

Iatrogenic Pneumothorax: Incidence and Evaluation of the Therapy

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Abstract

Objective: To determine the incidence of iatrogenic pneumothorax caused by various diagnostic procedures in our center and to investigate its impact on morbidity.

Methods: The outcomes of 418 invasive procedures performed between September 2000 and January 2001 were analyzed. The procedures were thoracentesis in 133 cases, computed tomography (CT) guided transthoracic fine needle aspiration (TFNA) in 123 cases, pleural biopsy in 84 cases, fluoroscopy guided TFNA in 42 cases, transbronchial biopsy in 30 cases and cutting-needle biopsy in 6 cases.

Results: Iatrogenic pneumothorax was identified in 32 cases. Incidence of iatrogenic pneumothorax was 13% for CT guided TFNA, 7.1% for pleural biopsy, 16.6% for transbronchial biopsy,

7.1% for fluoroscopy guided TFNA and 1.5% for thoracentesis. The pneumothorax was minimal in 12 cases, small in 11 cases, moderate in 5 cases, complete in 2 cases. Hydropneumothorax was identified in 2 cases. Twenty cases were followed by observation only, 7 cases received supplemental oxygen and a chest tube with underwater seal was inserted in 5 cases. One patient who underwent chest tube drainage after pleural biopsy died.

Conclusions: The leading causes of iatrogenic pneumothorax are transbronchial lung biopsy and CT-guided transthoracic fine needle aspiration. Iatrogenic pneumothorax is an important cause of morbidity, may cause prolonged hospital stay and may result in death.

Turkish Respiratory Journal, 2002;3 (2):64-67

Key words: *iatrogenic pneumothorax, transthoracic needle aspiration, chest tube drainage*

Introduction

Pneumothorax is defined as the presence of air in the pleural cavity, with secondary lung collapse (1). It is classified as spontaneous pneumothorax, which occurs without any preceding traumatic event and traumatic pneumothorax, which occurs as a result of direct or indirect trauma to the chest. Iatrogenic pneumothorax develops as a result of a diagnostic or therapeutic interventions and is categorized by most investigators as a subdivision of traumatic pneumothorax (1,2). Iatrogenic pneumothorax is a common complication of a variety of procedures such as thoracentesis, pleural biopsy, transbronchial lung biopsy, transthoracic fine needle aspiration, acupuncture, positive pressure ventilation and subclavian venepuncture (3-11). This complication may lead to an increase in cost of medical care and/or to a prolonged hospital stay (3,6). The aim of this present study was to determine the incidence of iatrogenic pneumothorax

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encountered during the diagnostic procedures performed in our center. The impact of this complication on morbidity was also investigated.

Methods

All diagnostic procedures performed between September 2000 and January 2001 were analyzed prospectively. Four hundred and eighteen invasive procedures were performed on 357 patients during this interval. The diagnostic procedures included thoracentesis, pleural biopsy, transbronchial lung biopsy, CT and fluoroscopy guided transthoracic fine needle aspiration and cutting-needle biopsy. Cope's needle was used for pleural biopsy. Transthoracic fine needle aspiration was performed using a 22-gauge Chiba needle. Cutting-needle biopsies were performed with computed tomography guide.

Posteroanterior chest X-ray was performed for the identification of pneumothorax after an invasive procedure in all patients. Chest X-rays were obtained within 4 hours after the procedure. When the patient had symptoms suggesting pneumothorax, chest X-rays were repeated. Once a patient with an iatrogenic pneumothorax was identified, we recorded the following information: (1) the procedure responsible for the pneumothorax; (2) the size of the pneumothorax; (3) the treatment modality of the pneumothorax; (4) the duration of treatment; and (5) the results of treatment.

The size of the pneumothorax was quantified by measuring the largest distance from the chest wall to the pleural line on the chest X-ray. The following criteria were used in the assessment: the pneumothorax was assessed as *minimal* when the largest distance was less than 1 cm; as *small* when the largest distance was between 1 and 2 cm; as *moderate* when the measurement was between small and large; as *large* when the distance was greater than the width of the remaining lung; and as *complete* when the lung was found to be restricted to the hilum (3).

