Trans-sternal Percutaneous Computed Tomography Guided Core Biopsy for Anterior Mediastinal Mass: a case report

SHENG-HENG TSAI1  I-CHEN TSAI1,2  MIN-CHI CHEN1,3  PAO-CHUN LIN1  WEI-LIN TSAI1  SI-WA CHAN1,4
CLAYTON CHI-CHANG CHEN1,3,5,6

Department of Radiology1, Taichung Veterans General Hospital
Institute of Clinical Medicine2, Department of Physical Therapy and Assistive Technology6,
National Yang Ming University
Department of Radiological Technology and Graduate Institute of Radiological Science3, Central Taiwan University of Science and Technology
Biomedical Informatics and Biomedical Engineering Department4, Feng Chia University
Department of Physical Therapy3, Hungkuang University of Technology

Trans-sternal percutaneous computed tomography (CT) guided biopsy for mediastinal mass is a difficult but feasible procedure. In the literature there have only been reports from four medical centers in western countries. Herein we report a case of 57-year-old man with a 38mm-sized mass in anterior mediastinum. Since the tumor access was blocked by both sternum and aortic arch branches, trans-sternal percutaneous CT-guided biopsy was the only possible way for tissue proof. The planning, imaging, and technique considerations of this procedure are discussed. With this particular case, we confirmed the feasibility of trans-sternal percutaneous CT-guided core biopsy in the Taiwanese population.

Reprint requests to: Dr. I-Chen Tsai
Department of Radiology, Taichung Veterans General Hospital.
No. 160, Sec. 3, Taichung Harbor Road, Taichung 407, Taiwan, R.O.C.
monitoring.

The patient initially underwent non-enhanced CT imaging in supine position, which was done by using a 40-detector-row CT scanner (Brilliance 40; Philips, Best, The Netherlands) with a section thickness of 5mm. Metallic strips were put on the anterior chest wall for localizing the entry of trajectory. The needle entry site was then marked on the skin. The skin was prepared in a sterile fashion and 2% lidocaine hydrochloride was administered with a 25-gauge hypodermic needle to anesthetize the skin, subcutaneous tissue, and the periosteum of the anterior sternal cortex. The alignment was checked again by CT scan with a hypodermic needle retained on the chest wall. Then we withdrew the hypodermic needle and replaced it with a 17-gauge coaxial needle (TruGuide; Bard, Covington, GA) pointed in the same direction. With a rotation motion and controlled pressure, the coaxial needle was inserted through the anterior sternal cortex. CT was performed again to reassess the correct trajectory and the distance from the needle tip to the mass. After the posterior cortex was penetrated, contrast-enhanced CT scan was performed to define the major vessels in the vicinity of the mass and the relative location of the needle tip and the tumor (Fig. 2). Volume-rendering reconstruction imaging was used to delineate the relative location between the trajectory and the great vessels (Fig. 2). An 18-gauge cutting biopsy needle was passed coaxially through the guiding needle to obtain the tissue sample of the mass. Immediate CT scan and chest X-ray performed 6 hours later were checked, and they revealed no pneumothorax or other complications. Throughout the procedure, patient’s consciousness was clear and he tolerated it well. The patient was discharged on the next day. The final pathology showed poorly differentiated adenocarcinoma and he received concurrent chemoradiotherapy. No delayed complication was found in the following three month.

**DISCUSSION**

Our case confirmed the feasibility of sternum penetration by routine coaxial needle which was first mentioned by Gupta et al. in 2002 [1]. In the Taiwanese population, this is the first report in which the trans-sternal core biopsy for anterior mediastinal mass was successfully performed under CT guidance.

The anterior mediastinal mass is a common clinical problem. When surgical excision is not indicated, it is very important to obtain the tissue sample for pathological diagnosis for treatment.

**Figure 1.** A 57 years old man suffered from progressive neck swelling for 6 months. a. Axial image of contrast-enhanced CT scan shows a lobulated mass (M) just behind the sternum (S) and closely surrounded by great vessels, including bilateral internal mammary arteries (arrowheads), right brachiocephalic vein (RBCV), right brachiocephalic trunk (RBCT), left common carotid artery (LCCA), and left brachiocephalic vein (LBCV). b. Axial image of contrast-enhanced CT scan with the level lower than Figure 1a. Encasement of left brachiocephalic vein is also noted (arrow). (LSA: left subclavian artery; T: trachea.)
planning. Image-guided trans-thoracic needle biopsy is a safe procedure and is sufficient to provide information for treatment. Its diagnostic accuracy is between 77% and 94% [2, 3]. The general accesses to anterior mediastinal lesions are the para-sternal, supra-sternal, or trans-pulmonary approach. The less common routes are the sub-xiphoid and trans-sternal approaches. The trans-sternal biopsy of mediastinal mass was first reported by Swanson and Wittich in 1990 [4]. The trans-sternal biopsy is usually used for sampling the tissue of an anterior mediastinal mass, which is usually small in size and located just behind the sternum. Due to the special trajectory of trans-sternal biopsy, injury to internal mammary arteries,
a potential complication of para-sternal biopsy can be avoided [5, 6]. Both the supra-sternal approach and the sub-xiphoïd approach are more difficult than the trans-sternal approach because in the former two procedures the patient must be placed in semi-erect position or angulate CT gantry in the craniocaudal plane. In addition, the longer the distance between tumor and sternal notch or xiphoïd, the more difficult it is to perform supra-sternal or sub-xiphoïd biopsy. The trajectory of trans-sternal biopsy does not pass through the lung parenchyma, hence pneumothorax is almost impossible [3]. Certainly, tumor seeding is a potential complication of trans-sternal biopsy. However, to our knowledge, there is no case report about tumor seeding after trans-sternal biopsy in the literature, probably due to the limited cases of trans-sternal biopsy and the low incidence of tumor seeding. Furthermore, coaxial cutting biopsy technique was utilized to avoid multiple entrance and manipulation, and to reduce the incidence of tumor seeding [7].

