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Case Report

Pre-operative Localization of a Chest Wall Needle by Ultrasonography: A Case Report

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High-resolution ultrasonography is a useful tool for the localization of non-palpable soft-tissue foreign bodies. A 21-year-old female underwent a routine health examination, during which chest radiography revealed a radio-opaque linear foreign body. The foreign body was located within left posterior chest wall, 4 to 5 cm lateral to the T8 spinous process. The shape indicated a needle. The possible presence of a needle in the chest wall meant that an operation to remove it was imperative. There was no tender point or palpable mass present on the chest wall and, consequently, there was difficulty determining the precise location of the object. Using high-resolution linear-array ultrasound, a linear hyperechoic focus was clearly demonstrated at the junction of the subcutaneous layer and the muscle layer. The needle was measured as 1.94 cm in length and was located 0.62 cm beneath the skin. After precise ultrasonographic localization and marking of the object’s location, the needle was successfully removed immediately by surgery. (Tw J Phys Med Rehabil 2009; 37(3): 201 - 206)

Key Words: ultrasound, foreign body, needle

INTRODUCTION

A needle in the chest wall either can be asymptomatic or may lead to a life-threatening pneumothorax.1, 2 In a retrospective study, 9% of secondary pneumothorax cases were found to have been caused by a needle puncture.3 Once a needle has become lodged in the chest wall, pneumothorax is liable to occur due to the object’s potential for migration. Thoracoscopy or even thoracotomy is necessary for the treatment of pneumothorax caused by a migrating needle.1, 2 In order to prevent pneumothorax and subsequent invasive treatment, removal of a needle from the chest wall is imperative even in an asymptomatic patient.

In a series of surgically removed foreign bodies, metallic material, including needles, can be correctly diagnosed by plain radiography in 100% of cases.4 However, owing to needles being small in size, the precise localization of the incision site that will minimize
the operation field is difficult to determine, even though the correct diagnosis has been made. Precise localization of a foreign body within the chest wall is crucial if extensive tissue damage, prolonged operating time, excessive blood loss, and increased likelihood of complications are to be avoided.[5]

The increasing availability of high-resolution transducers means that ultrasonography has become an important imaging modality for guidance during operations and invasive procedures.[6,7] With the application of ultrasonographic guidance, it has been reported that foreign bodies and bony fragments have been successfully removed from horses with a shorter time in surgery and minimal tissue dissection.[8]

Here, we report the case of a young female who had a needle located within her posterior chest wall. Using ultrasonography, the needle was precisely located prior to removal by surgery.

CASE REPORT

A 21-year-old female experienced sudden posterior chest discomfort after lying on a sofa one year ago. The pain subsided spontaneously within days without any treatment. One year later, she received a radiographic examination during a routine health examination. Physical examination revealed neither a skin change nor a tender point on the left posterior chest wall. However, a small, linear, sharp, radio-opaque foreign body was incidentally found on the chest plain radiograph. In two projections, a posterior-anterior view and a lateral view (Figure 1), the chest radiograph revealed that the foreign body was located within left posterior chest wall, 4-5cm lateral to the thoracic spinal process between levels T8 and T9. The shape of foreign body was similar to a needle. The radio-opaque density indicated that the object was metallic. An operation was arranged immediately for the removal of the suspected needle within the chest wall.

Taking into consideration the absence of any cutaneous change, the lack of a tender point, and no detectable palpable nodule using physical assessment, musculoskeletal ultrasonography was applied to obtain a pre-operative localization of the needle. Using a 7- to 12-MHz linear-array transducer (HDI 5000; Philips Ultrasound, Bothell, WA), the ultrasonography revealed a linear, hyperechoic focus with a faint comet-tail artifact.
Ultrasound Localization of a Needle

(Figure 2A) on its long-axis view and an echogenic dot with posterior acoustic shadowing on its short-axis view (Figure 2B). The foreign body was located at the junction of the subcutaneous fat and the muscle layers (Figure 2A). The object was located at a depth of 0.62 cm beneath the skin and was 1.94 cm in length (Figure 2A and 2B). There was no hypoechoic region surrounding the needle. A mark was made on the skin immediately after ultrasonographic localization to give the surgeon a precise target.

During the following open operation, the needle was found, as expected, at the junction of subcutaneous fat and muscle layer. No abscess formation was present, which was compatible with the lack of a surrounding hypoechoic region as revealed by ultrasonography. After carefully removing the needle, the length of the needle was measured to be 2.67 cm (Figure 3). The surrounding chronically inflammed soft tissue was subsequently debrided, and the surgical wound healed well without complications.

DISCUSSION

In this case report, a 2.67-cm-long needle was found located at a depth of 0.62 cm beneath the skin. It has previously been reported in a prospective study that the thickness of the chest wall can vary from 1.9 cm to 4.1 cm.[9] Therefore, a pneumothorax may potentially occur if a needle of this size is oriented perpendicularly to the chest wall or if a deep and extensive incision is performed during operation. Owing to the limited thickness of the chest wall and the potential for a life-threatening pneumothorax, the surgical removal of a needle within the chest wall demands a very precise localization and evaluation.

