

# PNEUMOTHORAX AFTER PERCUTANEOUS TRANSTHORACIC LUNG BIOPSY. NON-INVASIVE MANAGEMENT IN ORDER TO AVOID UNNECESSARY HOSPITALIZATIONS

NEUMOTÓRAX POST BIOPSIA PULMONAR TRANSTORÁCICA PERCUTÁNEA. MANEJO NO INVASIVO PARA EVITAR INTERNACIONES INNECESARIAS

PNEUMOTÓRAX APÓS BIÓPSIA PULMONAR TRANSTORÁCICA PERCUTÁNEA. MANEJO NÃO INVASIVO PARA EVITAR HOSPITALIZAÇÕES DESNECESSÁRIAS

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La biopsia de pulmón por vía percutánea transtorácica es una herramienta diagnóstica de gran utilidad al momento de estudiar diversas patologías de la pleura y pulmón, sobre todo patologías oncológicas. Sin embargo, como cualquier procedimiento invasivo, la biopsia percutánea no está exenta de complicaciones, siendo el neumotórax (fuga de aire hacia la cavidad pleural) la más frecuente. Este fue clásicamente tratado mediante el drenaje pleural, con tubos de diversos calibres. Se ha observado que es posible tratar al neumotórax post biopsia percutánea de pulmón con tratamiento no invasivo, es decir, control clínico y oxigenoterapia, sin necesidad de intervenir sobre el paciente o intubar al mismo, mejorando así la calidad del tratamiento del paciente y reduciendo los costos hospitalarios.

## Conceptos Claves

### A) ¿Qué sabemos sobre el tema?

La biopsia pulmonar transtorácica percutánea es una herramienta sumamente útil que asiste en el diagnóstico de múltiples enfermedades pleurales y pulmonares, especialmente tumores primarios. Al obtener muestras citológicas y/o histológicas, provee al médico tratante no solo con un diagnóstico de certeza sino también con información para dirigir terapias específicas. Sin embargo, la biopsia percutánea de pulmón no está exenta de complicaciones, siendo la más frecuente de estas el neumotórax.

### B) ¿Qué aporta éste trabajo?

El neumotórax secundario a la biopsia transtorácica percutánea puede ser manejado de forma segura en la mayoría de los casos con tratamiento médico para evitar procedimientos y hospitalizaciones innecesarias. Esta es la primera serie de casos en Latinoamérica según el conocimiento de los autores, y presenta concordancia con hallazgos en la literatura de otras regiones, indicando viabilidad y reproducibilidad en centros en países en desarrollo.

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## Resumen:

**INTRODUCCIÓN:** La punción biopsia percutánea transtorácica se ha convertido con el devenir del tiempo en un método diagnóstico de uso ubicuo y poco invasivo. Su principal complicación continúa siendo el neumotórax. El presente estudio describe la experiencia de este grupo con el manejo expectante del neumotórax pequeño y asintomático post biopsia, con el fin de reducir ingresos hospitalarios innecesarios.

**MÉTODOS:** Se realizó una revisión retrospectiva, analizando los resultados de aquellos pacientes sometidos a tratamiento conservador de neumotórax post punción percutánea transtorácica en un periodo de 6 años (enero 2013 a diciembre 2019).

**RESULTADOS:** Un total de 160 sujetos fueron sometidos a una punción percutánea diagnóstica de pulmón en el lapso de tiempo estudiado. De estos, 46 (29%) presentaron neumotórax, siendo 36 de estos neumotórax pequeños. Este grupo fue manejado de forma expectante, con una tasa de éxito terapéutico del 81 % (7 sujetos debieron ser sometidos a drenaje pleural percutáneo).

**CONCLUSIÓN:** El tratamiento conservador de pacientes con neumotórax secundario a biopsia percutánea transtorácica es seguro, efectivo y útil. Debería ser utilizado por cirujanos como herramienta para evitar internaciones y/o procedimientos innecesarios y costosos.

Palabras clave: neumotórax; cavidad pleural; tubos torácicos.

## Abstract:

**BACKGROUND:** Image-guided percutaneous transthoracic lung biopsy has become a widely used and less invasive diagnostic method. Pneumothorax is the most frequent complication after lung biopsy. The aim of the present study is to describe the experience with expectant management of asymptomatic small post-biopsy pneumothorax in order to reduce unnecessary hospital admissions.

