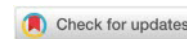


IATROGENIC PNEUMOTHORAX

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Abstract: Iatrogenic (a subtype of traumatic) pneumothorax commonly occurs as a complication of transthoracic puncture biopsy (TTPB), central venous catheterization (especially the subclavian vein), thoracentesis, positive pressure mechanical ventilation (PPMV), transbronchial (TBB) and pleural biopsy. The incidence has recently been increasing due to the increasing use of invasive diagnostic and therapeutic procedures.

The aim of this research is to present the results and the efficiency in the care of iatrogenic pneumothorax in the pneumophthysiologist practice in general hospital.

Material and methods: the analysis includes 290 hospital histories (mainly from the Pulmonology Department, in a much smaller number from other Internal Medicine or Surgery Department at the GOB "September 8") for a 4-year period (January 2018 - December 2021) with final discharge diagnoses: pleural effusion, pyothorax, lung cancer, pulmonary infiltration, pleural mesothelioma and metastatic pleural fluid - ICD codes: J90, J91, J86.9, C34, C45.0 and C78.2. All underwent an invasive diagnostic or therapeutic procedure. The diagnosis of pneumothorax included a radiological examination (PA-posteroanterior projection and LL -profile chest X-ray).

Results: from 290 diagnostic-therapeutic procedures, immediately and up to 24 hours after the intervention, a total of 24 (8.3%) pneumothoraxes were recorded, namely: 15 (27%) out of 54 after TTPB, 3 (4.8%) of 62 after TBB and 3 (2%) of 124 after thoracentesis and percutaneous biopsies of the parietal pleura. In 2 (4%) of 49 cases after lavage of the pleural space, partial pneumothorax was recorded, 1 complete hemato-pneumothorax after catheterization of the subclavian vein.

Thoracic drainage was performed in 12 (50%) (initially in 9, and in 3 after 24 hours due to progression of incomplete lung collapse). Of the remaining 12 patients, the pneumothorax was treated with exufflation in 4, and in 8 conservatively (with a procedure of forced expiration and respiratory exercises).

No case requiring a surgical approach has been registered.

Conclusion: a condition for successful care of iatrogenic pneumothorax is compliance with standards in the application of diagnostic procedures in pulmonology and related areas, careful observation and efficient application of modern attitudes in care of complications from invasive-interventional diagnostic-therapeutic procedures.

Keywords: *pneumothorax, thoracic drainage, exufflation, transbronchial biopsy, pleural biopsy*

Field: *Medical sciences and Health*

INTRODUCTION

Pneumothorax indicates the presence of air or gas in the pleural space. Then the adequate functioning of the lungs is hindered. Depending on the etiology, there is a division into spontaneous and traumatic. Iatrogenic pneumothorax is a category of traumatic caused by a medical procedure. A pneumothorax that occurs in the absence of any underlying etiology is called a primary spontaneous pneumothorax (PSP), and as a complication of an underlying lung disease is called a secondary spontaneous pneumothorax (SSP).

Due to a break in the continuity of the pleural membrane, marked as visceral, parietal or mediastinal pleura, air from the external environment enters the pleural space and depending on that it can be open, closed and tension pneumothorax (5).

Iatrogenic pneumothorax is the most common complication of procedures such as transthoracic needle aspiration biopsy (TTNA), subclavicular puncture, thoracentesis, transbronchial lung biopsy (TBB), pleural biopsy, positive pressure mechanical ventilation (PPMV) and represents the Patient Safety Index (PSI) (7). The increased incidence in recent times is the result of the greater use of invasive diagnostic and therapeutic procedures. In minimal pneumothorax the initial clinical signs may be imperceptible. The occurrence of tension pneumothorax in a patient placed on positive pressure ventilation is an emergency situation and prompt intervention is necessary. Chest computed tomography (CT) is often used to diagnose pneumothorax, but it is difficult to perform frequently and continuously especially in the operating

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room (4).