The rates of iatrogenic pneumothorax related to various diagnostic procedures were compared by Fischer's-exact test.

Results

The mean age of the patients was 51.9 years (range, 16 to 94 years). There were 34 women and 323 men in our series. A total of 32 cases of iatrogenic pneumothorax (in 30 male and 2 female patients) were identified during the study period. Nineteen of these patients were inpatients and 13 were ambulatory cases. The mean age of patients with iatrogenic pneumothorax was 52.8 years (range, 18 to 75 years). Table 1 shows the diagnostic procedures performed

Table 1. Incidence of iatrogenic pneumothorax with respect to procedure

Procedure	Number	% (95%, CI)
Thoracentesis †§	2/ 133	1.5 (0.2-5)
CT-guided TFNA †‡	16/ 123	13 (7-19)
Pleural biopsy †*	6/ 84	7.1 (3-16)
Fluoroscopy guided TFNA	3/ 42	7.1 (1.6-20)
Transbronchial biopsy §*	5/30	16.6 (6-35)
Cutting biopsy	0/ 6	0 (0-39)
Total	32/ 418	7.6 (5-10)

† p= 0.0003 ‡ p > 0.05 § p= 0.0023 * p > 0.05

on these patients and the rates of pneumothorax with respect to each diagnostic procedure.

The highest rate of iatrogenic pneumothorax was found for transbronchial biopsy, followed by CT-guided transthoracic fine needle aspiration.

Pneumothorax was on the right side in 21 patients and on the left side in 11. Frequency of pneumothorax was 8.4% for the right side and 6.5% for the left side ($p > 0.05$). While 26 patients with pneumothorax were asymptomatic, 6 had symptoms suggestive of pneumothorax (dyspnea in 3, chest pain in 1, dyspnea and chest pain in 2 and cough in 1 patient). The cause of the pneumothorax in these symptomatic cases was CT-guided transthoracic fine needle aspiration in 3 cases, pleural biopsy in 2 cases and transbronchial lung biopsy in 1 case. Pneumothorax was detected four hours after the procedure in 30 cases, after eight hours in 1 case and after sixteen hours in the remaining case. The cause of the iatrogenic pneumothorax was CT-guided transthoracic fine needle aspiration in the latter two cases. Seven of the 32 cases had underlying lung disease including chronic obstructive lung disease.

Table 2 summarizes the distribution of the size of pneumothorax with respect to diagnostic procedures. The cause of the pneumothorax was CT-guided transthoracic

Table 2. Size of pneumothorax with respect to procedure

Procedures	Size of pneumothorax				
	Minimal	Small	Moderate	Total	Hydropn*
Thoracentesis	1	1	-	-	-
Pleural biopsy	3	1	-	-	2
CT-guided TFNA	7	5	2	2	-
Fluoroscopy guided TFNA	-	2	1	-	-
Transbronchial biopsy	1	2	2	-	-
Total	12	11	5	2	2

* Hydropn= Hydropneumothorax

Table 3. Relationship between the size of pneumothorax and the treatment

Size of pneumothorax	Observation	Supplemental oxygen	Chest tube
Minimal pneumothorax	12	0	0
Small pneumothorax	8	3	0
Moderate pneumothorax	0	3	2
Total pneumothorax	0	0	2
Hydropneumothorax	0	1	1
Total	20	7	5

fine needle aspiration in the two cases with total pneumothorax.

Table 3 shows the relationship between the size of pneumothorax and the treatment modality in patients with iatrogenic pneumothorax.

Twenty patients were not given any treatment, only followed by observation. Seven patients required supplemental oxygen. Intercostal tube drainage was applied to 5 patients. The cause of the pneumothorax in these 5 cases was pleural biopsy in 2, CT-guided transthoracic fine needle aspiration in 2 and transbronchial biopsy in one case. The chest tubes were left in place for a mean period of 6.1 ± 2.1 days. In this latter group, one death from an iatrogenic pneumothorax secondary to pleural biopsy occurred in a 68-year-old man with a malignant pleural effusion. This patient had been treated with chest tube drainage for 9 days. The cause of death was tension pneumothorax.

