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## STUDYING THE PREDICTING ROLE OF HIGH RESOLUTION C T SCAN FINDINGS IN THERAPEUTIC PATH OF SPONTANEOUS PNEUMOTHORAX BY PATIENTS REFERRING TO RAZI AND ARIA HOSPITALS OF RASHT IN 2012-2016

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### ABSTRACT

**Introduction:** Pneumothorax is applied to the entering of air or gas into the peripheral space (pleural space) and creating a positive pressure in it; it can disrupt the performance of ventilation and oxygenation, and potentially threaten life. So far no detailed statistics has been collected in Iran on the prevalence of this disease. The present study was done to investigate the predicting role of the high resolution CT scan findings in the therapeutic path of spontaneous pneumothorax in patients referring to the Aria and Razi hospitals of Rasht during September 2013 to 2016.

**Research method:** This study is a retrospective cohort study. The files of all patients referred to the Aria and Razi hospital of Rasht were examined; after rejection of specified causes of pneumothorax they were hospitalized based on diagnosing spontaneous pneumothorax. Then based on having or not having a CT scan the patients were divided into spontaneous pneumothorax with HRCT and spontaneous pneumothorax without performing HRCT; they were followed up for one year through the registration of medical records, repeated references or via a phone call in terms of the incidence of relapse and the relapse side. The information of all patients was registered including age, sex, stature, history of tobacco use, status of the Dystrophic lesions (number and severity), involved side, pneumothorax volume, primary shortness of breath, breathing distress, heart rate etc. The therapeutic path was studied in the first group of patients having HRCT Scan and in the second group without HRCT Scan. An analysis of the variables was done using the Chi-square test and the significance level was considered 0.05.

**Results:** In this study, 80.1% of the patients under study were male and their average age was 42 years. 40.2% of the studied patients used HRCT. Patients who have suffered from a spontaneous pneumothorax for the first time were of 63.3% frequency and those who were exposed to relapse were of 36.7% frequency. Also using statistical analysis of Chi-Square there was observed a significant difference between the two groups ( $P = 0.001$ ). Using statistical analysis of Chi-Square, between the two groups of individuals suffering from PSP, those whose 49.7% had done HRCT and those whose 50.3% had not done it, a significant statistical difference was observed ( $P = 0.001$ ).

**Discussion and conclusion:** It seems that respecting the importance of the question, dealing with patients with spontaneous pneumothorax in our country needs to pay more serious attention; with understanding more and better this disease it should be tried as much as possible to use less costly therapies and less invasion like HRCT.

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### Introduction

Pneumothorax is applied to the entering of air or gas into the peripheral space (pleural space) and creating a positive pressure in it; it can disrupt the performance of ventilation and oxygenation, and potentially threaten life [1, 2]. The pleural cavity is a

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two-layer cavity that covers each lung separately from the outside. The lungs have a reactionary structure and tend to lay down, but the negative pressure that exists between the two pleural cavities causes to be kept the lungs to be opened [3]. In normal mode during breath, the pleural Space has a negative pressure. When the rib cage wall is expanded outward, it expands out the surface tension between the parietal and visceral pleura of the lung. Lung tissue has inherently an elastic flexibility that makes it back to the inside. If the pleural space is filled by gas, the lung until balance is achieved, or the tear is closed, lies down. When pneumothorax is enlarged, the lung is undersized. The main physiologic result of this process is the vital capacity decrease and partial pressure of oxygen.[4]

Pneumothorax generally is divided into two categories of spontaneous and acquired. More than half of pneumothoraxes are created following trauma or iatrogenic that are called acquired pneumothorax and in other cases they are created without any trauma; these are grouped as the spontaneous pneumothorax. Spontaneous pneumothorax is divided into two categories of primary and secondary. Primary spontaneous pneumothorax has the prevalence of 7.4 per 100,000 for men and 1.2 per 100,000 for women; it is seen mostly at the age of 20 to 30 year who are healthy in other respects and have no history of lung disease. Patients are usually tall and slim people. Male gender and smoking are considered as other risk factors for primary spontaneous pneumothorax [1, 5, 6]. Risk factors for primary spontaneous pneumothorax (PSP) include smoking, having tall height, thin and tall stature in a healthy person, Marfan syndrome, pregnancy and family pneumothorax. Lung inflammation and oxidative stress in the pathogenesis of PSP are important.

