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The diagnostic yield using ultrasound-guided needle-aspiration for subpleural primary lung cancer is not affected by the radiological properties of the lesions resulting from computed tomography

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ABSTRACT

Background: It is well known that ultrasound-guided needle-aspiration (USGNA) for intrapulmonary subpleural lesion in contact with the pleura is useful and safe, and its diagnostic yield is high. However, reports concerned with the analyses of cases with intrapulmonary subpleural lesion which could not be diagnosed using USGNA are limited. The objective of this study is to clarify the radiological properties of subpleural primary lung cancer which obstruct diagnosis by USGNA.

Methods: The consecutive cases with subpleural primary lung cancer whose radiological properties could be confirmed by thoracic computed tomography (CT) without contrast enhancement (CE), and examined by USGNA at our hospital between January 1999 and December 2014 have been analyzed. All cases were given pathological diagnoses of primary lung cancer. The diagnostic yield by USGNA was calculated, and the properties of the lesions of the subjects were analyzed by means of thoracic CT without CE images and pathological findings.

Results: 87 consecutive cases (41–86 year olds, 75 males, 12 females) were analyzed. The overall diagnostic yield by USGNA was 86.2%. There was no statistically significant difference regarding the diagnostic yield concerning radiological properties such as cavities, small airspaces and low density areas in the lesions and their sizes. However, the diagnostic yield for the cases with squamous cell carcinoma was statistically significantly low ($p=0.02$).

Abbreviations: USGNA, ultrasound-guided needle-aspiration; CT, computed tomography; CE, contrast enhancement; US, ultrasound; CI, confidence interval; OR, odds ratio

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Conclusion: Although the diagnostic yield of USGNA is not distorted by the radiological properties of lesions, it is statistically significantly low in cases with squamous cell carcinoma.

1. Introduction

Intrapulmonary subpleural lesions can be detected by ultrasound (US) when these lesions make contact with the pleura. Ultrasound-guided needle-aspiration (USGNA) for such intrapulmonary subpleural lesions can be performed by using this specific characteristic of US. USGNA for intrapulmonary subpleural lesions can be performed at the bedside or at the outpatients' clinic, and is a convenient diagnostic procedure. It is useful and safe because an operator can carry out an examination with a real-time image on a monitor [1,2]. It is well-known that the diagnostic sensitivity of this method for cases with intrapulmonary subpleural lesions is high, even if the lesion is small or if patients have respiratory comorbidities [3–7]. On the other hand, the fact is that some cases with intrapulmonary subpleural lesions cannot be diagnosed using this procedure. It is unclear what kinds of radiological properties of the lesions using thoracic computed tomography (CT) hinder the diagnosis of intrapulmonary subpleural lesions by USGNA. In other words, it is unclear which USGNA should be chosen to make a definitive diagnosis or not in accordance with the radiological properties of the lesions by using thoracic CT.

The objective of this study is to clarify what kinds of radiological properties of subpleural primary lung cancer by using thoracic CT without contrast enhancement (CE) hinder diagnosis of intrapulmonary subpleural lesions by using USGNA.

2. Patients and methods

2.1. Subjects and study design

Consecutive cases with subpleural primary lung cancer examined by USGNA at Juntendo University Shizuoka Hospital (Nagaoka, Izunokuni-City, Shizuoka, Japan) between January 1999 and December 2014 have been analyzed. All cases could be confirmed the radiological properties by thoracic CT without CE and diagnosed as primary lung cancer. Subpleural primary lung cancer which was the target of USGNA in this study means that there is contact with the pleura, resulting in its being detectable by US.

USGNA was performed up to twice before diagnosing primary lung cancer. If a diagnosis could not be made using USGNA, other procedures including flexible bronchoscope, CT-guided needle biopsy and surgery were performed in order to make a diagnosis.

The diagnostic yield by USGNA was calculated, then pathological findings of the lesions and the properties of the lesions of subjects using thoracic CT without CE images were analyzed to examine features such as the size of the lesions and whether or not there were cavities, small airspaces, and low density areas in the lesions. These radiological properties were selected because they were expected to hinder the diagnosis of subpleural primary lung cancer by USGNA. In other words, low density areas in a lesion may mean necrosis and a lesion that includes air can only be detected with difficulty by US because air such as in cavities, or in small airspaces, does not permit US penetration.

The complications caused by USGNA were also investigated using medical records.

2.2. Equipment

The equipment used in this study was a commercially available US unit (Ultrasonic Diagnostic Equipment Model SSD-2200; Aloka Co., Ltd. Japan) and a linear probe emitting 3.5 MHz cycles. A metallic needle (20 gauge in diameter, 150 mm in length) was used for aspiration.

2.3. Procedures of USGNA

The USGNA was conducted by a respiratory physician with over ten years' experience of USGNA. A solid area in a lesion detected by ultrasound was decided as the site to obtain a specimen. An area including high echo-spots which coincided with air was avoided. The methods for the use of USGNA were as follows: after the sterilization of skin including an area for centesis by povidone-iodine, operators undertook standard precautions. Then, after the induction of subcutaneous local anesthesia using lidocaine hydrochloride, a metallic needle was introduced in the direction of the lesion, under US guidance. After anesthesia at the parietal pleura, the injector syringe for anesthesia was removed and a 20 ml syringe fixed to a one-handed grip aspirator was fitted with a metallic needle. The patient was instructed to hold his/her breath to permit the needle to be positioned just above the lesion. Then the needle was inserted into the lesion, and moved up and down as widely as possible, visible in US images. Negative pressure during aspiration was generated by the aspirator. The correct positioning of the tip of the needle in a lesion was confirmed by the appearance of a high echo spot within the lesion in a US image. A smear was taken from the aspirated sample and fixed with 95% ethanol for cytology. Then, the residue in the needle was given a saline wash, and examined for cytology and culture. Rapid on-site evaluation was not performed.

A chest X-ray was subsequently performed to confirm the presence of complications such as pneumothorax or intrapulmonary hemorrhage.