**METHODS:** A retrospective review was performed analyzing the results of subjects who underwent expectant and conservative treatment after presenting pneumothorax following percutaneous lung biopsy, in a period of 6 years (January 2013 - December 2019)

**RESULTS:** 160 subjects who underwent diagnostic percutaneous lung biopsy of lung nodules were evaluated. Of these, 46 subjects (29%) presented pneumothorax, of which 36 were small. This group of subjects was managed expectantly, with a therapeutic success of 81% (7 subjects had to undergo percutaneous pleural drainage).

**CONCLUSION:** Expectant management in subjects with pneumothorax following percutaneous lung biopsy is a useful tool and should be applied by surgeons in order to avoid hospitalizations and / or unnecessary and expensive procedures.

Key words: pneumothorax; pleural cavity; chest tubes.

## Resumo

**INTRODUÇÃO:** A biópsia pulmonar transtorácica percutânea guiada por imagens tornou-se um método diagnóstico amplamente utilizado e pouco invasivo. O pneumotórax é a complicação mais frequente após biópsia pulmonar. O objetivo do presente estudo é descrever a experiência com tratamento expectante de pequenos pneumotórax pós-biópsia assintomáticos, a fim de reduzir internações desnecessárias e custos hospitalares.

**MÉTODOS:** Foi realizada uma revisão retrospectiva analisando os resultados de indivíduos submetidos a tratamento expectante e conservador após apresentar pneumotórax secundário a biópsia pulmonar percutânea, em um período de 6 anos (janeiro de 2013 a dezembro de 2019)

**RESULTADOS:** Foram avaliados 160 indivíduos submetidos à biópsia percutânea pulmonar diagnóstica de nódulos pulmonares. Destes, 46 indivíduos (29%) apresentaram pneumotórax, dos quais 36 foram pequenos. Esse grupo de sujeitos foi tratado com tratamento conservador, com um sucesso terapêutico de 81% (sete pacientes tiveram que ser submetidos à drenagem pleural percutânea).

**CONCLUSÃO:** O tratamento expectante em indivíduos com pneumotórax após biópsia pulmonar percutânea é uma ferramenta útil e deve ser aplicada pelos cirurgiões, a fim de evitar hospitalizações e / ou procedimentos desnecessários e caros.

Palavras-chave: pneumotórax; cavidade pleural; tubos torácicos.

## INTRODUCTION

Percutaneous transthoracic biopsies (PTB) are nowadays the main procedure in the evaluation of single or multiple lung lesions<sup>1</sup>. With the technical advances achieved in computed tomography (CT), this is the preferred guidance method to perform PTB. CT guided PTB is a relatively safe procedure with limited morbidity, very low mortality<sup>2</sup> and diagnostic accuracy of more than 80% and 90% for benign and malignant lesions, respectively<sup>3</sup>. The most common complication is pneumothorax (PTX), which occurs in 17-26.6% of standard procedures and in up to 60% of the most complex procedures (in relation to the increase in the duration of the procedure and smaller lesion size), requiring pleural drainage in a minority of cases (1-14.2%)<sup>4</sup>. Although there are guidelines regarding the management of spontaneous pneumothorax with the recommendations according to the size of the pneumothorax and patient's clinical manifestations<sup>5-7</sup>, there are no randomized prospective studies that establish when active treatment of pneumothorax following PTB is required. In published case series, which are retrospective, there is agreement that both the size of the PTX and the patient's clinical condition should be weighed. According to some authors, these type of iatrogenic PTXs are comparable to traumatic PTXs and should be treated by surgical or percutaneous drainage of the pleural space; others perform only simple needle aspiration of the air without posterior catheter placement. Lastly, some choose expectant treatment without intervention.

We conducted a retrospective review of the results of expectant / outpatient management of subjects with small pneumothorax after a PTB in a single center in Argentina.

## MATERIALS AND METHODS

This is a descriptive observational study of a prospectively maintained database. Data from all adult subjects (> 18 years) undergoing CT-guided PTB of pulmonary nodules in the Interventional Radiology Section of the Diagnostic Imaging Service of a single institution between January 2013 and December 2019 were reviewed. The exclusion criteria were: subjects who underwent PTB in the course of a previous hospitalization and subjects who after the PTB underwent a pre-established scheduled thoracic surgery.

