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Analysis of factors affecting successful microcoil localization for pulmonary nodules

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ABSTRACT

Background: This study aimed to investigate the factors affecting successful microcoil localization for subsequent thoracoscopic resection of pulmonary small nodules and ground-glass nodules. Microcoil has been useful for preoperative localization. Nevertheless, microcoil may dislocate before video-assisted thoracoscopic surgery.

Methods: The medical data of patients with pulmonary solid nodules and ground-glass nodules, who underwent computed tomography–guided microcoil localization before thoracoscopic surgery, were retrospectively reviewed. Factors including clinical data, imaging data, surgical data, and technical data of microcoil localization were collected for stepwise logistic regression analysis.

Results: A total of 206 nodules in 192 patients were included in this study. Microcoil dislocation was identified on video-assisted thoracoscopic surgery exploration in six patients (2.9%), resulting in a successful localization rate of 97.1%. The insertion depth of Chiba needle, transfissure needle tract, and pneumothorax after localization were implicated as significant factors for successful microcoil localization. Based on logistic regression, the insertion depth of Chiba needle and pneumothorax after localization were identified as the independent factors for successful microcoil localization.

Conclusions: The insertion depth of Chiba needle and pneumothorax after localization were the independent factors affecting successful microcoil localization for subsequent thoracoscopic resection. Special care should be taken in terms of the sufficient insertion depth of Chiba needle during microcoil localization and the risk of dislocation.

Introduction

The incidence of small pulmonary nodules and ground-glass nodules (GGNs) has been more frequently detected with the application of computed tomography (CT) scan for lung cancer screening. Video-assisted thoracoscopic surgery (VATS) is preferred for diagnosis and treatment of these small pulmonary lesions with reduced postoperative pain. However, intraoperative localization of small pulmonary lesions tends to be difficult.[1] Preoperative localization by CT-guided percutaneous localization has been proved to improve the success rates of VATS resection. Moreover, various localizers, including hookwires, dyes, Lipiodol, and radiotracers, have been used.[2-7] Microcoil has been identified as a useful localizer

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for preoperative localization.[8,9] Nevertheless, similar to the hookwire localizers inserted into the lung parenchyma, microcoil localization may also dislocate from lung parenchyma before VATS resection (Fig. 1).Various factors (e.g., patient characteristics, nodule-related factors on the CT images, or procedure-related factors) might be related for a successful microcoil localization before VATS resection. However, few studies have presented empirical evidence of the factors necessary for success in nodule localization. We reviewed the experiences of microcoil localization in a single center and investigated the factors affecting successful microcoil localization for the subsequent thoracoscopic resection of pulmonary small nodules and GGNs.

Materials and methods

Study subjects

The medical records of patients with small pulmonary solid nodules and GGNs, who underwent microcoil localization and subsequent thoracoscopic resection in Peking University People's Hospital between December 2012 and April 2015, were retrospectively analyzed. The preoperative localization using microcoil was performed with the following criteria: (1) solid nodules with a diameter $\leq$1 cm and distance to visceral pleura $\geq$0.5 cm, (2) GGN, and (3) part-solid GGN, with a solid portion $\leq$1 cm and distance to the visceral pleura $\geq$1 cm. Patients with nodules at a deep location, which were removed by direct lobectomy, who underwent microcoil localization to facilitate localization in the resected specimen by a pathologist were excluded from the study. As a standard of care, all patients signed an informed consent form before preoperative localization. The present retrospective study was approved by the ethics committee of the institution, and the requirement for informed consent for collecting medical data from the related patients was waived.

Microcoil localization

A 64-row multidetector CT system (LightSpeed VCT; GE Healthcare, Milwaukee, WI) was used for microcoil localization, with a 1.25-mm reconstruction thickness and a 1.25-mm interval. A platinum microcoil with an entire length of 7 cm (Cook Incorporated, Bloomington, IN) and a 21G Chiba needle (Argon Medical Devices Inc, Athens, TX) were used for the localization. A guiding CT scan was taken first to determine the body position and needle pathway, which was selected to avoid penetrating the lesion, with the tip positioned near the lesion. Another CT scan was taken to determine the skin puncture site and needle insertion depth. The successful puncture was confirmed by the CT scan, and then the loading cannula of the microcoil was connected to the needle. The microcoils inserted into the lung were deployed by two methods. For the simple method, the entire microcoil was deployed by advancing the guidewire to the tip of the needle and coiled in the lung parenchyma (Fig. 2). For the other method named as the "trailing" method,[10] the microcoil was deployed stepwise by adjusting the guidewire and the needle, with the proximal end of the microcoil beyond the parietal pleura with the distal part anchoring in the lung parenchyma (Fig. 3). Each adjustment of needle position was confirmed by CT scan, and the times of CT scan from local anesthesia to the deployment of the microcoil were counted. Afterward, a CT scan was performed to confirm the position of the microcoil. The presence of pneumothorax and hemorrhage was also assessed. Later, the patients were sent back to the ward. As certain patients underwent multiple localizations, complications were recorded per localization. Delayed pneumothorax and hemoptysis in patients who underwent multiple localizations were recorded as complications for all the related localizations.

Thoracoscopic surgery

Thoracoscopic surgery was adopted within 3 d after localization. Each patient was intubated with a double-lumen endotracheal tube under general anesthesia. The patient was placed in the lateral decubitus position with one-lung ventilation. Two or three VATS ports were made, with an observation port at the midaxillary line of the seventh or eighth intercostal space, a main operating incision at the anterior

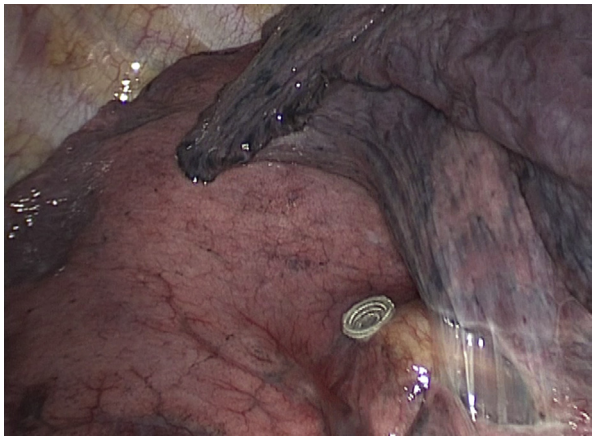

Fig. 1 – Identifying microcoil dislocation. The dislocated microcoil was identified during VATS exploration. (Color version of figure is available online.)

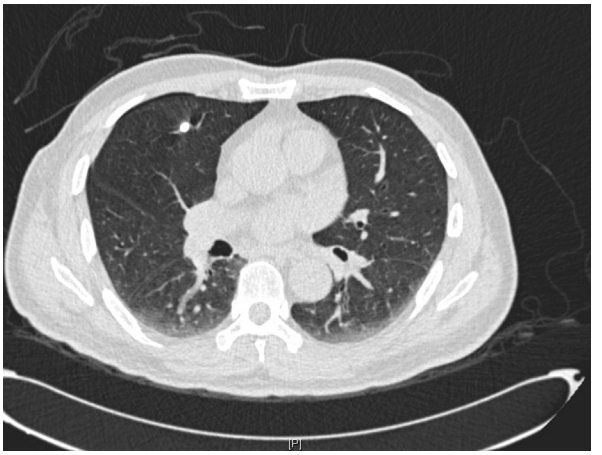

Fig. 2 – Microcoil localization by the "simple" method. The microcoil was deployed entirely into the lung parenchyma.