



Preoperative localization of indeterminate pulmonary nodules before videothoracoscopic resection

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Received: 17 January 2001/Accepted: 6 June 2001/Online publication: 4 December 2001

Abstract

Background: The management of a solitary pulmonary nodule is the subject of debate and minimally invasive diagnostic approaches have low sensitivity for small peripheral nodules. We discuss the role of video-assisted thoracoscopic surgery (VATS) in the management of solitary pulmonary nodules (SPNs) ≤ 1 cm performed with a preoperative computed tomography-guided wire localization.

Methods: Thirty-five selected patients underwent VATS resection for SPN, with localization by guide wire before surgery.

Results: Seven patients, after VATS exploration, underwent thoracotomy because of pleuropulmonary adhesions, depth or dimensions. Histological diagnosis was obtained in all procedures; there was no postoperative morbidity or mortality.

Conclusion: Preoperative computed tomography hook-wire localization is a suitable strategy for peripheral nodules ≤ 1 cm in diameter.

Key words: Pulmonary nodule — Videothoracoscopy — Hook-wire technique — Computed tomography — Preoperative localization

The management of a solitary pulmonary nodule (SPN) is the subject of debate for both surgeons and clinicians. Although all the approaches described in the literature [4, 8] stress the importance of a histological diagnosis of all SPNs, the “wait and watch” strategy with radiological follow-up of an undiagnosed nodule is still encountered. The high incidence of malignant lesions between SPNs compels prompt treatment of SPNs. Transbronchial biopsy (TBB), computed tomography-

guided transthoracic needle aspiration biopsy (CT-TNAB), and ultrasound-guided transthoracic needle aspiration biopsy (US-TNAB), proposed as more conservative diagnostic approaches, have low sensitivity for small peripheral nodules [3]. Video-assisted thoracoscopic surgery (VATS) has gained widespread acceptance for the resection of small pulmonary nodules, ensuring lower morbidity than the standard thoracotomy approach. The lack of digital palpation of pulmonary parenchyma is the major factor limiting the success of thoracoscopic resection of small or deeply situated nodules.

In this article, we discuss VATS resection of SPNs ≤ 1 cm performed with a preoperative computed tomography guide wire localization.

Material and methods

From January 1993 to December 1999, we treated 291 patients with SPNs. Thirty-five patients (12%) with small lesions (≤ 1 cm) underwent VATS resection after preoperative localization of the nodule with a guide wire. This surgical procedure entails histological diagnosis of the resected nodule in all patients. The surgical resection was undertaken after lack of success of less invasive procedures, such as TBB, TNAB, or US-TNAB

A thoracic CT examination identified the nodule position. Centrolobar or scissural nodules were not considered in this study because VATS resection cannot be safely performed for this lesion.

All cases were performed with a CT scanner Twin flash (Elsint Limited, Haifa, Israel). The correct nodule position was found with a preliminary scout view and some axial scans with patients in a lateral position. The admittance point of the needle, the angle of incidence, and the depth of the nodules were identified with metal landmarks positioned on the skin. We used a set for localization MAMMOREP (SteryLab s.p.a., Rho, Milan, Italy) for all cases. After local anesthesia was carried out using 1% lidocaine, we introduced through the chest wall the 20-gauge needle with the tip positioned into or near the lesion. Subsequently, a 30-cm hook-wire was inserted through the needle with the patient holding his breath (Fig. 1). A CT axial scan checked the right position of the wire and then, to avoid dislodgement, the free end of the wire was covered with gauzes that were taped to the skin.

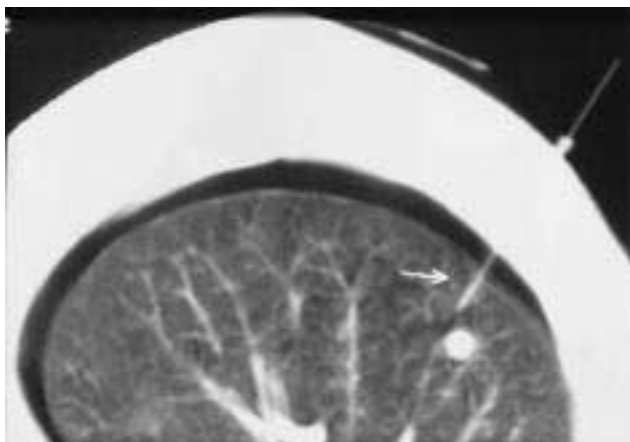


Fig. 1. Pulmonary nodule localized with the computed tomography-guided wire technique (the arrow shows the closeness of the hook-wire to the nodule).