The main reason for a soft-tissue foreign body being extracted or undergoing surgical removal is to prevent further painful discomfort or any possible complications. Soft tissue infection is the most common complication associated with a penetrating foreign body and this is followed secondarily by nerve injury.[4] In this reported case, however, no such complications were noted. Ultrasonography is a useful tool for foreign body localization, particularly in cases where a non-palpable soft-tissue foreign body is present.[10] Although metallic material can be detected by radiography, ultrasonography is able to better focus on the lesion and can differentiate the various layers of soft tissue that has similar densities in an radiograph.[11] Furthermore, the real-time immediate localization characteristics of ultrasonography just before operation helped with the pre-operative localization of this metallic needle. Ultrasound is able to differentiate the subcutaneous layer, the fascia, the muscles, and the surrounding vessels and nerves, and thus provides valuable information about the exact location of the foreign body and its anatomical relationship to adjacent structures. Besides, ultrasound can be used intra-operatively to assist

Figure 2. Ultrasonographic pre-operative localization of the needle. (A) The long-axis view of the needle. Arrow indicated the comet tail behind the linear hyperechoic focus. The length of the needle was 1.94 cm. (B) The short-axis view of the needle. It was located 0.62 cm beneath the skin. Minor arrow pointed to the foreign body. Major arrow indicated the acoustic shadow.
In this case, a foreign body with ultrasonographic features of both the acoustic shadow and a comet tail indicated high possibility of metallic nature. With comparable linear shape, the foreign body was highly suspected as a needle under ultrasonographic examination. An acoustic shadow would not appear in the case of thorns or glass, whereas a comet tail would not appear in the case of wood or thorn.

Although a plain radiographic film of the chest can demonstrate the presence of a metallic object, ultrasound is able to better focus on the point of the lesion and thus helps to minimize the incision area during surgical removal. Furthermore, ultrasonography can detect both radiopaque and radiolucent foreign bodies. Computed tomography (CT) has also been used to identify foreign bodies; however, CT produces only limited soft tissue contrast. A previous study revealed that ultrasonography is able to identify about 90% of all foreign bodies, whereas CT scans can only identify about 70%.[13]

C-arm imaging is able to provide real-time multiplanar views of the anatomy and is already applied to hip, knee and spinal operation as well as neurosurgery. The major disadvantages of C-arm imaging include an increased intraoperative time, an increased cost, the need for specific positioning techniques, and a requirement for a radiolucent operating table. After examining cases where there has been operative guidance during foreign body removal, there are two case reports with one in vitro study using C-arm imaging. Overall, compared to ultrasonography, although more precise intraoperative navigation is possible using C-arm for foreign body localization, this approach is not yet as popular as ultrasonography, probably due to the cost and availability of machines.

Magnetic resonance imaging (MRI) has superior soft tissue contrast compared with other imaging modalities. However, metallic fragments can give rise to obvious artifacts when using MRI.[20] Even though a procedure has been developed for the localization and removal for ferromagnetic foreign bodies, this is not suitable for paramagnetic foreign bodies, fragments less than 0.5 cm in length, or a foreign body located under thick skin or in a deep cavity.[21]

Despite the clear advantages of pre-operative ultrason sound localization, there are some disadvantages. The sensitivity for foreign body detection is lower when the foreign body is close to a bony structure and prominent reflection from the bone may obscure the appearance of a foreign body when using ultrasonography.[22] Furthermore, when the body has irregular surfaces, smaller transducers may be needed in order to prevent false negatives that are caused by unsuitable transducer size.[12]

In conclusion, high-resolution ultrasonography is a useful imaging modality for the pre-operative localization of non-palpable, soft-tissue foreign bodies. It is also less expensive, more available, and can be used intra-operatively more easily compared with other imaging modalities. In the present study using ultrasonography, a detailed evaluation was carried out and a precise localization obtained prior to the removal of a needle from the chest wall.

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利用超音波進行手術前定位胸壁內的針：病例報告

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高解析度超音波( ultrasound)是定位觸摸不到的異物(foreign body)最有方便且精準的工具。一位二十
一歲女性，進行例行性健康檢查時，在胸壁上發現有一幅射線不能透過的線狀異物。異物的位置在左後
胸壁中，距第八肋椎突四至五公分，形狀似一根針(needle)。由於高度懷疑胸壁中有一根針，有必要藉
由手術移除。因沒有任何壓痛點及可觸摸到的腫塊，定位精確的開刀位置有其困難。此時應用高解析度
的超音波進行術前精準的定位，結果發現位在皮下脂肪層和肌肉層的交界處清楚呈現一線性，且具高度
回音的物體。經過量測，針長約 1.94 公分、深度在皮下 0.62 公分。由於應用超音波進行精準的定位並標
記，之後隨即進行手術順利將胸壁中的針取出。（台灣復健醫誌 2009; 37(3): 201 - 206）

關鍵詞：超音波(ultrasound)，異物(foreign body)，針(needle)