Original Article

Factors Predicting Chest Tube Insertion for the Management of Pneumothorax Post Transthoracic Needle-Guided Biopsy of Lung Lesions

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Abstract

Introduction and aim: While transthoracic needle biopsy (TTNB) is a well-established method for diagnosis of lung lesions, pneumothorax is a frequent complication, with an estimated incidence between 12-45%. Up to 53% of post-TTNB pneumothorax require chest tube placement. This has wide implications, particularly for the elderly patient with pre-existing respiratory disease and multiple comorbidities. This study aims to determine the premorbid respiratory factors that predict chest tube insertion for pneumothorax post TTNB.

Methods: Demographic data of all patients who underwent TTNB were retrospectively collected from two centres from August 2014 to February 2016. Patients who developed a pneumothorax post-TTNB requiring admission and chest drain were identified. Chi-squared and t-tests were used to determine associations between pre-existing COPD, lung function and insertion of chest tube.

Results: 129 TTNB procedures were carried out with a mean length of stay of 1.37 days (±1.41). 60 of the procedures (46.5%) were complicated by pneumothorax and 13 patients (10.1%) required a chest drain. of those who required chest tube insertion, the average FEV1 was 2.14 litres per second and average DLCO was 15.6 mmol CO per min per kPA. 7 out of the 13 patients (53.8%) who requred a chest drain had COPD. Chi-squared testing did not show any statistically significant association between COPD and requiring chest tube insertion (p=0.698). There was no statistically significant association between FEV1 and DLCO and requiring chest tube insertion (p=0.593 and p=0.983 respectively).

Conclusion: There is no correlation between presence of COPD or reduced lung function and chest tube insertion for pneumothorax post-TTNB .

Key Words: Transthoracic needle biopsy, Pneumothorax, Chest tube , Lung function test, Chronic Obstructive Pulmonary Disease

Introduction

While transthoracic needle biopsy (TTNB) is a well-established method for diagnosis of lung lesions and less invasive than thoracotomy[1,2], pneumothorax is a frequent complication, with an estimated incidence between 12-45% [3-5]. Up to 53% of post - TTNB pneumothorax require chest tube placement[3,6-8]. This has wide implications, particularly for the elderly patient with pre-existing respiratory disease and multiple comorbidities.

Aim

This study aims to determine the premorbid respiratory risk factors that predict poor tolerance to pneumothorax post-TTNB and increased length of stay.

Methods

A retrospective, cross-sectional study was performed on all patients undergoing TTNB at two Australian tertiary centres from August 2014 to February 2016. A total of 129 conventional CT-guided TTNB were performed in 129 patients in this period. Demographic information, comorbidities, smoking status, lung function tests and length of stay were retrospectively obtained from patient histories.

All procedures were performed under CT-guidance by members of the radiology department using a noncoaxial biopsy technique. All biopsies were performed with the patient in either prone or supine positions as determined by the location of the lesion. The patient was instructed to breath-hold after normal inspiration at functional residual capacity.

CT images were obtained from lung apex to diaphragm, and the puncture point determined following measurements from skin surface to pleura. The initial puncture did not penetrate the pleura; CT images were first obtained to confirm trajectory of the biopsy needle and adjustments made if required.

Once the lesion was penetrated, further CT images were used to confirm the position of the needle tip, and specimens then obtained. Immediately following the conclusion of the procedure, further chest CT images were acquired to assess for potential complications. Pneumothoraces were noted, and chest tube placement considered in symptomatic patients or those with large pneumothoraces determined as >30% of lung volume.

Patients developing pneumothorax post TTNB were divided into two groups: those requiring chest tube placement and those who did not. Characteristics reviewed between the two groups included age, prior diagnosis of Chronic Obstructive Pulmonary Disease (COPD), smoking history and lung function. Cross-tabulation, student t-test and Chi-squared analysis were performed to determine associations between these potential risk factors and the development of a pneumothorax post TTNB requiring chest tube insertion. All statistical analysis was performed with STATA 13.1 for Windows.

Results

A total of 129 TTNB procedures were performed in this 18-month period from August 2014 to February 2016. 60 cases (46.5%) were complicated by pneumothorax, with 13 patients (10.1%) requiring chest tube placement.