Increasing evidences suggest that genetic factors may be important in the pathogenesis of many cases of PSP. Genetic disorders that are related to PSP include Marfan syndrome, Homocystinuria and Brit-Hogg-Dube syndrome (BHD) [7]. Blebs and bullae that is called sometimes Emphysematous like changes or ELCs is related with the occurrence of primary spontaneous pneumothorax. Rib cage computed tomography scan (CT) in patients with PSP shows that ELC of the same side exists in 89% of cases and on the opposite side in 80% of cases. These changes (ELC) in similar control individuals in terms of age and smoking have been reported about 20% [2]. Non-smokers suffering from PSP have ELC in CT scan in 80% of cases. In comparison the ELC has been reported in the control group of non-smokers by 0% [8]. Although the patients with PSP have not apparent Parenchyme disease, this situation is highly associated with smoking; 80-90% of primary spontaneous pneumothorax (PSP) occur in smokers or people who were already smoking.

Secondary spontaneous pneumothorax (SSP) occurs by the pulmonary diseases and primarily by the COPD. Other diseases through which SSP may occur include cystic fibrosis, tuberculosis, Sarcoidosis, idiopathic pulmonary fibrosis.

Iatrogenic pneumothorax is an incident or a consequence arising from medical or surgical procedures. The most common cause of it is the fine-needle aspiration of the rib cage. The other type of acquired pneumothorax is one caused by trauma. It is created by the non-penetrating trauma (fracture of rib), the trauma penetrating rib cage or abdomen (bullet or knife wound) or tear of the diaphragm. Traumatic pneumothorax occurs with a prevalence more than the spontaneous one. Its prevalence in different regions of the world and different conditions is different and there is no exact statistics for its prevalence. The prevalence of iatrogenic pneumothorax is 5-7 people per 1000 hospital admission; that can cause significant morbidity and rarely death.[8]

Manifestations of the patients with pneumothorax are different depending on the type of pneumothorax. As long as the tear on bolus does not cause pneumothorax, no clinical symptoms or signs in patients with primary spontaneous pneumothorax (PSP) will manifest. In the rib cage traumas with a significant intensity, it may be covered due to damages the physical findings and be not detected by the doctor. The rib cage trauma has the risk of pneumothorax in 10-50% of cases. So the CT scan (CT) of the rib cage should be always done for trauma of rib cage with a remarkable intensity, because the simple rib cage radiograph may-be does not show the pneumothorax. It is a method with high sensitivity and specificity for detecting pneumothorax even on small extent and in a sleeping mode[16]

HRCT Scan has sensitivity of 95% and specificity of about 100% in specifying the pulmonary lesions and can get more information than a simple radiography and usual CT scan on them. Some clinical applications of the HRCT scan are the diagnosis of lung diseases in marked patients having normal graphy of chest.

In a prospective study in 2003 Gupta et al studied the role of CT scan in diagnosis of etiology and subsequently treatment of patients with primary spontaneous pneumothorax. 40% of patients with spontaneous pneumothorax and with normal rib cage graphy were entered into study after treatment of pneumothorax. In 75% of them the CT scan showed the underlying pathology of the lung as a cause of primary spontaneous pneumothorax. Their study showed that the CT scan is a useful diagnostic tool in determining the etiology of primary spontaneous pneumothorax.[9]

A study was conducted by Ouanes-Besbes et al in 2007 with the aim of determining the relationship between the relapse of primary spontaneous pneumothorax and the findings of CT scan and other variables influencing the clinical manifestations and treatment. In this study, the patients who had been hospitalized because of primary spontaneous pneumothorax and treated by various strategies were investigated. All of the patients in the first week were fallen under the CT scan after release to assess the score that included the number of the Dystrophic lesions, their size and distribution. This score along with clinical and therapeutic parameters in patients were compared with the relapse and non-relapse of primary spontaneous pneumothorax. 80 patients with pneumothorax with a mean age of  $27 \pm 7$  years were examined. There were some dystrophic lesions in CT scan of 72.5% of patients. After a period of  $20 \pm 34$ -month follow-up, 15 cases of 80 patients had a relapse of primary spontaneous pneumothorax. Also the intensity of the Dystrophic lesions that were specified through the Dystrophic

score, was not associated significantly with the risk of relapse. Finally, the findings of the study showed that the Dystrophic lesions are found most often in patients with primary spontaneous pneumothorax, but they are not associated with an increased risk of relapse.[7]

