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A New Safe and Stable Spiral Wire Needle for Thoracoscopic Resection of Lung Nodules*

Massimo Torre, MD; Giorgio M. Ferraroli, MD; Angelo Vanzulli, MD; and Stefano Fieschi, MD

Background: To show the safety and stability of a spiral wire needle (Somatex; Rietzneuendorf, Germany) in the detection and subsequent thoracoscopic resection of subpleural and/or small nodules of the lung.

Methods: Under local anesthesia and CT control, 13 patients underwent the positioning of a spiral wire needle into the lung, with the spiral located close to or inside the nodule to be resected. Then the patients underwent video-assisted thoracoscopic surgery resection of the nodules with only two thoracoscopic accesses.

Results: All the nodules were identified due to the precise location of the spiral wire needle. The presence of a stable spiral wire inside the parenchyma has allowed us to put under tension the overlying parenchyma, which had previously been excluded from ventilation. The external traction on the needle facilitates the detection of the nodule and simplifies thoracoscopic resection with a stapler. With this new tool, we have always reached an adequate diagnosis and observed no cases of dislodgment of the needle during the traction maneuvers, nor cases of conversion from thoracoscopy to thoracotomy.

Conclusions: Although our initial experience is limited, the use of this spiral wire needle has been shown to be extremely advantageous in identifying subpleural and/or small nodules of the lung, even sparing the classic third thoracoscopic access for their resection. The presence of a wire needle with a spiral terminal portion (which is placed firmly inside the lung parenchyma) is very useful for the thoracoscopic resection of pulmonary nodules.

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Key words: lung nodules; spiral needle; thoracoscopy

Abbreviation: VATS = video-assisted thoracic surgery

The improvement in surgical instruments, new techniques, and surgical skill has allowed the extension of video-assisted thoracic surgery (VATS) to always wider fields of thoracic pathology, both for diagnostic and therapeutic purposes, and both for pulmonary and mediastinal diseases. However, an important limitation in using VATS in the resection of pulmonary nodules is when they are subpleural and/or so small that could not be identified with either direct thoracoscopic inspection or with the instrumental palpation of the lung. Different methods have been proposed for the solution of the problem, both preoperatively or intraoperatively (injection of methylene blue or colored collagen around the lesion, identification of the nodule by intraoperative ultrasound ecography, and the position of a hook wire needle around or inside the nodule). Each method has shownundoubted specific features for the subsequent resection of the pulmonary nodule.

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In this article, we report our initial experience with 13 patients treated with a new kind of spiral wire needle (Somatex; Rietzneuendorf, Germany; distributed in Italy by Italmedtec; Milano, Italy) [Fig 1], which allowed us to identify and remove small nodules located inside the lung parenchyma with video-thoracoscopic technique. According to our experience, this new kind of wire needle possesses unique characteristics, making it a real and successful alternative to other methods already used in this kind of surgery.

**Materials and Methods**

Between January 2001 and September 2002, 13 patients (7 men and 6 women) with an average age of 60.8 years (range, 31 to 76 years) were referred to our department for pulmonary nodules. Five lesions were on the right side and six lesions were on the left; in the remaining two cases, the lesions were bilateral. In three cases, there were multiple nodules. Nine patients presented with a history of previously diagnosed cancer. In the remaining four patients, there was an incidental discovery of a single pulmonary nodule on the chest radiograph. The maximum dimensions of the nodules on CT scan and the patients’ histories are reported in Table 1. In all cases, the lesions were subpleural on the CT images, with a distance from the visceral pleura from 0.5 to 2 cm.

The 18-gauge spiral wire needle is made of nitinol, and has length of 120 mm and a diameter of 1.20 mm; the terminal spiral portion has a length of 0.8 cm and a diameter of 1 cm (Fig 1). The set we use is composed of two other metallic needles: the first one (introducer) needs to reach the pulmonary lesion passing through the parietal wall; when the CT scan shows the proper localization of this one (its correct direction and its proximity to the lesion), a second needle (that contains the spiral wire needle) is introduced through the first one and places the spiral (gently pushed forward through the second needle) close to or inside the nodule to be resected.

