Is Total Collapse a Good Sign for Treatment Process of Spontaneous Pneumothorax?

Total Kollaps Spontan Pnömotoraksın Tedavi Süreci için İyi Bir İşaret midir?

Spontaneous Pneumothorax and Total Collapse / Spontan Pnömotoraks ve Total Kollaps

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Özet

Amaç: Biz bu çalışmamızda total kollapsın erken re-ekspansiyona, hava kaçağının erken kesilmesine, göğüs tüpünün erken çekilmesine ve erken taburculuğa sebep olup olmadığını sunmayı amaçladık. Gereç ve Yöntem: 74 spontan pnömotorakslı olgu retrospektif olarak analiz edildi. Hastalar yaş, cinsiyet, pnömotoraks tarafı, pnömotoraks yüzdesi, büllöz lezyon varlığı, semptom süresi, hava kaçağının kesilme, akciğerin ekspanse olma, göğüs tüpünün çekilme ve taburculuk zamanı açısından istatistiksel olarak değerlendirildi. Bulgular: Total pnömotorakslı hastalarda pnömotoraks süresi anlamlı şekilde kısa idi (p<0.001). Tedavi sonrası akciğerin ekspansiyon süresi (p<0.001), hava kaçağının kesilme süresi (p<0.001), göğüs tüpünün çekilme zamanı (p<0.001) ve hastanın taburculuk zamanı (p<0.001) anlamlı şekilde kısa idi. Sonuç: Total kollapslı olgularda kısa pnömotoraks yaşı nedeniyle plevral kalınlaşma olmadan yapılan müdahale kolay re-ekspansiyona sebep olabilir, öte yandan ciddi akciğer kollapsı ve yüksek intraplevral hava basıncı perfore büllöz lezyonun kapanmasına sebep olabilmektedir.

Anahtar Kelimeler

Spontan; Pnömotoraks; Akciğer; Kollaps

Abstract

Aim: We aimed to investigate possible effects of total collapse on early re-expansion of lung, early cessation of air leak, chest tube withdrawal time and early discharge. Material and Method: A retrospective analysis of 74 consecutive patients treated for Spontaneous pneumothorax was evaluated. Patients' data including age, sex, localization and percentage of pneumothorax, presence of bullous lesions, duration of symptoms and time lengths for cessation of air leaks, lung re-expansion, chest tube withdrawal and discharge was collected and statistically analyzed. Results: There was a significantly shorter pneumothorax duration in total collapse patients (p<0.001). Following the treatment, significantly shorter time lengths were further observed in total collapse patients on lung expansion time (p<0.001), air leak cessation time (p<0.001), chest tube withdrawal time (p<0.001) and discharge time (p<0.001). Discussion: Our results have suggested that shorter duration of pneumothorax without pleural thickening may provide rapid re-expansion of the lungs in the spontaneous pneumothorax patients with total collapse. Severe lung tissue collapse and high intra-pleural air pressure together may result with closure of the perforated bullous lesion.

Keywords

Spontaneous; Pneumothorax; Lung; Collapse

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Introduction

Spontaneous pneumothorax (SP) is a common cause of bullous disease of the lungs [1-4]. The diagnosis of SP is established with physical, radiographic and thoracoscopic examinations [5]. The aim of the treatment consists of maintaining the air drainage, re-expansion of the lung(s) and preventing the recurrence. Quantification of pneumothorax in size is important for selecting appropriate therapy. Therapeutic options include the conservative, intermediate and invasive procedure [6].

Early management of pneumothorax is critical due to the fact that delayed therapy may yield with pleural thickening and long re-expansion time. Though total collapse is a very acute condition that causes severe respiratory distress and chest pain, it may compel to patients to admit to medical aid immediately. Consequently, providing early re-expansion of the lung(s) may offer early chest tube withdrawal and shorter hospitalization. In this perspective, there is little data about possible positive effects of the total collapse on the clinical outcome of SP.

In this study, we aimed to investigate whether total collapse causes early re-expansion of lung, early cessation of air leak, early chest tube withdrawal time, and allows early discharge? In addition, we discussed the therapeutic approaches for minimal, partial and total pneumothorax cases on this perspective.