Casali et al in 2012 studied 176 patients with spontaneous pneumothorax who were treated conservatively and were exposed to CT scan; they examined in a follow-up the relapse of spontaneous pneumothorax of the same lung. The rate of relapse of spontaneous pneumothorax in the same lung depending on bolus being seen or not was 68.1% and 6.1% respectively. The risk of relapse of spontaneous pneumothorax in the Lung on the opposite side depending on a bolus being seen or not was respectively 19% and zero. Ultimately they came to the conclusion that the presence of bolus in HRCT after primary episode of primary spontaneous pneumothorax is associated significantly with the relapse in the same side or the opposite side of pneumothorax.[10]

In this study we examined the role of CT scan in determination of spontaneous pneumothorax therapeutic path. Because if we can specify that a patient has a bolus on HRCT scan, we can prevent relapse through the determined treatment in the same bed.

### Research Method

This study was a retrospective cohort study. Given that all the files of all patients with spontaneous pneumothorax referring to Razi and Aria Hospitals of Rasht during 2013-2016, who had the criteria for inclusion (such as not having a history of pulmonary disease and not having a history of trauma to the chest), were examined, the sample size was equal to all files of this period. The exclusion criteria of the study included patients who had been in any reason exposed to diagnosis pulse of the chest and there was existed possibility of creating an iatrogenic lesion, the patients with a history of chest surgery, cancer patients and patients who have persistent air leak for more than three days from chest tube and full lungs collapse.

In this study the files of all patients referred to the Aria and Razi hospital of Rasht were examined; after rejection of specified causes of pneumothorax they were hospitalized based on diagnosing spontaneous pneumothorax. Then based on having or not having a CT scan the patients were divided into spontaneous pneumothorax with HRCT and spontaneous pneumothorax without performing HRCT; they were followed up for one year through the registration of medical records, repeated references or via a phone call in terms of the incidence of relapse and the relapse side.

The information of all patients was registered including age, sex, stature, history of tobacco use, status of the Dystrophic lesions (number and severity), involved side, pneumothorax volume, primary shortness of breath, breathing distress, heart rate etc. The therapeutic path was studied in the first group of patients having HRCT Scan and in the second group without HRCT Scan. All the information that was gotten from the persons participating in the research as well as their name remained confidential; the research results were published generally and within the framework of the group under study. In addition, the patient' satisfaction was obtained without coercion, threat, enticing and seduction. Information relating the method of implementation and purpose of conducting research, benefits, nature and duration of the research was explained to the individuals and their questions were persuasively answered.

To report the qualitative data, the frequency and percentage were used and to compare them in groups the Chi-square test. Also for reporting the quantitative data the average and standard deviation were used; after examining their normality, for comparing these variables in study groups the independent t-test was used. The significance level of tests was considered  $P < 0.05$ .

### Results

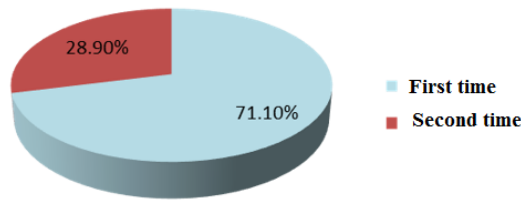
In this study from between 169 patients referring to the Aria and Razi hospitals of Rasht who were hospitalized as patients with spontaneous pneumothorax, 76.3% of the patients with PSP were men and 23.7% of them were women; in other words, the ratio of male to female was about 4 to 1.

Also the average age of patients was 42 years and the highest frequency of patients in the age group 20-40 years was 41.1% (Table 1). In this study there was only 0.6% (1 patient) of mortality.