The spiral needle guide is inserted in the radiology suite under direct CT control. The patient is positioned on the radiologic bed exposing the affected side to the operator, with a different slope according to the individual technical needs. Under local anesthesia and sterile conditions, the radiologist proceeds with the insertion of the needle through the thoracic wall until it reaches the proximity of the lesion with the terminal spiral portion of the needle (Fig 2). The external portion of the needle was then laid down on the parietal thoracic wall with gauze, in sterile conditions and without being fixed on it, so to avoid the dislodgment of the needle from the lung during respiratory movements. The patient is then brought to the operating room, maintaining the position in which the procedure was performed in the radiologic theater.

Under general anesthesia (a double tracheal lumen is necessary to completely exclude the lung from ventilation), the patient is placed in a lateral decubitus position; then we proceed to a video-thoracoscopic resection of the nodule, using only two incisions (one for the thoracoscope and one for the stapler). The lung resection is always obtained using thoracoscopic staplers (EndoGIA 45; Ethicon; Rome, Italy), with a mean of three to five reloads (Fig 3).

**Results**

Written informed consent was obtained from all patients. All the nodules were adequately identified...
thanks to the accurate location of the spiral needle in close proximity to the lesion. There were no cases of dislodgment of the needle during the transport of the patients to the operating room, or during surgical maneuvers. Only two small pneumothoraces were identified during the positioning of the wire needle, but they caused neither lung collapse nor any problem with the anesthesiologic or surgical procedures, due to the firm anchorage of the wire needle in the lung parenchyma. The average time between the end of the procedure and the incision in the operating room was 45 min (range, 30 to 70 min). The presence of the intrapulmonary spiral needle allowed us to place tension on the lung parenchyma, which had been previously excluded from ventilation; the traction exerted on the external portion of the needle facilitates identification of the lesion inside the parenchyma and exposes the portion of the lung to be resected to the stapler.

We performed seven left and six right thoracoscopies. Instead of the classic three skin incisions for surgical lung resections, in 10 patients we required only two incisions (one for the thoracoscope and one for the stapler), due to the firm and stable anchorage

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Diagnosis</th>
<th>Diameter of Nodule, cm</th>
<th>Distance of Nodule to Visceral Pleura, cm</th>
<th>Side</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Previous cancer penis</td>
<td>0.8</td>
<td>1</td>
<td>RLL</td>
<td>Anthracotic nodule</td>
</tr>
<tr>
<td>2</td>
<td>Previous cancer uterus</td>
<td>2</td>
<td>2</td>
<td>LLL</td>
<td>Primary lung cancer</td>
</tr>
<tr>
<td>3</td>
<td>Bilateral nodules in prostatic PNET</td>
<td>1</td>
<td>2</td>
<td>LLL</td>
<td>PNET</td>
</tr>
<tr>
<td>4</td>
<td>Solitary nodule</td>
<td>1</td>
<td>2</td>
<td>LLL</td>
<td>Hamartoma</td>
</tr>
<tr>
<td>5</td>
<td>Incidental bilateral nodules</td>
<td>0.5</td>
<td>1</td>
<td>RLL</td>
<td>Anthracotic nodule</td>
</tr>
<tr>
<td>6</td>
<td>Contralateral mass</td>
<td>0.5</td>
<td>0.5</td>
<td>RUL</td>
<td>Metastasis of lung cancer</td>
</tr>
<tr>
<td>7</td>
<td>Previous ductal cancer</td>
<td>0.6</td>
<td>1</td>
<td>RLL</td>
<td>Primary lung cancer</td>
</tr>
<tr>
<td>8</td>
<td>Solitary nodule</td>
<td>0.6</td>
<td>1.5</td>
<td>LLL</td>
<td>Anthracotic nodule</td>
</tr>
<tr>
<td>9</td>
<td>Previous lung cancer</td>
<td>1</td>
<td>1.5</td>
<td>LLL</td>
<td>Relapse of lung cancer</td>
</tr>
<tr>
<td>10</td>
<td>Ocular metastasis of unknown origin</td>
<td>0.9</td>
<td>1.5</td>
<td>RUL</td>
<td>Primary lung cancer</td>
</tr>
<tr>
<td>11</td>
<td>Solitary nodule</td>
<td>1.5</td>
<td>1</td>
<td>ML</td>
<td>Hamartoma</td>
</tr>
<tr>
<td>12</td>
<td>Solitary nodule in colon cancer</td>
<td>0.3</td>
<td>1.5</td>
<td>LLL</td>
<td>Metastatic lesion</td>
</tr>
<tr>
<td>13</td>
<td>Bilateral nodules in resected colon cancer</td>
<td>1.5</td>
<td>1</td>
<td>LUL</td>
<td>Metastatic lesion</td>
</tr>
</tbody>
</table>