We present the results for the occurrence of iatrogenic pneumothorax and the efficiency of its care in the practice of a pneumophysiologist in a general hospital

MATERIALS AND METHODS

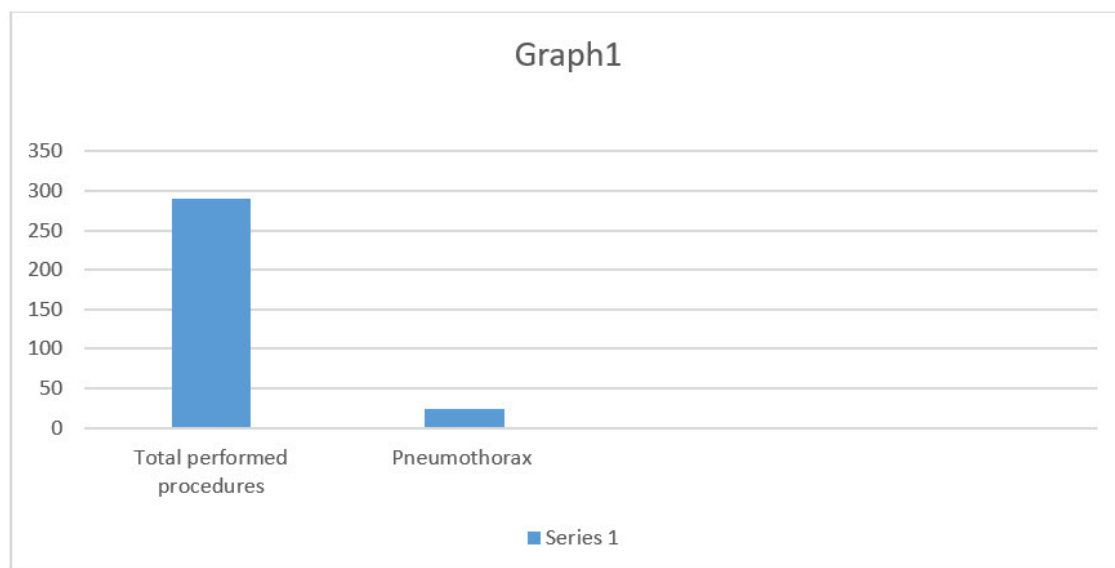
We performed a cohort retrospective study on iatrogenic pneumothorax incidence which include 290 hospital histories (mainly from the Pulmonology Department, in a much smaller number from other Internal Medicine or Surgery Department at the City General Hospital "8-th September" Skopje, Republic of Nort Macedonia for a 4-year period (from January 2018 to December 2021) with final discharge diagnoses: pleural effusion, pyothorax, lung cancer, pulmonary infiltration, pleural mesothelioma and metastatic pleural fluid - ICD codes: J90, J91, J86.9, C34, C45.0 and C78.2).

All examined underwent an invasive diagnostic or therapeutic procedure, in the majority it was diagnostic, in rare cases a therapeutic intervention was made. A radiological examination with a posteroanterior and lateral chest x-ray film was taken in all patients immediately after the procedure as well as within 12 and 24 hours to evaluated rule out progression. Collapsed lung and a visible line of visceral pleura indicate partial or complete pneumothorax in support of the diagnosis. In some cases, computed tomography of the chest was also used.

RESULTS

The results of the research are shown in Graph 1 and Table 1

Graph 1. Pneumothorax in performed diagnostic interventional procedures



Total performed procedures N 290
Pneumothorax N 24

Table 1. Iatrogenic pneumothorax

Procedure	Pneumothorax		
	Number	Number	Percentage
Transthoracic needle aspiration (TTNA)	54	15	27
Transbronchial biopsy (TBB)	62	3	4.8
Thoracocentesis and closed pleural biopsy	124	3	2
Rinsing of the pleural space	49	2	4

Among 290 diagnostic interventional and therapeutic procedures, a total of 24 (8.3%) pneumothoraxes were recorded immediately and up to 24 hours after the intervention, the most numerous after the completed TTNA. In 2 (4%) of 49 cases after lavage of the pleural space, partial pneumothorax was recorded, 1 complete hemothorax after catheterization of the subclavian vein.

