In so doing, we have thought to be able to prevent symptomatic RPE for a case with atelectasis for tension pneumothorax by controlling a cough.

ETHICS APPROVAL

This retrospective study was approved by the Ethics Committee of our institution (IRB No.

R01-059-609).

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