**Table 1:** distribution of the frequency of gender and age in patients with pneumothorax

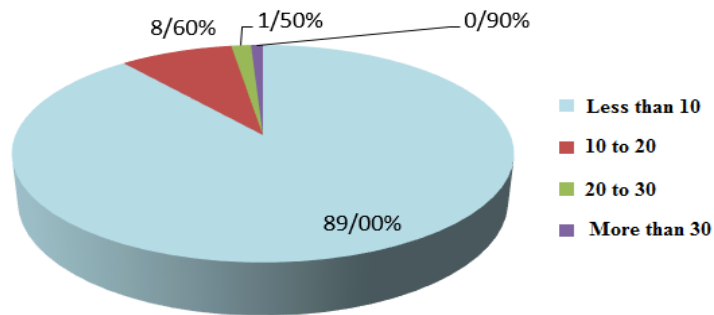
variable		Frequency
Man	Gender	76/3
Woman		23/7
Less than 20 year	Age	%13/40
Between 20 and 30 year		%41/40
Between 40 and 60 year		%21/70
More than 60 year		%23/80

(Diagram 1) shows the frequency distribution of the times of first episode and the relapse of pneumothorax in patients suffering from primary spontaneous pneumothorax.



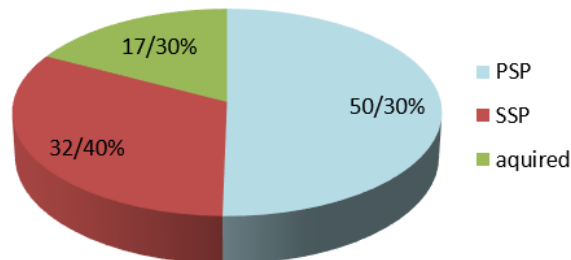
**Diagram 1:** frequency distribution of the number of times of first episode and relapse of pneumothorax

(Diagram 2) shows the frequency distribution of duration of hospitalization in patients with primary spontaneous pneumothorax.



**Diagram 2:** frequency distribution of duration of hospitalization

In this study, 50.3% of the patients under study were experiencing the primary spontaneous pneumothorax; it was of high frequency. the acquired pneumothorax with 17.3% had the least frequency (Diagram 3).



**Diagram 3:** frequency distribution of type of pneumothorax

In (Table 2) the results related to frequency distribution of iatrogenic pneumothorax and traumatic pneumothorax have been mentioned.

**Table 2:** frequency distribution of iatrogenic pneumothorax and traumatic pneumothorax

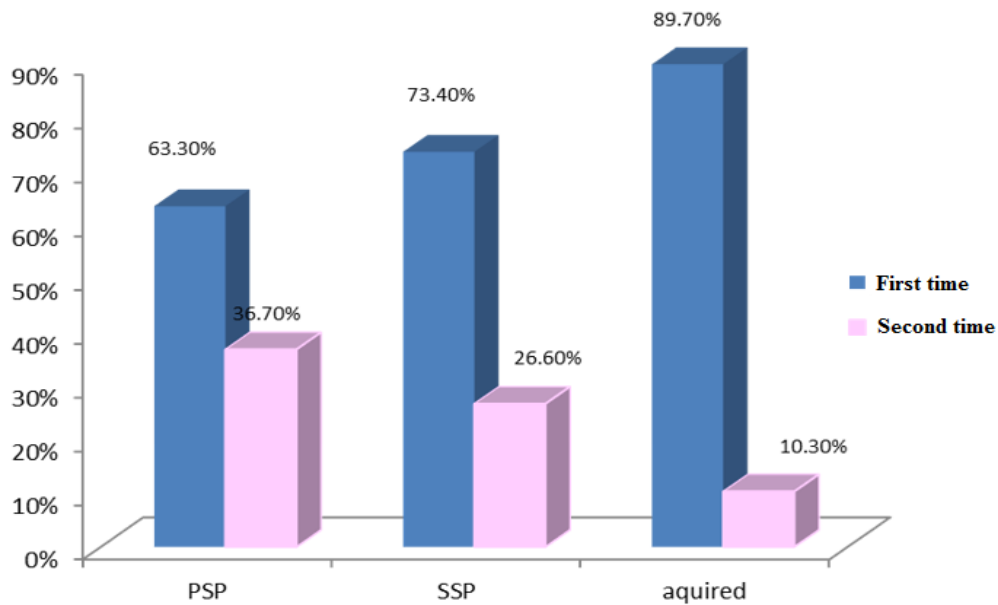
Treatment	status	Frequency (percentage)
Iatrogenic pneumothorax	Yes	%2/40
	No	%97/60
Traumatic pneumothorax	Yes	%15/50
	No	%84/50

In (table 3) the results related to using HRCT have been mentioned.