Drainage treatment (chest tube placement) was performed in one half. Immediately after the intervention, due to progressive dyspnea and massive pneumothorax confirmed by X-ray in 9 patients, placement of a chest tube was necessary. During the 24-hour observation period, three patients developed symptoms of progressive dyspnea and chest pain, and a chest X-ray showed a completely collapsed lung and a chest tube was placed.

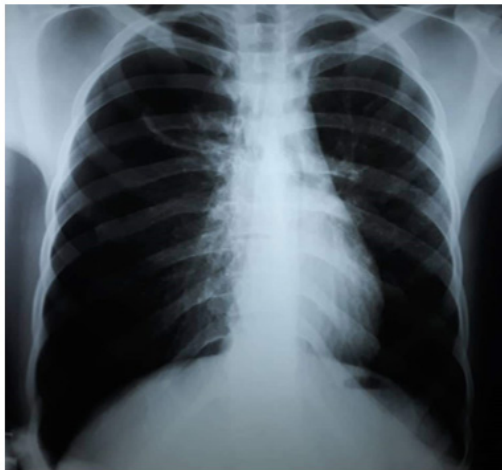
In the remaining 12, pneumothorax was treated with conservative treatment with exercises and a forced exhalation procedure. The persons were observed in hospital conditions and treated medically with symptomatic drugs.

No case requiring surgical therapy and operation was observed.

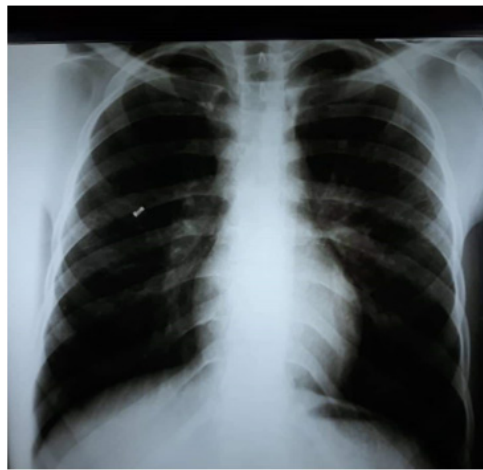
Reports of pneumothorax iatrogenic

Case 1 22-year-old man, with herpes zoster on the right side of the chest

Chest x-ray film immediately after TBB



Chest x-ray film after 7 days conservative treatment



Case 2 A 61-year-old woman with SCLC on the right

Chest x-ray film 24 hours after TBB



Chest x-ray film before TBB



DISCUSSION

Due to the increasing use of interventional diagnostic procedures in routine outpatient practice, such as transthoracic and transbronchial needle lung biopsies, iatrogenic pneumothorax is becoming a recognizable complication (1). When the pressure in the pleural space is positive, a tension pneumothorax may develop during the respiratory cycle, causing decreased venous return, hypotension and hypoxia. A pneumothorax can range from asymptomatic to potentially life-threatening. In invasive procedures iatrogenic pneumothorax is a patient safety indicator (PSI). For patients with pneumothorax greater than 15%, simple aspiration is suggested (16).

A chest tube is usually inserted to treat a pneumothorax, but chest tubes are invasive and have risk of complications. Patients with clinically significant pneumothorax are typically managed with evacuation through percutaneously placed catheter or chest tube. Chest tube management have traditionally been performed by thoracic surgeons, but with the increase in the number of interventional pulmonologists and interventional radiologists, chest tubes are placed by those specialists and they manage patients in the inpatient and outpatient settings (1). The responsibility for admitting the patients to hospital service fell to the internist and the interventional pulmonologist who, in conditions of secondary level hospitals where there is no chest surgeon, take care of patients with iatrogenic pneumothorax. The latter refers to the "8th of September" City General Hospital, from which the material presented in this study originates.

A discussion of management and care algorithms for patients admitted with iatrogenic pneumothorax is presented in the current published literature. A significantly higher incidence of iatrogenic pneumothorax was observed in teaching hospitals compared to non-teaching hospitals from 2000 to 2012 (7).

