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Computed tomography-guided mediastinal biopsy: a single center's experience focusing upon efficacy and safety

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ABSTRACT

Purpose: The purpose of this study is to evaluate the efficacy and safety of Computed Tomography (CT)-guided mediastinal biopsy.

Material and Methods: This is a single centered retrospective study including 32 mediastinal biopsies performed during the last 24 months in a cohort of 29 patients (15 male-14 female, average age 57 years, lesions diameter ranging between 2-12 cm); 3 patients underwent a second biopsy due to insufficient sample post the first attempt . All percutaneous biopsies were performed under local anaesthesia and CT guidance; in all cases an 18G semi-automatic soft tissue biopsy needle was used for tissue sampling. CT scan was used for evaluation of potential complications.

Results: The histological outcome was conclusive for 26/29 patients (89.6%), whilst post the second attempt efficacy rate increased to 93.7% (27/29 patients - 30/32 biopsies). Biopsy reports included lymphoma (14 cases), bronchogenic carcinoma (10 cases), metastasis (1 case) and benign substrate (2 cases). The mean ionising rate per CT-guided biopsy was 14mGy. No complications were noted in this study according to the CIRSE classification system.

Conclusions: Imaging-guided percutaneous needle biopsy of mediastinal masses is a safe and effective technique for diagnosis of suspicious lesions. Imaging guidance and correct route selection increase efficacy and safety rates.

KEY WORDS

Computed Tomography; biopsy; mediastinum; safety; efficacy

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1. Introduction

The differential diagnosis of mediastinal masses includes a wide spectrum of pathologies (both neoplastic and non-neoplastic), the diagnostic discrimination of which is crucial for proper therapy planning [1-4]. Axial imaging (Computed Tomography-CT or Magnetic Resonance-MR) can be used not only for characterisation of a mediastinal mass but also to delineate the lesion's relation to the surrounding structures. Additionally, the histopathologic profile of each lesion can be determined by image-guided percutaneous core needle biopsy; CT or MR can be used as guiding modalities. Alternatives to percutaneous approaches include transbronchial biopsy, mediastinoscopy, endoscopic ultrasound biopsy (EUSBx), endobronchial ultrasound biopsy (EBUS-Bx) and transcaval approach; method selection depends upon clinical circumstances, patient's co-morbidities, location and size of the lesion, operator's preference and each technique's availability in a specific center [1-7]. Percutaneous CT-guided biopsy is a well established technique for the diagnostic evaluation of mediastinal masses [2-6] . Its diagnostic accuracy rates range between 77-90% with a pooled mean success rate of 83.1% [1-4]. The complications of this technique include mainly pneumothorax, haemorrhage, cardiac tamponade, air embolism, needle tract seeding and death [2-12]. Core biopsy is performed with 18-20 Gauge needles; diameter selection depends upon location and size of the lesion, biopsy tract, operator's preference and suspected diagnosis [6]. Needle tracts for percutaneous approach of a mediastinal mass mainly depend upon lesion's location and include extrapleural (or direct) routes such as parasternal, trans-sternal, suprasternal, subxiphoid and paravertebral approaches or indirect routes such as transpulmonary routes or access through pleural effusions [6].

The purpose of this study is to report a single center's experience upon CT-guided mediastinal biopsy focusing upon efficacy and safety rates.

2. Material and Methods

Patients were informed about the technique itself as well as its success and potential complications (types and rates) and provided written informed consent. This study was approved by the Review Board of our institution. The principles of national legislation and the Declaration of Helsinki were followed.

We retrospectively reviewed all mediastinal biopsies performed in our department during the last 24 months.

Table 1. Baseline demographic parameters of the study participants

Patients	*n=29*
Age (year), mean±SD	57.06 ± 14.85
Male/female	15/14
Size of lesion (cm), mean±SD	5.10 ± 2.45
Anterior /posterior compartment	26/3

Data are n (%), means ± SD (standard deviation)

Table 2. Histologic diagnoses of biopsies

	n=29
Malignant	25
Hodgkin Lymphoma	7
non- Hodgkin Lymphoma	7
NSCLC	7
SCLC	3
Metastatic neuroendocrine Ca	1
Benign	2
Inconclusive	2

Review was performed by DF (Interventional Radiologist with nine years of experience). Reviewer at the time of review was blind to the results of other studies. We evaluated data from 29 patients (15 males and 14 females - average age 57 years, range 18–76 years) with mediastinal occupying lesions who underwent CT-guided percutaneous biopsy. Mean lesion diameter was 5.1 cm±2.45. Patient demographics are illustrated in **Table 1**.