**Table 3:** frequency distribution of using HRCT

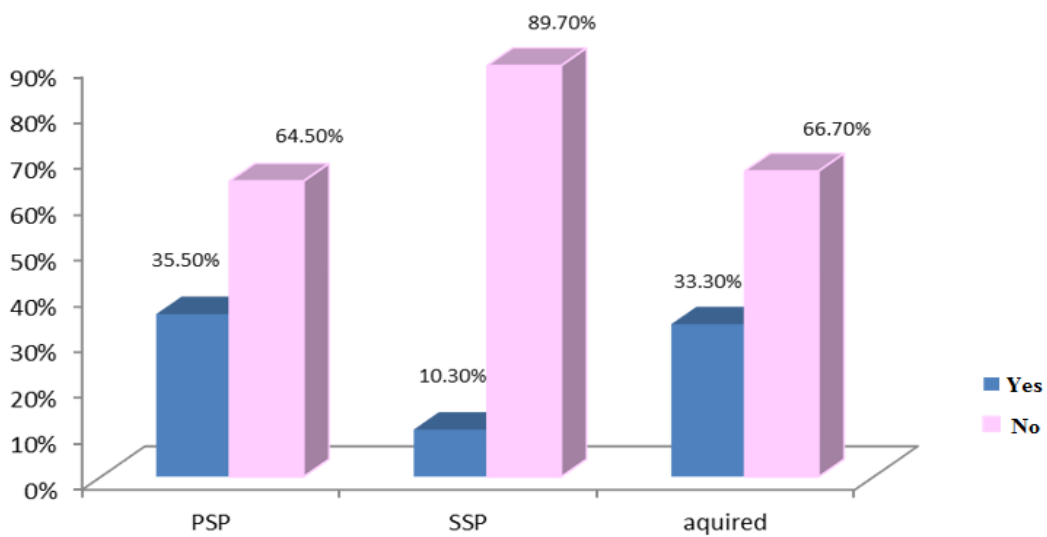
Variable	Status	Frequency (percentage)
<b>using HRCT</b>	Yes	%20/40
	No	%59/80

The results represent that in this study 63.3% of patients suffered for the first time from the primary spontaneous pneumothorax and 36.7% of patients with primary spontaneous pneumothorax were subjected to relapse (Diagram 4).



**Diagram 4:** frequency distribution of relapse of primary spontaneous pneumothorax

In (Diagram 5) the results suggest that 35.5% of patients who were subjected to relapse of the primary spontaneous pneumothorax had done HRCT and 64.5% of them had not done HRCT; so between the two groups a significant statistical difference was observed.



**Diagram 5:** frequency distribution of doing HRCT in relapse cases

Using the statistical analysis of Chi-square, we observed a significant difference between the two groups ( $P = 0.001$ ).

## Discussion and conclusion

Pneumothorax or air gathering in the pleural space is one of the respiratory difficulties that can potentially be dangerous. For dealing with pneumothorax the different therapeutic methods have been employed; the indications and contraindications of these methods have been not specified in certain way and there are many differences of opinion among experts. Therefore, in this study we examined the predicting role of the high resolution CT scan findings in the therapeutic path of spontaneous pneumothorax in patients referring to the Aria and Razi hospitals of Rasht during 2013 to 2016.

In the present study, 76.3% of patients with PSP have been male and 23.7% of them female; in other words, the ratio of male to female was about 4 to 1; the results of other studies in this field are similar [11]. In a study conducted by WM Johnny Chan et al in 2009, 66% of patients were male and 34% of them were comprised of women [11]. Also in the study of Cristiana Sousa et al in 2011 in Portugal, the ratio of male to female was about three to one [12]; that complies with the present study. In the study of Mohebbi et al in 2003 in Tehran, the conclusion obtained that the incidence of pneumothorax in men was more than women [13]. The results of all these studies could represent the incidence of the pneumothorax in men and the women get involved less in this issue.