Eight of the 13 patients in the ambulatory group had to be hospitalized and the hospital stay had to be prolonged in 4 of the patients in the inpatients group.

Discussion

Iatrogenic pneumothorax is a frequently encountered complication related to common diagnostic or therapeutic procedures (9). According to Weissberg et al. (1), 6.1% of all cases of pneumothorax are of iatrogenic origin. The incidence of iatrogenic pneumothorax is reported to exceed that of spontaneous pneumothorax (3). Transthoracic needle aspiration, thoracentesis, pleural biopsy, transbronchial lung biopsy, subclavian vein catheterization and positive pressure mechanical ventilation are the most common causes of iatrogenic pneumothorax and the incidence is related to the type of procedure (3,5-7,12). We also investigated in our patients the relationship of the incidence of iatrogenic pneumothorax to various procedures including transthoracic fine needle aspiration, thoracentesis, pleural biopsy, transbronchial lung biopsy, and cutting biopsy. In this series, the highest rate of iatrogenic pneumothorax (16.6%) was found to occur

following transbronchial lung biopsy. While this incidence is relatively high compared to many previous reports (7,13,14), frequencies as high as 25% have also been reported following transbronchial lung biopsy (15). In most series, transthoracic needle aspiration appears as the leading cause of iatrogenic pneumothorax (3,12). In our patients, CT-guided transthoracic fine needle aspiration ranked second on the list as a cause of iatrogenic pneumothorax. Sassoon et al. (12) reported that about 24% of iatrogenic pneumothoraces were caused by transthoracic lung biopsy, but it was impossible to establish the true rate of pneumothorax due to transthoracic needle biopsy in their data. The incidence of pneumothorax with transthoracic needle biopsy is higher than 10% in many series (3,9,16,17). The present study demonstrates that thoracentesis is a relatively rare cause of iatrogenic pneumothorax. The incidence of pneumothorax following thoracentesis was 1.5% and pleural biopsy was 7.1% in our series. The incidence of iatrogenic pneumothorax was reported as 5% for thoracentesis and 8% for pleural biopsy in previous reports (8,18).

All patients with minimal pneumothorax in our series were followed by close observation only and no treatment was applied. Most of the patients in the small pneumothorax group were also managed by observation only. Reports in the literature also indicate that minimal and small pneumothoraces usually require no treatment or may sometimes require supplemental oxygen (1,3). Treatment by chest tube drainage was performed in two cases with total pneumothorax, two cases with moderate pneumothorax and one case with hydropneumothorax in our series. It was reported that chest tube therapy was a safe and effective treatment for iatrogenic pneumothoraces (4). All patients with moderate or total pneumothorax were treated by chest tube in a previous series and these same authors advocated aspiration or insertion of a chest tube as the treatment modality if the patient is symptomatic or the size of pneumothorax is estimated as $>20\%$ (3). Another study demonstrated that the use of aspiration was successful for the management of pneumothorax (19). Thus, we can conclude that treatment of iatrogenic pneumothorax should be individualized. If the patient with pneumothorax is asymptomatic, management should consist of observation only or supplemental oxygen. If the patient is symptomatic or the size of pneumothorax is estimated as $>20\%$, the treatment modality is aspiration or insertion of a chest tube (3). It is possible that aspiration was underutilized in our series.

According to our data, iatrogenic pneumothorax is an important cause of morbidity and was found to occur in 32 of 418 patients (7.6%) who underwent a diagnostic or therapeutic thoracic intervention. As suggested by previous

reports (3), hospital stay was prolonged also in 5 of our patients who required chest tube drainage. Also, one death occurred among these patients.

In conclusion, according to our data, the leading causes of iatrogenic pneumothorax are transbronchial lung biopsy and CT-guided transthoracic fine needle aspiration. Iatrogenic pneumothorax is an important cause of morbidity and may cause prolonged hospital stay and may also result in death.

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