*RLL = right lower lobe; LLL = left lower lobe; RUL = right upper lobe; ML = middle lobe; LUL = left upper lobe; PNET = primitive neuroectodermal tumor.

Figure 2. Left: The CT scan shows the lesion and the introducer needle inserted through the thoracic wall (its tip has reaches the area surrounding the nodule). Right: The spiral wire needle has been pushed forward to reach the lesion.
of the spiral needle. In three patients, we had to use a third access because of strong adhesions and for the extremely dorsal position of the lesions. After lung resection, we cut the needle inside the thoracic cavity to ensure sterility and to facilitate the extraction of the resected lung. In all suspected cancer cases, we use an endobag for the extraction of the resected lung from the thoracic cavity to avoid dissemination of malignant cells.

All resected cases were examined by frozen section. The average volume of the resected lung was $5 \times 5$ cm (range, $6 \times 2$ cm). The average diameter of the nodules was $0.7$ cm (range, 0.3 to 2 cm), with a margin free parenchyma of $>0.5$ cm in all cases. The frozen examination diagnosis was confirmed in all cases by definitive histologic diagnosis: one metastasis from prostatic neuroendocrine cancer, two hamartomas, three inflammatory lesions, one metastasis from contralateral adenocarcinoma, one relapse of lung cancer, two metastatic lesions from colon cancer, and three primary pulmonary adenocarcinoma (one patient had a choroid metastasis; the other two patients underwent lobectomies—these patients had a previous breast cancer and uterine carcinoma) [Table 1]. There were no operative or postoperative complications. Conversion from VATS to thoracotomies was not necessary during the diagnostic resection procedure nodules.

**DISCUSSION**

The use of the wire needle helps identify nodules in the pulmonary parenchyma that are subpleural or too small to be accurately localized by thoracic CT. This means that the nodule would be impossible to detect on simple direct thoracoscopic inspection of the lung or by palpation with the usual thoracoscopic instruments.

This technique also solves a second problem in video-thoracoscopic resection of lung nodules: the changed anatomic points of reference (preoperatively identified on CT) caused by the intentional complete collapse of the lung during the surgical procedure. The wire needle provides a precise point of reference for the placement of the trocars, through which to insert the instruments for the video-thoracoscopic lung resection.

With the help of the wire needle, it is moreover possible to evaluate the free margins of lung parenchyma, allowing a sure and complete resection with free margins in suspected malignant cases. The new method we propose provides all the advantages of those already used in thoracic surgery, but the spiral needle we use provides an added unique characteristic: stability.

The wire needle with a terminal hook is sometimes dislodged from lung parenchyma due to the low anchorage capacity of the hook. With the spiral needle placed inside the lung, it is even possible to exert traction (applied to the portion of the needle located outside the thoracic wall) on the parenchyma that surrounds the lesion. The spiral screws into the lung, making it stable and firm. This facilitates surgical maneuvers, and exposes the portion of the lung to be resected. It furthermore avoids the need for more invasive procedures.
for a third thoracoscopic access, which is usually necessary to permit the suspension of the parenchyma.

In conclusion, although our initial experience is limited, the spiral needle has been shown to be extremely useful in identifying pulmonary nodules located in the lung parenchyma that are too small to be detected by VATS inspection or to undergo biopsy. Avoiding a third thoracic access is also really advantageous for the possibility to spare a thoracoscopic access. Therefore, this method may be more widely used in the future for enhancing the accurate treatment of very small pulmonary nodules.

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