Material and Method

A total 74 consecutive SP patients who had been treated in thoracic surgery clinic between May 2007 and October 2009 were studied retrospectively. Patients' demographic data, including age and gender, and the data of clinical presentation and outcome, including localization and size of pneumothorax, presence of bullous lesions, duration of symptoms, and the time lengths of air leak cessation, re-expansion of lung(s), chest tube withdrawal and of discharge were collected. Diagnosis of SP was established with medical history, physical examination and posteroanterior chest x-ray during inspiration. Computerized tomography scan of the chest was performed for all patients with bullous lung disease. The pneumothorax size was determined with posteroanterior chest x-ray. More than 40% indicated total pneumothorax, 20-40% indicated partial, and less than 20% indicated minimal pneumothorax. Quantification of the pneumothorax is important for selecting the most appropriate therapy. In the minimal pneumothorax cases (23 patients (31%)), we generally follow the patient with oxygen therapy as long as the size of the pneumothorax remains stabile. However, we perform tube thoracostomy partial and total pneumothorax and if the size expands and dispnea develops in minimal pneumothorax. In minimal group, 2 patients turned into partial pneumothorax during the observation period, that is why total 53 patients (71%) underwent tube thoracostomy in follow up. Generally, 28F chest tube is used for tube thoracostomy throughout mid-axillary line of 4th or 5th intercostal space, under local anesthesia. The chest tube is clamped for 12 hours of air leak cessation and providing the re-expansion of lung, and is withdrawed if the air leak is not detected after the loosing of the clamp.

The patients who have recurrent pneumothorax and/or have air leak more than 10 days usually undergo to surgery. Bullectomy, bleb excision, apical parietal pleurectomy and/or mechanical pleural abrasion may be performed with thoracotomy.

Statistical analysis

Statistical analysis of the collected data was performed with SPSS 11.5 software (Chicago IL. USA). Chi-square test was used for comparison of the categorical data of the groups. Student's t test and Mann-Whitney U test were used for the comparison of quantitative data of two groups. Oneway ANOVA test and Kruskall-Wallis variant analysis were used for comparison of quantitative data, if more than two groups were compared. Spearman rank correlation analysis was used for the evaluation of the relationship between quantitative variables of the groups. For the categorical data, numbers and percentages, for the quantitative data, means and medians were calculated as descriptive values. $P<0.05$ was considered as statistically significant.

Results

The mean age of the patients was 26.54±10.76 years (15-77 years). Sixty-eight (91.9%) of the patients were male and 6 (8.1%) were female. Thirty-eight (%51.4) had pneumothorax in the right side and 36 (%48.6) had in the left side. Twenty-three (31.1%) of the patients had minimal, 16 (21.6%) had partial, and 35 (47.3%) had total pneumothorax. Sixty-two (83.8%) patients presented bullous lesions. The mean duration of pneumothorax was 2.12±1.56 days (median; 2.00). The mean time of lungs' expansion was 3.25±2.12 days (median; 2.50), cessation of air leak was 4.13±2.63 days (median; 3.00), chest tube withdrawal was 6.01±2.51 days (rank 3-13 days), discharge was 6.95±2.45 days (rank 4-15 days). Nine (12.2%) patients had recurrences (2 patients had once, and 7 had 2 recurrences) (Table 1,2).

There was no significant difference according to the size of pneumothorax when compared to age ($P>0.05$), gender ($P>0.05$), localization side ($P>0.05$) and presence of bullous lesion ($P>0.05$).

Durations of symptoms in patients with minimal, partial, and total pneumothorax were 3.56±1.94 (median:3.00), 2.25±0.68 (median:2.00), and 1.11±0.32 days (median:1.00), respectively. Expantion times of the lungs in patients with minimal, partial and total pneumothorax were 4.95±1.87 (median:5.00), 4.56±1.63 (median:5.00), and 1.54±0.70 (median:1.00) days, orderly. Air leak cessation times in patients with minimal, partial and total pneumothorax were 6.13±2.41 (median:6.00), 5.68±2.27 (median:5.00), and 2.11±0.93 (median:2.00) days, respectively. Significantly shorter time lengths were observed in total pneumothorax patients, according to duration of symptoms, expansion time of the lungs, and air leak cessation time ($P<0.001$) (Table 3).

When minimal and partial pneumothorax patients were compared, though duration of symptoms was found significant ($p<0.05$), lungs' expansion time and air leak cessation time were not found as significant ($p>0.05$). Furthermore, according to lungs' expansion time and air leak cessation time, significantly shorter time lengths were observed between minimal and total pneumothorax; and between partial and total pneumothorax patients ($p<0.001$).

Chest tube withdrawal times in patients with minimal, partial and total pneumothorax were 7.91±2.50, 7.31±2.21, and 4.17±0.82 days, respectively. Discharge times in patients with minimal, partial and total pneumothorax were 8.86±2.58, 7.93±2.04, and 5.25±0.91 days, orderly. Regarding the patients with minimal and partial pneumothorax, statistically shorter chest tube withdrawal time and discharge time were found in the patients with total pneumothorax ($p<0.001$).