A pre-biopsy chest CT scan (pre and post contrast medium injection in arterial and venous phase of enhancement) was available for biopsy planning in each case. Prothrombin time (PT), activated partial thromboplastin time (APTT), and platelet count were evaluated prior to the biopsy session; a platelet count <100.000, APTT ratio or PT ra-

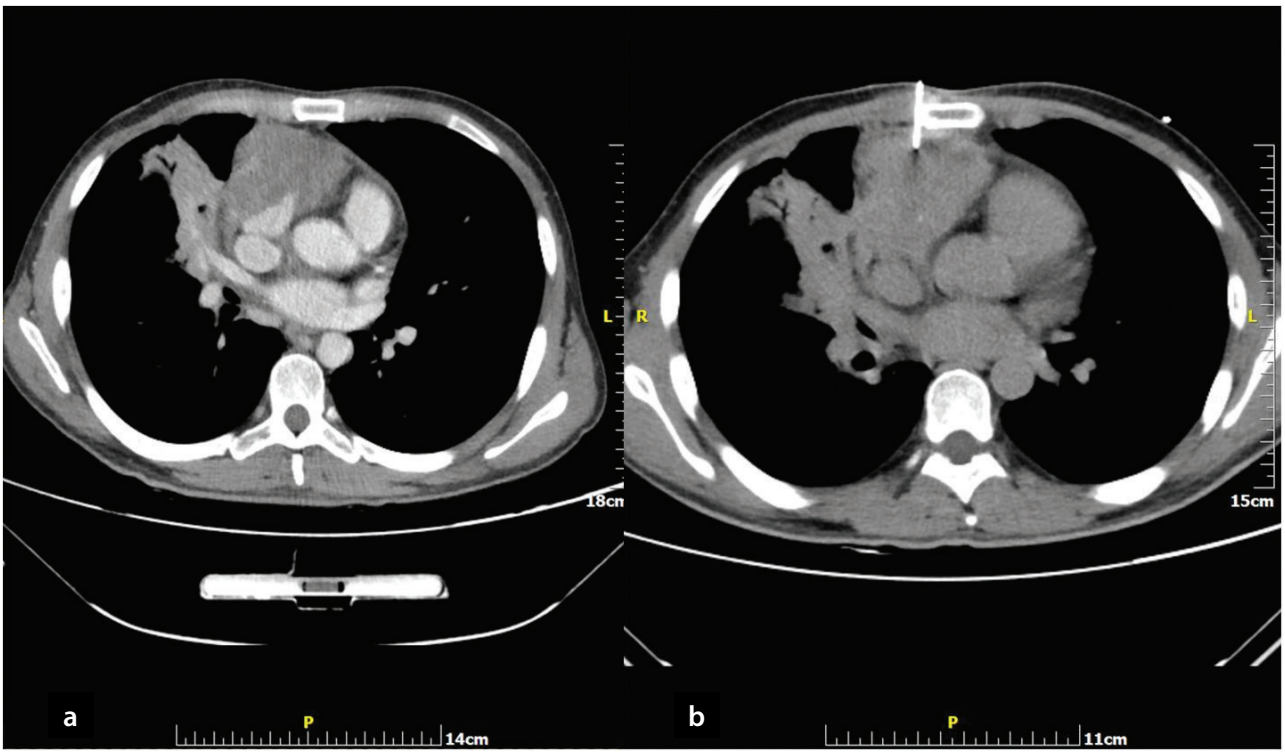

Fig. 1. a*. Computed tomography axial scan (post intra-venous contrast medium injection) used to delineate the lesion's relation to the surrounding structures.*
b*. Computed tomography axial scan (without intra-venous contrast medium injection). Patient is placed in supine positioning for a parasternal approach. Needle is inserted in close proximity to sternal edge in order to avoid internal mammary vessels damage.*