Patient demographics and comorbidities are summarised in Table 1. The mean age of patients was 66.8 years, with a relatively even spread of males (50.4%) and females. Patients with a pneumothorax requiring chest tube placement had a statistically significant increase in length of stay (1.7 days) compare Patient Characteristics Pneumothorax P-value

Table 1. Characteristics of the total sample and stratified by post TTNB pneumothorax (N=129)

Patient Characteristics		Pneumothorax		P-value
	Total Sample *N = 129*	Yes *n=60*	No *n=69*	
Age (years)	66.8 (± 13.2)	67.1 (± 12.1)	66.5 (± 13.1)	0.578
Male	65 (50.4)	36 (60)	29 (42.0)	0.663
Length of stay (days)	1.37 (± 1.41)	1.7 (± 2.00)	1.09 (± 0.28)	0.013
Hypertension	48 (37.2)	29 (48.3)	19 (27.5)	0.225
Ischaemic Heart Disease	23 (17.8)	11 (18.3)	12 (17.4)	0.548
Diabetes Mellitus	27 (20.9)	16 (26.7)	11 (15.9)	0.498
Chronic Kidney Disease (>Stage 4)	12 (9.3)	5 (8.3)	7 (10.1)	0.389
Chronic Obstructive Pulmonary Disease	60 (46.5)	27 (45%)	32 (46.4)	0.106
Smoking status				0.583
Current smoker	41 (31.8)	21 (35)	20 (29.0)	
Ex-smoker	72 (55.8)	34 (56.7)	38 (55.0)	
Non-smoker	16 (12.4)	5 (8.3)	11 (15.9)	

A significant relationship is indicated by p<0.05. p-values were calculated using Pearson's Chi-squared test for categorical variables. Variables are described with standard deviation (±SD) or as a percentage of the total, enclosed in parentheses.

Of the chest tube group, 53.8% of patients had COPD, with an average Forced Expiratory Volume in one second (FEV_1) in this population being 2.14 litres and average Diffusing Capacity for Carbon Monoxide (DLCO) of 15.57 mmol CO per min per kPA. This is in comparison to 53.2% of the non-chest tube group, with an average FEV_1 of 2.16 litres and average DLCO of 15.16 mmol CO per min per kPA. Chi-Squared testing did not show any statistically significant association between COPD (p=0.698), FEV_1 (p=0.593) or DLCO (p=0.983) and development of a pneumothorax requiring chest tube insertion (Table 2).

Table 2. Characteristics of COPD and lung function testing stratified by management of patients who developed pneumothorax post TTNB (N=60).

Variable	Chest tube group *(n=13)*	Non-chest tube group *(n=47)*	P-value
COPD	7 (53.8)	25 (53.2)	0.698
FEV_1	2.14 (± 1.24)	2.16 (± 1.00)	0.5925
DLCO	15.57 (± 5.89)	15.16 (± 5.22)	0.9832

A significant relationship is indicated by p<0.05.

Discussion

CT-guided TTNB is a commonly performed diagnostic procedure in the investigation of pulmonary lesions. Pneumothorax is a well-established complication of TTNB. In this study, the observed incidence of both pneumothorax (46.5%), as well as patients requiring chest tube insertion for pneumothorax (10.1%) is consistent with findings of previous studies [3-8].

A wide range of studies have been performed to identify different risk factors for developing pneumothorax post TTNB. Emphysema, graded on CT, has been suggested by several studies[9-14] to be an independent risk factor for pneumothorax. The underlying pathophysiology behind this theory is that the increased airway pressure associated with obstructive airways disease, as well as penetration of emphysematous bullae during the procedure may increase air leakage from the lung. Nonetheless, our study, among several others[15-17], did not show any statistical correlation between the presence of emphysema and rates of pneumothorax.

Our study also did not show any significant correlation between reduced FEV1 % predicted or increased FVC % predicted, and rates of pneumothorax. While some studies agree with this finding[18-19], Saji et al. found a positive correlation between reduced lung function and rates of pneumothorax, whereas Branden et al. found that patients with FEV1< 35% predicted experienced high rates of pneumothorax, though spirometry data was only available for 72% of their patient cohort.

This study is limited by its retrospective design and small sample size. Due to the type of data collected, the study is unable to comment on other postulated risk factors such as lesion size, lesion depth, and lesion-pleural angle.

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Leisurely Walk To Drive Away the Blues

There is no doubt about the importance of regular exercise in the maintenance of physical health. However, its effect on psychological health (subjective wellbeing) of an individual is a subject of considerable debate. Although many studies have hinted at possible benefit, none of them are clear about the intensity of exercise required to realise that benefit. To clear the air, researchers from University of Connecticut (UConn) in Mansfield, armed with accelerometers and a questionnaire, conducted a study on 419 healthy adults. The physical activity of these adults were monitored over a period of 4 days using accelerometer. Then the subjects were made to complete the questionnaire giving details about their exercise routine, subjective well-being, level of depression, presence of pain and its severity. When the results were analysed, it was found that light physical activity (leisurely walk causing no increase in heart rate, breathing and sweating) was more effective in improving subjective wellbeing and alleviating depression; moderate physical activity (walking a mile in 15 to 20 minutes with some increase in heart rate and breathing) was in addition effective in reducing the pain. But vigorous activity was ineffective. So, when you have a bad case of blues, take a leisurely walk!

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- Dr. K. Ramesh Rao