There was no significant difference according to thoracotomy in the patients with minimal pneumothorax (n:5, 21.7%), with partial pneumothorax (n:2, 12.5%), and with total pneumothorax

Table 1. Characteristics of the patients

		n	*%*
Age (15-77) (26.54±10.76)			
Sex	Female	6	8.1
	Male	68	91.9
Side	Right	38	51.4
	Left	36	48.6
Pneumothorax Size	Minimal	23	31.1
	Partial	16	21.6
	Total	35	47.3
Bullous Lesions	Detected	62	83.8
	No detected	12	16.2
Recurrence	0	65	87.8
	1	2	2.7
	2	7	9.5
Thoracotomy	+	8	10.8
	-	66	89.2
Smoking	Smoking	67	90.5
	No Smoking	7	9.5

Table 2. General Results of Treatment Process

	Mean±SD (days)	Median (days)
Duration of symptoms	2.12±1.56	2,00
Lungs' expansion time	3.25±2.12	2,50
Air leak cessation time	4.13±2.63	3,00
Chest tube withdrawal time (3-13 days)	6,01±2,51	
Discharge time (4-15 days)	6,95±2,45	

Table 3. Comparison of the clinical characteristics according to the size of pneumothorax

	Size	Mean±SD (days)	Median (days)	Statistic
Duration of symptoms	Minimal	3.56±1.94	3.00	
	Partial	2.25±0.68	2.00	
	Total	1.11±0.32	1.00	P<0.001
Time the expansion of the lungs	Minimal	4.95±1.87	5.00	
	Partial	4.56±1.63	5.00	
	Total	1.54±0.70	1.00	P<0.001
Air leak cessation time	Minimal	6.13±2.41	6.00	
	Partial	5.68±2.27	5.00	
	Total	2.11±0.93	2.00	P<0.001
Chest tube withdrawal time (3-13 days)	Minimal	7.91±2.50		
	Partial	7.31±2.21		
	Total	4.17±0.82		P<0.001
Discharge time (4-15 days)	Minimal	8.86±2.58		
	Partial	7.93±2.04		
	Total	5.25±0.91		P<0.001

(n:1, 2.9%) (p>0.05). According to smoking, there was no significant difference in three patients groups (p>0.05). Furthermore, there was no significant difference in duration of symptoms, lungs' expansion time and air leak cessation time according to gender, sides of pneumothorax and presence of bullous lesions (p>0.05).

Recurrence was observed in six patients with minimal pneumothorax (26.1%), in two patients with partial pneumothorax (12.5%) and in one patient with total pneumothorax (2.9%). A statistically lower recurrence rate was observed in the patients with total pneumothorax (P<0.05). Durations of symptoms in non-recurrence and recurrence patients were 1.84±1.12 (median:1.00) and 4.11±2.66 (median:3.00) days, respectively. Expansion time of the lung(s) in non recurrence patients was 2.95±1.94 days (median:2.00) and in recurrence patients was 5.44±2.18 days (median:5.00). Air leak cessation times in non recurrence and recurrence patients were 3.76±2.42 (median:3.00) and 6.77±2.72 (median:6.00) days, respectively. Duration of symptoms, lungs' expansion time and air leak cessation time were statistically higher in recurrences patients (P<0.01).

Durations of symptoms in non thoracotomy and thoracotomy patients were 1.86±1.12 (median:1.00) and 4.25±2.81 (median:3.50) days, respectively. Lungs' expansion time in non thoracotomy patients was 2.96±1.93 days (median:2.00) and in thoracotomy patients was 5.62±2.26 days (median:6.00). Air leak cessation times in non thoracotomy and thoracotomy patients were 3.78±2.41 (median:3.00) and 7.00±2.82 (median:6.50) days, respectively. Duration of symptoms, lungs' expansion time and air leak cessation time were statistically higher in thoracotomy patients (p<0.01).

There was an effect of recurrences and thoracotomy patients according to duration of symptoms, time the expansion of the lungs and air leak cessation time. We looked for an answer for what was the effect of pneumothorax percentage in non recurrences and non thoracotomy patients on duration of symptoms, expansion time of lungs and air leak cessation time? There was no significant difference between minimal and partial pneumothorax (P>0.05), but there was significant difference between minimal and total pneumothorax (P<0.001), and between partial and total pneumothorax (P<0.001) in non recurrences patients and in non thoracotomy patients.