tio >1.4 were considered contraindications. In cases where coagulation medication withdrawal should have been applied, the CIRSE-SIR consensus guidelines were followed [13-15]. The patient position was selected depending on lesion location (supine positioning for anterior mediastinal lesion, prone or prone oblique positioning for posterior mediastinal lesion) [**Figs. 1, 2**]. Under local anaesthesia, local sterility measures and CT guidance, biopsy of the mediastinal mass was performed using an 18 Gauge semi-automatic biopsy needle (one tissue sample was obtained per biopsy session). CT scans were obtained between incremental needle advancements to evaluate the trajectory of the needle and ensure that the internal mammary vessels were not in the needle path in a parasternal approach or that azygos vein, oesophagus, nerves and vertebral vessels were not in the needle path in a paravertebral approach. Oxygen saturation, blood pressure and cardiac rate were recorded during the intervention and periodically (every 30 minutes) in the following four hours. CT scan was performed immediately needle withdrawal in order to identify complications. A chest X ray was performed prior patient's discharge from the hospital.

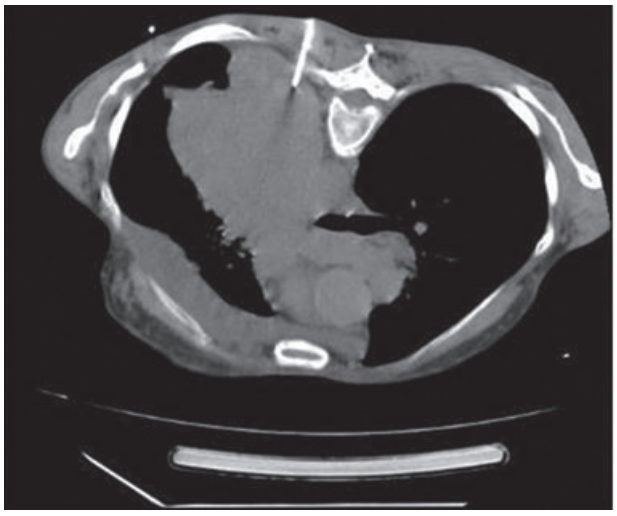

Fig. 2*. Computed tomography axial scan (without intra-venous contrast medium injection): patient is placed in prone position for a paravertebral approach.*

Statistical analysis

Patient demographic characteristics are expressed as mean and standard deviation values. P values less than 0.05 were

considered to indicate a statistically significant difference. IBM SPSS Statistics (version 21) was used.

3. Results

The needle approaches performed in this study included parasternal (n=14), anterolateral (n=11), posterolateral (n=2), paravertebral (n=1) and trans-pulmonary (n=1) routes. According to the reviewed data, 26/29 (89.7%) biopsies were performed in masses located in the anterior mediastinum whilst 3/29 (10.3%) biopsies were performed in posterior mediastinal masses. Of these 29 biopsies, 26 yielded a correct diagnosis with histological typing, while 3 samples were inadequate (initial efficacy rate 89.6%). A second attempt was performed in these 3 patients with diagnostic conclusion in 1/3 cases (secondary success rate 93.7%). Results of histopathologic diagnosis included non-Hodgin Lymphoma (7/29), Hodgkin Lymphoma (7/29), Non Small Cell Lung Carcinoma (7/29), Small Cell Lung Carcinoma (3/29), benign substrate (2/29) and metastatic lesion (1/29). All results are reported in details in **Table 2**.

In our study, there were no complications reported according to the international guidelines CIRSE classification system of complications [15]. Assessing the post biopsy CT and the aftercare chest radiograph while simultaneously monitoring the O2 level, no signs of pneumothorax were recorded. There was no case of haemoptysis or any indication of haemorrhage on the post biopsy CT. The mean ionising rate per CT- guided biopsy was 14 mGy.

4. Discussion

Differentiation and accurate diagnosis of mediastinal lesions is of critical importance for appropriate treatment planning. A CT-guided percutaneous biopsy can potentially obviate more invasive alternative procedures (mediastinoscopy, exploratory thoracoscopy) which are associated to statistically significant more complications, hospitalisation and exposure to anaesthetics [3, 4, 6]. Whenever the specimen is inadequate from the CT- guided biopsy or when the biopsy result is inconclusive, a repeat biopsy could always be considered before passing on to invasive second- line diagnostic techniques [3, 4].