Immediately after this minimally invasive procedure, the patient was led to the operating theater, where he underwent VATS resection of the nodule. All VATS procedures were performed under one-lung ventilation general anesthesia. In all cases, three entry sites were used. Once identified, the guide wire is stretched, allowing the identification of the nodule in the collapsed lung. The nodule is then confirmed by endoscopic ring forceps outlining resection limits. Lesions were resected by endoscopic linear stapler (ATB 35 Ethicon). Surgical specimens of all resected nodules were sent for intraoperative histopathological examination. For benign lesions the minimally invasive surgical resection was curative.

For malignant tumors a lateral muscle-sparing thoracotomy was performed and a lobectomy was carried out, allowing radical resection of the neoplasia with complete lymphadenectomy.

Results

This study includes 35 patients with peripheral SPNs ≤ 1 cm. In all patients the metal guide wire was positioned under CT visualization without any complications. In 27 cases the wire tip depth from the visceral pleura was > 20 mm, and in 8 cases it was 0.5 to 20 mm. The mean size of the nodules was 0.7 mm. In 28 patients the nodule was resected using a VATS procedure. Histological examinations revealed 13 benign tumors (10 inflammatory nodules, 2 hamartomas, and 1 aspergilloma), 8 metastatic lesions (4 intestinal, 2 renal, and 2 endometrial), 6 primary pulmonary malignant neoplasia (4 adenocarcinomas, 1 large cell cancer, and 1 squamous cancer), and 1 atypical carcinoma. Seven patients required conversion to open thoracotomy: 4 because of pleuropulmonary adhesions, 1 because of a too deep intra-parenchymal lesion, and 2 because the lesion was so small (a few millimeters) that the endoscopic rings forceps were not able to detect it. Histological examination of the specimen of these 7 patients revealed the presence of 4 primary pulmonary malignant neoplasia (3 adenocarcinomas and 1 squamous cancer), 2 metastatic lesions (1 breast and 1 sarcoma), and 1 inflammatory nodule. We did not record any complications related to the surgical procedure

and the duration of postoperative hospital stay was up to 3 days (range 1–5 days).

Discussion

VATS offers a minimally invasive approach for the treatment of lung nodules. Despite recent advances in thoracoscopic surgical techniques and equipment, lesions < 1 cm in diameter and those that are not located in the immediate subpleural region remain difficult to localize at the time of surgical procedure. In these cases, a thoracotomy approach with direct digital exploration of the pulmonary parenchyma was the only reliable approach until a few years ago. Recently, several techniques of preoperative and intraoperative nodule localization have been reported. Preoperative CT dye injection (methylene, colored collagen injection) has been performed in many centers but is limited by the rapid spread of the dye through the lung parenchyma [1, 9]. Intraoperative endoscopic ultrasonography is useful for peripheral, not too small nodules but is associated with a high false-negative rate up to 40% [5]. Preoperative CT guide wire localization is successfully used by some general thoracic surgeons [2, 6].

We have reported 35 cases of CT hook-wire technique for localization of pulmonary nodules before thoracoscopic resection. We have found this technique to be very accurate and safe, allowing a correct placement of the guide wire in each patient without major complications, such as persistent air leaks, emothorax, or dislodgement of the guide wire, as reported by other authors (in our series the average wire tip depth from the visceral pleura was 17 mm) [7]. The only minor complication related to this technique was a little pneumothorax (18 cases), although none required a preoperative treatment. With this technique we avoided a thoracotomy approach in 60% of our patients and we treated 80% of the benign lesions.

These results suggest that preoperative CT hook-wire localization is a suitable strategy for peripheral nodules ≤ 1 cm in diameter. Although other studies are needed, this technique supports a more widespread utilization of the VATS procedure for the resection of solitary pulmonary nodules.

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