Characteristics of the patient including age, gender, tobacco consumption, presence of chronic obstructive pulmonary disease (COPD), tomographic findings compatible with pulmonary emphysema, hospital stay if tube placement was required for pleural drainage, biopsy lesion size, were obtained from computerized records of the institution.

The location of the lesions and the positioning of the puncture needle was carried out under tomographic guidance with 64- or 128-slice equipment. Prior to proceeding with the biopsy, a chest scan was performed during contained inspiration to confirm and evaluate the position of the target lesion. subjects were positioned so as to minimize the intraparenchymal path of the needle and avoid structures such as vessels, bronchi or fissures. Local anesthesia with 10 ml of 1% lidocaine was administered in the soft tissue along the projected path of the biopsy needle. The scans for needle positioning and puncture were performed with a low dose intervention protocol (100 kV, 50 mAs, 1 mm thickness, 1 mm reconstruction interval). Biopsies were performed in all cases using 18-20 G. With needle tip correctly positioned, the sample was retrieved with a combination of aspiration and push/rotation movements. After every biopsy, a control CT scan was performed to assess immediate occurrence of procedure-related complications; thereafter, all subjects were observed for at least 4 h and eventually discharged after a control chest X-ray if asymptomatic<sup>1</sup>.

If PTX was found after the procedure and if pleural drainage tube placement was consequently required, small-bore catheters were placed under tomographic guidance.

The size of the pneumothorax was classified as "large" or "small" using as a cut-off point the presence of a visible edge > or <2 cm between the pulmonary margin and the chest wall (at the level of the hilum) measured in an axial section of tomography<sup>8</sup>.

## Research ethics standards compliance

The main investigators and co-investigators responsible for this research protocol affirm that this protocol conforms and respects the ethical principles for medical research involving human subjects of the World Medical Association in its 2013 version.

Informed consent was obtained from all individual participants included in the study upon admission to the institution's electronic medical system to access the medical records for unspecified research in the future.

The authors declare no conflict of interest.

## RESULTS

During the analyzed period, 160 PTB were performed. subjects' and nodule characteristics are listed in Table 1. Forty-six subjects (29%) presented PTX immediately after the procedure. Of the diagnosed 46 PTXs, 36 (78%) were small. Among those subjects who presented PTX, 31 (68%) presented functional class II dyspnea according to the Medical Research Council dyspnea scale<sup>9</sup>. On the other hand, none of the subjects presented altered vital signs in relations to their baseline, such as heart rate and blood oxygen saturation. Among small PTXs, only 7 (19%) required placement of percutaneous small-bore pleural catheters.

The mean distance from the nodule to the parietal pleura at the puncture site was 10.4 mm. Of the 160 PTB, 81 (50.6%) were subpleural nodules; of these, only 11 (13.5%) presented PTX, and, in that subgroup, all PTXs were small. Among all the procedures that presented post-puncture PTX, the mean distance from the nodule to the parietal pleura was 18.35 mm.

Table 1. Demographic and nodule characteristics of the sample .

	Without PTX post-PTB (n = 114)	With PTX post-PTB (n = 46)
Gender, male n (%)	65 (57)	30 (65)
Age, years (Median ± SD)	68 ± 10	63 ± 16
Smoking habit n (%)	67 (59)	26 (56)
Chronic obstructive pulmonary disease n (%)	22 (19)	8 (17)
Lung emphysema* n (%)	28 (25)	12 (26)
Nodule size, mm (Median ± SD)	35 ± 26	32 ± 21
(minimum-maximum)]	7,4 (0-50)	18,4 (0-85)
Hospital stay, days (Median (minimum-maximum))	0,5 (0-33)	3 ± (0-39)

\* Pulmonary emphysema diagnosed by tomographic criterion.