According to the results of the present study, CT- guided mediastinal biopsy seems to constitute a minimally invasive technique with high efficacy rate, providing adequate specimen from mediastinal lesions which may harbour a variety of malignant or benign entities. In accordance with previous reports, which have established the safety of this method, no adverse events were recorded in our cohort. The results of the present study are in accordance with previous published studies, which have demonstrated the efficacy and safety of CT-guided mediastinal biopsy. The secondary success rate in the present study is 93.7% (30/32 biopsies), which is similar to the 83.6% diagnostic yield reported by Priola et al., with 91.8% sensitivity for correct diagnosis of malignant lesions when the non-diagnostic cases were excluded [3]. The small number of patients participating in our study does not allow any statistical inference but, according to other studies, the overall complication rate is 6.8%, mainly referring to low grade or minor complications, while those requiring intervention (placement of a chest tube in a severe pneumothorax) were 1.4 % [3, 8, 9, 11].

Relevant studies, comparing the advantages of MR-guided biopsies over CT-guided biopsies, suggest that the MR-guided biopsy is a novel promising technique, without exposure to radiation for the patient, but significantly more expensive and time-costly in a clinical setting, with the additional risk of movement artefacts [16]. MR imaging can be applied before the CT-guided biopsy for precise localisation of the potential biopsied area, as the avoidance of inappropriate material collection leading to the need for a new biopsy is extremely desirable for the patients [16-18]. The failure to collect adequate material from complex cases, including large, heterogeneous and mixed-pattern lesions and the resulting need for repeat biopsy increase the risks and costs of the procedure. DW images and automatically reconstructed ADC maps illuminate the cellularity of a tissue as well as the integrity of cellular membranes. A region with low ADC values provides a potential area for CT-guided biopsy with higher percentage of collecting adequate specimen. Specific softwares are necessary for the fusion of DW and CT images in order to obtain a corresponding plan [16-18].

On the other hand, alternative endoscopic (transtracheal, transbronchial, or transoesaphageal) fine needle aspiration biopsy has been introduced as a minimally invasive procedure to evaluate mediastinal lesions. The major weakness of these endoscopic approaches is that they do not provide easy access to the upper and anterior mediastinum [1]. Additionally, contrast-enhanced ultrasonography (CEUS) can be considered an alternative to CT as a guiding method for percutaneous biopsy of anterior mediastinal tumours. Real-time guidance with CEUS can effectively differentiate necrosis and viable tumour areas during core needle biopsy of anterior mediastinal

lesions, increasing the rate of sufficient specimen. Moreover, by showing rapid and obvious hyperenhanchement of the internal mammary artery after 5–10 s from the injection of contrast agents, it can effectively depict and avoid internal mammary arteries during core needle biopsy of anterior mediastinal lesions [6, 19]. Compared to CT, US-guided biopsy offers a number of advantages, including lower cost, bedside capabilities, lack of radiation exposure, time savings, and real-time monitoring. However, a main limitation of this technique is that CEUS is highly operator-dependent [19].

A novel method, that is recently gaining acceptance, is the use of laser guidance devices for guidance during CT procedures, while the free hand techniques may be time consuming, requiring numerous needle passes and increasing the radiation dose to the patient. The study by Klöppel et al. compared results between 54 cases of CT-guided interventions with laser guidance and 40 cases of CT-guided interventions without laser guidance and concluded that laser guidance decreased the number of control scan from 30% to 50% and the number of needle corrections by a maximum of 30% [20]. The advantage is especially marked if the target area is small. Laser guidance can also prevent frequent needle malposition, thereby reducing the number of check/control scans and radiation dose and possibly the rate of complications [20, 21].

Limitations of the present study include its single centered, retrospective design with a small number of participants (29 patients). Additionally, a cytopathologist was not present in the CT room, in order to assess the sample and immediately repeat the biopsy session in cases of inadequacy. Finally there was no comparison to a group of patients undergoing alternative surgical or endoscopic approaches.

In conclusion, the present study demonstrates that CT-guided percutaneous needle biopsy of mediastinal masses with an 18 Gauge semi-automatic soft tissue needle biopsy is a safe, effective and well-tolerated procedure with high overall diagnostic rate of 93.7%. **R**

Conflict of interest

The authors declared no conflicts of interest.