In this study it was specified that the average age of patients with pneumothorax was 42 years and the highest frequency of patients was in the age group 20-40 years by 41.1%; that is consistent with the results of other studies under review. In the study of Zeybek et al in 2012, from between 79 hospitalized patients with spontaneous pneumothorax the most involved age group was the age group 20-25 years; that is consistent also with the results of our investigation.[5]

Also, in the study conducted by Gorur Rauf et al in 2007, the average age of the patients was obtained by 39.2; this is consistent also with the results of the present study. The closeness of the average age in all the studies could represent that is the age group less than 45 years is exposed more than others to risk for being suffered from spontaneous pneumothorax and most people in this age range are associated with this disease.[14]

In this study from between 169 patients there was mortality just by 0.6% (1 patient); that was consistent with other studies under review [14], so that in the study of Ouanes-Besbes et al in 2007, from between 80 patients there was not exist any mortality [7]. Also in the study of Seguiet-Lipszyc et al in 2011 [15] and the study of Gupta et al in 2003 [13] the similar results were obtained. With respect to the other studies we can conclude that the quick action and timely treatment reduce the mortality rate of patients with spontaneous pneumothorax.

In this study, 50.3% of the patients under study were experiencing primary spontaneous pneumothorax; this was of high frequency. The acquired pneumothorax with 17.3% was of least frequency. In the study of Ashby et al in 2014 the rate of incidence of primary spontaneous pneumothorax had the highest frequency and was about 58.7% [20]; it is consistent with the present study .

In a study conducted in Hong Kong by WM Johnny Chan et al in 2009 under the title treatment of patients with pneumothorax, 62% of the patients were suffered from primary spontaneous pneumothorax [11]. Also, in the study conducted by Cristiana Sousa et al in 2011, 55% of patients were suffered from primary pneumothorax [12]. Also in the study of Laituri et al in 2011 the similar results were obtained.[17]

In this study 63.3% of patients were suffered for the first time from primary spontaneous pneumothorax and 36.7% of patients with primary spontaneous pneumothorax were exposed to relapse. In the similar studies, for example in that of Casali et al in 2012, the rate of relapse of spontaneous pneumothorax in terms of bolus being seen or not was 68.1% and 6.1% respectively [10]. In a study of Ouanes-Besbes et al in 2007, 15 patients from 80 people, after a period of follow-up of 20±34-month, had a relapse of primary spontaneous pneumothorax [7]; that complies with the present study. Also Seguiet-Lipszyc et al in 2011 in a cohort study examined the role of CT scan and early surgical intervention in the treatment of patients with primary spontaneous pneumothorax. 46 patients were known with 70 episodes of pneumothorax. The rate of relapse among patients who had gotten supportive treatment was 50% in the first episode and the next episode. The rate of relapse in patients was comparable in CT with and without bolus. Finally, the findings of the study showed that the relapse after the first episode of primary spontaneous pneumothorax is common by the patients and predicting it is difficult without a CT scan.[15]

In the present study there was not observed any significant statistical difference between the patients suffering from primary spontaneous pneumothorax relapse with 35.5% HRCT and those with 64.5% HRCT. It is consistent with other studies under examination, so that in the study of Casali et al in 2012, the risk of relapse of spontaneous pneumothorax in the Lung of the opposite side in terms of bolus being seen or not has been 19% and zero respectively. Ultimately they came to the conclusion that the presence of bolus in HRCT after the initial episode of primary spontaneous pneumothorax is associated significantly with a relapse in the same side or the opposite side of pneumothorax [10]. Also in a prospective study in 2003 Gupta et al studied the role of CT scan in diagnosis of etiology and subsequently treatment of patients with primary spontaneous pneumothorax. In this study, in 75% of patients the high resolution CT scan revealed the cause of primary spontaneous pneumothorax [9]. This study showed that CT scan is a useful diagnostic tool in determining the etiology of primary spontaneous pneumothorax. In a cohort study in 2011 Seguiet-Lipszyc et al examined the role of CT scans and early surgical intervention in the treatment of patients with primary spontaneous pneumothorax. 46 patients were known with 70 episodes

of pneumothorax. The rate of relapse among patients who had been supportive treatment in the first episode and the next one was 50%. The rate of relapse in patients was comparable in CT scan with and without bolus.[15]

It seems that respecting the importance of the question, dealing with patients with spontaneous pneumothorax in our country needs to pay more serious attention; with understanding more and better this disease it should be tried as much as possible to use less costly therapies and less invasion like HRCT.

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