Some reports about the trans-sternal biopsy in the non-Asian populations have been mentioned in the literature [1, 4, 8-10]. In the report by D’Agostino et al., seven patients with anterior mediastinal lesions underwent trans-sternal biopsy with a phlebotomy needle under local anesthesia and conscious sedation [8]. The authors noted that the procedure was safe without complication and was well tolerated. Astrom et al. performed trans-sternal biopsy in ten patients by using a bone biopsy system [9]. Thereafter Hagberg et al. used the same technique in 21 patients [10]. Thirty-seven patients were included in Gupta et al.’s study which was the largest series of trans-sternal biopsy performed with an 18-gauge coaxial needle [1]. In addition to biopsy of anterior mediastinal lesions, they also performed trans-sternal biopsy to obtain the tissue samples of masses in middle mediastinum and posterior mediastinum. These procedures were all performed in non-Asian populations. Although different biopsy needles were used in these reports, the sternum was penetrated successfully without complication and almost all of these patients tolerated the procedure well. The only exception was a case in which an 18-gauge needle could not penetrate the sternum of a patient who had a past history of sternotomy [1]. However, no cases of tumor seeding after trans-sternal biopsy has been report.

In our patient, it is very difficult to obtain the tissue sample with supra-sternal access because the mass is just under sternum and far from sternal notch. The internal mammary arteries may be damaged using para-sternal approach [5, 6]. In our case we successfully obtained the tissue sample of the anterior mediastinal mass with the same technique as Gupta and colleagues by using a 17-gauge coaxial needle (TruGuide; Bard, Covington, GA) under local anesthesia, and the patient tolerated the procedure well. To the best of our knowledge, this is the first report about trans-sternal biopsy of an anterior mediastinal mass in the Taiwanese population. It also proves the feasibility of trans-sternal biopsy performed with a coaxial needle in this population. Thus, in patients who have anterior mediastinal lesions which are small or far from the sternal notch, trans-sternal biopsy could be considered. In Gupta’s study, nonenhanced CT alone is sufficient for biopsy planning in most patients who had previous diagnostic contrast-enhanced CT. But there were still two patients who need contrast-enhanced images to define the relative location between the mass and the great vessels during biopsy procedure. In our case, contrast-enhanced CT was performed using the contrast-covering time concept [11] and only 60c.c. of contrast medium was used to pinpoint the location of the coaxial needle, tumor, and great vessels to avoid vessel injury. This not only defined the vessels but also reduced the loading of contrast medium.

In summary, we presented the case of a patient with a 38mm-sized anterior mediastinal mass just behind the sternum. To obtain the tissue sample of tumor in this location, trans-sternal CT-guided percutaneous coaxial core needle biopsy under local anesthesia is a feasible and safe method for patients in the Taiwanese population.

REFERENCES

5. Glassberg RM, Sussman SK, Glickstein MF. CT anatomy of the internal mammary vessels: importance in planning percutaneous transthoracic procedures. AJR Am J Roentgenol 1990; 155: 397-400
穿胸骨電腦斷層導引切片術於前縱隔腫瘤之應用：
病例報告

蔡昇亨 1  蔡依橙 1,2  陳明至 1,3  林保鐘 1  蔡瑋琳 1  陳詩華 1,4  陳啟昌 1,3,5,6

台中榮民總醫院 放射線部 1
國立陽明大學 臨床醫學研究所 2  物理治療暨輔助科技學系 6
中台科技大學 放射技術學系與放射科學研究所 3
逢甲大學 生物醫學資訊工程系 4
弘光科技大學 物理治療系 5

使用穿胸骨電腦斷層導引經皮切片術來取得前縱隔腫瘤的組織是一個困難的技術，在國外的幾篇報告中曾提及其可行性。我們將報告一位 57 歲男性病人，意外發現有一個 38 毫米的前縱隔腔腫瘤。因為取得切片的路徑被胸骨及主動脈弓的分支所阻擋，因此我們選擇穿胸骨的路徑來做切片。我們成功的取得腫瘤組織而且沒有任何併發症產生。本文中我們將把相關影像、穿刺前的計畫與穿刺的技術與大家分享。經由這份報告我們也印證了穿胸骨電腦斷層導引切片術在台灣患者族群的可行性。