## DISCUSSION

Percutaneous transthoracic lung biopsy guided by computed tomography represents one of the most useful tools in the diagnosis of both benign and malignant pulmonary pathology, with sensitivity and specificity rates that according to some series reach 90 and 100% respectively<sup>9</sup>. Among the options for percutaneous biopsy, there is the possibility of performing fine needle aspiration (20-25 G), which provides material for cytological study, or thicker needle punctures (18-20 G), which provide sufficient material for a histological study<sup>2</sup>. The latter presents greater specificity for the detection of benign lesions of the lung parenchyma and lymphoma. The technical progress around this type of procedures and its improvement, has generated an exponential increase in its use in recent years because it has numerous

advantages over other types of surgical approaches, in relation to duration of hospitalization, treatment aggressiveness and costs [9,10](#).

However, PTBs are not free of complications. Multiple complications are described in the literature such as hemothorax, air embolism, pulmonary hematoma, infections, seeding of the puncture path and pneumothorax. Pneumothorax and pulmonary hemorrhage are more frequent, while the other complications are rare [11](#). The reported frequency of pneumothorax after PTB varies between 24% and 60% [12](#). In the present study, the rate of pneumothorax was 26% consistent with the published literature.

To date, there are numerous publications regarding the risk factors involved in the genesis of pneumothorax. Hiraki et al. (2010), analyzed 1098 subjects who underwent CT-guided PTB, with a percentage of post-procedure pneumothorax of 42.3%. They found as independent risk factors for the generation of pneumothorax and the need for a pleural drainage tube, male gender, the presence of pulmonary emphysema, lesions of the middle or upper lobe, the depth of the lesion and the supine position [13](#). Shiekh et al. describe a significant association between post-biopsy PTX and the patient's age, the size and depth of the lesion and the angle of entry of the needle in relation to the pleura [10](#).

Although there are numerous publications regarding the pathogenesis and / or risk factors that would predispose to the appearance of pneumothorax after BTP, there is no consensus regarding the management of this prevalent complication and with great significance both economical and regarding the management of the patient. Nor is the role of surgeons in these types of situations clear. In many cases they are not consulted since the complication is resolved by the interventionist doctors by simple aspiration of the pleural space. O'Neill et al. (2015) presented good results with rapid needle removal techniques, patient rolling and fine needle pneumothorax aspiration [14](#).

In cases where surgeons are consulted, there is no consensus as to how they should address this situation. Classically, being considered a traumatic pneumothorax, the therapeutic approach was to perform surgical drainage with drainage tubes > 25 French in the operating room [15](#). However, in recent studies, various centers have used different techniques for the management of pneumothorax. Among them, the small-bore drainage tube (8-10-12 French) has been widely used with good results [16](#).

While the expectant management protocol for iatrogenic small PTX is described [11,17](#), to our knowledge, there are few publications that present series of subjects who underwent expectant management of post-PTB pneumothorax and their results [18,19](#). This approach involves, in subjects with small pneumothorax and clinical stability, the administration of supplemental oxygen, rest and hemodynamic and oxygen saturation monitoring. According to the protocol carried out in our center, following an immediate post-procedure CT scan with a small PTX finding, 2 hours after the puncture, a new CT scan is performed to assess whether the patient has progression of the size of the PTX. In our experience, of 31 subjects with small pneumothorax and clinical and imaging stability, only 5 (16%) presented a therapeutic failure of expectant management, evidencing a greater pulmonary collapse corresponding to a persistent pulmonary fistula secondary to puncture. In these subjects the situation was resolved by percutaneous drainage of the pleural space with a thin catheter, with an average hospitalization of 3 days. In those subjects who were discharged with an asymptomatic small PTX without progression, medical and imaging control was performed with a chest radiograph 24 hours after the puncture. None of them presented progression of symptoms or pneumothorax.

This study was subject to limitations, including its retrospective design, as well as its relatively low number of subjects, which prevented an in-depth statistical analysis.

In conclusion, pneumothorax is known to be the most common complication of PTB. Compared to other types of approaches, expectant management of asymptomatic, small and stable iatrogenic PTXs would bring benefits not only in relation to subjects' comfort when compared

to other methods, but in hospitalization days and eventually in health costs.

Through larger randomized future publications evaluating the conservative therapeutic approach of post-PTB PTX for pulmonary nodules, a consensus could be reached on the type of subjects and/or nodules that would benefit from initial expectant management with protocolized controls over a more aggressive initial approach.

**Limitations of liability:** The responsibility of the present work is only of the authors.

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