BRIEF REPORT

Video-Assisted Thoracic Surgery Resection without Intraoperative Fluoroscopy after CT-Guided Microcoil Localization of Peripheral Pulmonary Nodules

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ABSTRACT

The aim of this brief report is to determine the safety and reliability of minimally invasive video-assisted thoracic surgery (VATS) resection without the aid of intraoperative fluoroscopy after computed tomography (CT)–guided microcoil localization of small peripheral pulmonary nodules. Twenty patients with peripheral lung nodules underwent percutaneous needle localization with a microcoil that was tagged back to the visceral pleural surface. Same-day VATS resection was performed without the use of intraoperative fluoroscopy. All 20 nodules were successfully localized in the CT procedure room, and all 20 nodules were resected with negative margins and no major complications.

ABBREVIATION

VATS = video-assisted thoracic surgery

Small, soft, or deep lung nodules can present a technical challenge for the surgeon attempting to localize these lesions with direct visualization or digital palpation before resection. This can lead to excessive operative times or, even worse, conversion to open thoracotomy if a nodule is not easily detected. Suzuki et al (1) reported 46% of cases being converted from video-assisted thoracic surgery (VATS) to open thoracotomy as a result of the inability to localize the lesion. Not surprisingly, several preoperative localization techniques have been introduced as a way to improve VATS resection rates and decrease patient morbidity (2–9). Each of the more common techniques have their own sets of benefits, risks, and technical challenges. Rigid hook-wire localization is associated with a relatively high risk of pneumothorax, parenchymal hemorrhage, and wire dislodgment (4,5). Injection of methylene blue dye, Lipiodol, or technetium-99m radiotracer carries the risk of embolization or parenchymal diffusion of the injected substance preventing accurate guidance (5–9).

A recently reported method involving the use of platinum fiber–coated microcoils was described by Mayo et al (10), who demonstrated encouraging technical and clinical success. In their series, all cases were localized with a microcoil, 3% of microcoils dislodged before VATS resection, and 97% of nodules were successfully resected. However, 1 drawback to this coil-localization technique is the reported need for intraoperative fluoroscopic guidance, potentially increasing intraoperative time, cost, and radiation exposure, as well as surgeon discomfort while wearing a heavy lead apron throughout the surgical procedure. In the present report, we describe an initial experience with the computed tomography (CT)–guided microcoil localization technique

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to guide VATS resection of 20 lung nodules without the aid of fluoroscopy.

MATERIALS AND METHODS

Patient Selection

The institutional review board at Cleveland Clinic approved this retrospective study, which included patients who were referred for surgical resection of small peripheral pulmonary nodules between February 2016 and June 2017. In all cases, the surgeon determined that thoracoscopic wedge resection was appropriate and that it would be beneficial to have the nodule marked and localized for excision. Patients were included when they met criteria for suspicion of neoplasm with documented nodule growth, concerning nodule morphology, or biopsy-proven neoplastic disease. In all cases, the thoracic interventional radiologist and surgeon reviewed available CT images and discussed the surgical plan together to determine the feasibility and approach of percutaneous needle localization and surgical wedge resection.

Twenty patients with 20 presumably nonpalpable peripheral lung nodules who were preoperatively evaluated for percutaneous microcoil localization and planned subsequent VATS resection without the intended use of intraoperative fluoroscopy formed the study group. Alternative options that were offered to patients included the possibility of lobectomy or open thoracotomy. Table 1 details patient demographic data, nodule characteristics, and indications for VATS resection of all localized lesions.

Table 1. Patient Demographic and Nodule Characteristics of Patients Undergoing Percutaneous Needle Localization and Subsequent VATS Resection

Characteristic	Value
Patient age (y)	
Mean ± SD	63 ± 13
Range	16–79
Sex	
Male	11 (55)
Female	9 (45)
Nodule morphology	
Solid	11 (55)
Ground-glass	2 (10)
Part-solid	5 (25)
Cavitary	2 (10)
Nodule size (mm)	
Mean ± SD	16 ± 11
Range	5–49
Lobe	
Left lower	4 (20)
Left upper	2 (10)
Right lower	8 (40)
Right middle	4 (20)
Right upper	2 (10)
Resection reason	
Diagnostic	12 (60)
Therapeutic	8 (40)
Initially detected on lung cancer screening examination	3 (15)

Note–Values in parentheses are percentages.
VATS = video-assisted thoracic surgery.

Needle Preparation and Nodule Localization

In all cases, a planning CT scan was performed before percutaneous needle insertion. The mean nodule size was 16 mm ± 11 (range, 5–49 mm), and the mean distance from the superficial edge of the nodule to the nearest pleural surface was 7 mm ± 6 (range, 0–23 mm).

The localization technique described by Mayo et al (10) was used, but with slight modification. An appropriately sized 22-gauge Chiba needle (10–15 cm; Cook, Bloomington, Indiana) was preloaded with a 0.018-inch, 8-cm fiber-coated microcoil (Vortex-18; Boston Scientific, Marlborough, Massachusetts) by using the packaged metal pusher. A 40-cm nitinol guide wire (Argon Medical, Athens, Texas) was marked in 2 different locations near its rigid end. By bending and kinking the guide wire, the first spot was marked as the distance needed to push the guide wire through the needle and deploy the entire coil at the pleural surface. By clamping a hemostat around the guide wire, the second spot was marked as the distance needed to deploy the distal end of the coil adjacent to the deep surface of the nodule.

All nodule localizations were performed by 1 thoracic interventional radiologist with 5 years of subspecialty experience. Using CT fluoroscopy with a 64- or 128-detector scanner and i-sequence 2.4-mm slices (SOMATOM Definition AS, Siemens, Erlangen, Germany), the Chiba needle was inserted into the lung and advanced along the surface of and just deep to the nodule margin. After confirming the needle tip location, the guide wire was pushed through the needle bore to the premeasured distance, deploying approximately 3 cm of the coil alongside the deep end of the nodule. Slowly and incrementally, the needle was retracted to the pleural surface (Fig 1a), deliberately attempting to create a small pneumothorax. After placement of the needle tip along the pleural surface, the proximal end of the coil was deployed into the pleural space by pushing the guide wire through the hollow bore of the needle to the level of the wire kink. The needle was removed, and postprocedural CT imaging was obtained for confirmation of coil deployment and as a guide for surgical planning (Fig 1b).

VATS Resection

In all cases, thoracoscopic resection was performed the same day as microcoil placement. All patients were transported by bed to a preoperative holding area before being transferred to the operating room.