References

1. Assaad MW, Pantanowitz L, Otis CN. Diagnostic accuracy of image-guided percutaneous fine needle aspiration biopsy of the mediastinum. *Diagn Cytopathol* 2007: 705-709.
2. Masoud R, Sarrami AH. Computed tomography-guided percutaneous core needle biopsy for diagnosis of mediastinal mass lesions: Experience with 110 cases in two university hospitals in Isfahan, Iran. *Adv Biomed Res* 2016; 5: 152.
3. Priola AM, Priola SM, Cataldi A, et al. CT-guided percutaneous transthoracic biopsy in the diagnosis of mediastinal masses: evaluation of 73 procedures. *Radiol Med* 2008; 113(1): 3-15.
4. Petranovic M, Gilman MD, Muniappan A, et al. Diagnostic yield of CT-guided percutaneous transthoracic needle biopsy for diagnosis of anterior mediastinal masses. *AJR Am J Roentgenol* 2015; 205(4): 774-779.
5. Alda T. Mediastinal biopsy. In: Gervais, DA. and Sabharwal T, eds. Interventional radiology procedures in biopsy and drainage. *Springer-Verlag London* 2011; pp 31-46.
6. Gupta S, Seaberg K, Wallace MJ, et al. Imaging-guided percutaneous biopsy of mediastinal lesions: different approaches and anatomic considerations. *Radiographics* 2005; 25(3): 763-786; discussion 786-788.
7. Logaraj A, Edwards P. Transcaval biopsy of a mediastinal mass compressing the superior vena cava. *Respirol Case Rep* 2017; 5(2): e00213.
8. Laurent F, Michel P, Latrabe V, et al. Pneumothoraces and chest tube placement after CT-guided transthoracic lung biopsy using a coaxial technique: incidence and risk factors. *AJR Am J Roentgenol* 1999; 172(4): 1049-1053.
9. Filippiadis D, Velonakis G, Kelekis A, et al. Computed tomography-guided lung biopsy with the patient in lateral decubitus position and the biopsy side down: effect on pneumothorax rate and clinical significance. *Hell J Radiol* 2017; 2(3): 22-29.
10. Moore EH, LeBlanc J, Montesi SA, et al. Effect of pa-

tient positioning after needle aspiration lung biopsy. *Radiology* 1991; 181(2): 385-387.
11. Herman SJ, Holub RV, Weisbrod GL, et al. Anterior mediastinal masses: utility of transthoracic needle biopsy. *Radiology* 1991; 180(1): 167-170.
12. Kulkarni S, Kulkarni A, Royet D, al. Percutaneous computed tomography-guided core biopsy for the diagnosis of mediastinal masses. *Ann Thorac Med* 2008; 3(1): 13-17.
13. Patel IJ, Davidson JC, Nikolic B, et al. Consensus guidelines for periprocedural management of coagulation status and hemostasis risk in percutaneous image-guided interventions. *J Vasc Interv Radiol* 2012; 23(6): 727-736.
14. Patel IJ, Davidson JC, Nikolic B et al. Addendum of newer anticoagulants to the SIR consensus guideline. *J Vasc Interv Radiol* 2013; 24(5): 641-645.
15. Filippiadis DK, Binkert C, Pellerin O, et al. Cirse quality assurance document and standards for classification of complications: The Cirse classification system. *Cardiovasc Intervent Radiol* 2017; 40(8): 1141-1146.
16. Guimaraes MD, Groos JL, Chojnak R, et al. MRI-guided biopsy: a valuable procedure alternative to avoid the risks of ionizing radiation from diagnostic imaging methods. *CVIR* 2014; 37(3): 858-860.
17. Guimarães MD, Hochhegger B, Benveniste MFK, et al. Improving CT-guided transthoracic biopsy of mediastinal lesions by diffusion-weighted magnetic resonance imaging. *Clinics* (Sao Paulo) 2014; 69(11): 787–791.
18. Garnon J, Ramamurthy N, Caudrelier J et al. MRI-guided percutaneous biopsy of mediastinal masses using a large bore magnet: technical feasibility. *Cardiovasc Intervent Radiol* 2016; 39(5): 761-767.
19. Yi D, Feng M, Wen-Pinet W, et al. Contrast-enhanced US-guided percutaneous biopsy of anterior mediastinal lesions. *Diagn Interv Radiol* 2017; 23(1): 43–48.
20. Klöppel R, Wilke W, Weisse T, et al. CT-guided intervention by means of a laser marking and targeting aid. *Rofo* 1997; 167(2): 194-197.
21. Honganoor VV, Keshava SKN, Moses V, et al. CT guided biopsy using additional laser guidance: Case series from India comparing with conventional free hand technique. *Egypt J Radiol Nucl Med* 2016; 47(2): 493-499.

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