However, we observed that real effect was caused by the group of total pneumothorax. It caused to early re-expansion of lung, early cessation of air leak, early chest tube withdrawal time and allows early discharge (P<0.001).

Discussion

Bronchiolar inflammation, fibrosis and high mechanical stresses are the common causes of the blast of the apical subpleural bleb [7]. Bullous lung disease is characterized by formation of blebs, bullae and emphysema which generally yield with SP. Primary SP usually occurs in young people as a result of rupture of an apical subpleural bleb [8]. Secondary SP is associated with people who have lung disease, such as chronic obstructive pulmonary disease, or have metabolically disease, malignancy or infectious disease [7].

Bullous lung disease is clinically silent unless one of the blebs ruptures and pneumothorax develops [7]. Nevertheless, it was reported that approximately 46% of the patients did not consult for medical aid more than 2 days despite of symptoms [8]. In this study, we found that the mean time of the symptoms emerged was 2.12±1.56 days at admission. Additionally, a shorter time was observed for total collapse patients as 1.11±0.32 days (p<0.001). The chest pain is first and most common symptom because of the direct irritation caused by the leaked air into parietal pleura, and the induced inflammation by eosinophilic infiltration [9].

The main goal of the treatment of SP consists of providing air drainage, lung's re-expansion and of preventing the recurrence. In our study, we considered to measure pneumothorax in size for selecting appropriate therapy. For quantification, the Light

Index is commonly used in Europe and Rhea Method is preferred in US [8]. We used the Light index. Therapeutic options of SP include conservative, intermediate, and invasive procedures according to the lesion's volume [6]. Observation and conservative treatment are preferred in the patients without respiratory complication, if the size of pneumothorax 20% or less [8,10]. The leaked air may be aspirated with a syringe or with placing a catheter into the pleural space [8,11]. Intercostal catheters 10-40 F in size are usually inserted throughout axillary, posteroapical or anterior directions [8,12].

Surgical therapy of SP is preferred for the patients with persistent air leak, recurrences, large bulla, spontaneous haemopneumothorax, incomplete expansion of the lung (despite chest drainage and suction), tension pneumothorax, and bilateral localization of pneumothorax, and the patients have high occupational risk, such as pilot and scuba diver [13]. Thoracotomy is considered the last therapeutic option for SP patients who could not be treated by observation (self recovery), manual aspiration, drainage or thoracoscopy. Video-assisted thoracoscopic surgery is a safe procedure with low incidence of postoperative pulmonary complications [13,14]. It can also be a useful approach in the pediatric and geriatric populations, and in the high-risk bearing patients [13].

We preferred observation with oxygen supply, intercostal catheter drainage and thoracotomy to treat our patients with spontaneous pneumotharx. The air pressure on the lungs was eliminated with drainage of the air from the pleural space and the perforated bullous lesion was closed after tube thoracostomy. In our study, surgery was considered in the patients with recurrence or prolonged re-expansion period. Duration of the pneumothorax is critical for the success of the treatment. The longer duration of the pneumothorax causes to the pleural thickening, and consequently, it is required to longer time to the lungs' re-expansion. In our study, we determined 2.12 ± 1.56 days of pneumothorax duration. However, statistically shorter duration was observed in the total collapse patients as 1.11 ± 0.32 days (P<0.001). We found that the total collapse patients early admitted to our clinic because of the severe respiratory distress and chest pain induced by increased air pressure in the pleural space. We determined significantly shorter lung's re-expansion time in total collapse patients regarding the all studied patients (1.54±0.70, p<0.001). In addition, we observed significantly shorter air leak cessation time in total collapse patients (2.11±0.93, p<0.001). Although the chest tube withdrawal time was reported to be 5.8-7.1 days in some studies [15,16], we determined 4.17±0.82 days in total collapse patients (p<0.001). Correspondingly, however 7.7-8.8days of mean discharge times were reported [15,17], we found 5.25±0.91 days for total collapse patients in our study (p<0.001).

In conclusion, yet the total collapse is a life-threatening, urgent and a serious complication of the SP, our results have suggested that it is associated with early re-expansion of lung, early cessation of air leak, early chest tube withdrawal time and early discharge time (p<0.001). Therefore, short duration of pneumothorax and absence the pleural thickening may facilitate the re-expansion of the lungs. On the other hand, severe lung tissue collapse and high intra-pleural air pressure may provide closure of the perforated bullous lesion in total collapse patients. We observed that real effect was caused by the group of total pneumothorax. Further clinical studies may be needed to be carried out with larger patients groups to compare the possible effects of total collapse on the re-expansion time of lungs.

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