The results of this research indicate that during any invasive diagnostic procedure in the chest region, during therapeutic interventions such as in the care of an emergency case with the application of mechanical ventilation, the occurrence of pneumothorax is expected. This is especially important in persons with increased risk, in advanced age and with cardiovascular comorbidities.

One study reported the incidence of secondary spontaneous pneumothorax for individual interventions as follows: needle biopsy (24%), subclavicular catheterization (22%), thoracocentesis (20%), transbronchial biopsy (10%), pleural biopsy (8%), assisted positive pressure ventilation (7%) (10).

Our results are almost identical for TTNA, and we observe a lower percentage in thoracocentesis, transbronchial and closed pleural biopsy. In the conditions of general type hospitals in which there are developed multidisciplinary areas and an emergency department such as "8th of September" City General Hospital in which numerous interventional diagnostic and therapeutic procedures are performed, the occurrence of complications is expected. We had iatrogenic pneumothorax in different hospital departments. Continuous care and observation of the patient after the procedure was carried out in order to prevent the progression of pneumothorax. Chest X-ray and computed tomography of the chest were used, and ultrasonography is also helpful in monitoring the condition and evaluating the progression of partial pneumothorax. A chest X-ray immediately after a procedure may not clearly show changes for a pneumothorax. Compared to the results of one study where ultrasonography stands out as an effective tool for the evaluation of pneumothorax progression (4), others emphasize the advantage of computed tomography for diagnosis, but point out that it is difficult to perform continuously in the operating room (6, 13).). However, in the intensive care unit and operating room, ultrasonography facilitates the decision of whether chest tube placement is necessary for traumatic or iatrogenic pneumothorax when positive pressure mechanical ventilation is used (4).

In our presented study, computed tomography for the diagnosis of pneumothorax was rarely used because the patients were urgent. But the X-ray recording was mandatory, the recording was often repeated, which was a guide for the doctor.

The results of this study showed a low rate of iatrogenic pneumothorax. There is an explanation in the fact that in some cases, a minimal amount similar to "trapped air" was shown in the pleural space, which could not be seen with imaging techniques, and the patient had minimal or no symptoms at all. But careful observation was decisive as to whether the placement of a chest tube was necessary, given that it was an additional trauma for the patient, knowing that a greater number suffered from pulmonary or pleural malignancy. In some studies, percentages of iatrogenic pneumothorax are given (10).

Compared with the results of another study (7, 13, 18), we had a significantly lower percentage in TBB, as well as in thoracocentesis and pleural biopsy, and in TTNA the percentage was slightly higher. The explanation has already been given.

The percentage is also small in the therapeutic lavage of the pleural space, which we often apply to purulent inflammations such as pyothorax without a fistula or advanced pleuropneumonia, but we did not consider this to be pathological because we repeated the intervention and could also apply it on an out-

patient basis post-hospital, and the patients tolerated it well. All the more so that the "trapped air" in these cases did not allow the pleural adhesion to occur, which prevented a significant fibrothorax. No extensive references have been found for this method, but in the practice of a pneumophthysiologist it has proven to be effective and without complications.

Catheter and vacuum drainage of iatrogenic pneumothorax has been shown to be safe and effective.

It can be considered as an alternative treatment for stable post-procedural pneumothorax with a size of over 15% (16). VATS and open thoracotomy are reserved for severe or recurrent cases (5).

CONCLUSION

Iatrogenic pneumothorax as an important patient safety indicator is associated with significant morbidity. It is attributed to procedural techniques and decision-making pitfalls, as well as the experience of the medical team. A condition for successful care of iatrogenic pneumothorax is compliance with standards in the application of diagnostic procedures in pulmonology and related areas, reduction of errors, careful observation and efficient application of modern attitudes in the care of complications from invasive-interventional diagnostic-therapeutic procedures. Interprofessional communication and careful coordination between medical workers plays an important role that cannot be underestimated when it comes to patient outcomes.

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