



DISCLOSURE

NO CONFLICTS OF INTEREST

INTRODUCTION (I)

- In recent years, the number of patients with small or ill-defined lung nodules has increased
- Reasons for this increasing findings on CT scan were:
 - Large use of CT scans for staging extra-thoracic malignancies
 - Use of new advanced CT scan devices
 - Large use of CT scan for coronary disease
 - Screening programs for patients at high risk for lung cancer

INTRODUCTION (II)

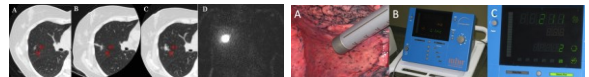
- Diagnosis of these pulmonary nodules is important because in case of lung cancer the prognosis is correlate with their size
- PET scan, transthoracic or transbronchial needle biopsy do not always allow definitive exclusion of the malignant nature of these lesions >>> surgical exeresis become necessary
- VATS is the procedure of choice for surgical biopsy and removal of peripheral lung nodules

RATIONALE

- Use of VATS can be difficult in case of small, nonsolid, or deep lung nodules because of the impossibility of localizing them by endoscopic instruments or by direct finger palpation
- Many innovative techniques have been developed to improve the intraoperative identification of these pulmonary lesions and achieving an adequate surgical resection avoiding thoracotomy:
 - wire hook, dye, and coil markers
 - radiopaque markers using intraoperative fluoroscopy
 - intraoperative US guidance
 - navigational bronchoscopy

BACKGROUND

- In recent years, a new method for increasing the intraoperative identification and resection of small lung nodules has been reported:
 - preoperative percutaneous placement of a ^{99}Tc radiotracer in or near the lung lesion under CT guidance with subsequent surgical localization by use of an endoscopic radio probe



Chella A, et al. *Eur J Cardiothorac Surg* 2000;18:17-21
Grogan EL, et al. *Ann Thorac Surg* 2008;85:5772-7

Bellomi M, et al. *Surg Endosc* 2010;90:1759-65
Galetta D, et al. *Ann Thorac Surg* 2015;100:1175-80

TECHNICAL EVOLUTION

- Chella: used CT-guided percutaneous placement of ^{99}Tc in or near the small lung nodule
- Grogan: used $^{99\text{m}}\text{Tc}$ macro-aggregated albumin (MAA) that stayed localized in lung parenchyma for up to 18 hours
- Bellomi and Galetta: used $^{99\text{m}}\text{Tc}$ MAA together with 0.1 to 0.15 mL nonionic iodinated contrast medium to define and visualize on CT scan and scintigraphy the marked area

OBJECTIVE

To evaluate the results of a consolidated experience in terms of feasibility, safety, and efficacy of the procedure of preoperative CT-guided radiotracer localization followed by resection of small or indistinct pulmonary lesions

METHODS

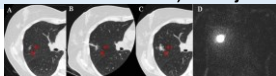
- We reviewed our prospective database and we selected the medical records of all patients who underwent radiotracer injection followed by localization with gamma probe and surgical resection between November 2007 and December 2017
- Clinical, radiological, and surgical data were reviewed and analyzed

Patients Selection

- Patients were enrolled both from the Division of Thoracic Surgery and from a concurrent lung cancer screening program
- Patients were selected for radiotracer in case of difficult in thoroscopically locating their nodules:
 - Nodule <1cm
 - Radiological characteristics (GGO, subsolid morphology)
 - Distance from the pleura was >1cm
- We excluded patients in which more than 1 nodule was localized during the same setting

INJECTION TECHNIQUE

- The undetermined pulmonary nodules were localized by ^{99m}Tc -MAA almost 24 hours before surgery (usually in the morning or previous afternoon)
- Patients underwent a limited chest CT without contrast medium to confirm nodule localization
- The correct placement of the tip of the needle in or near the nodule was verified by 12-20 CT slides and the solution (^{99m}Tc -MAA and non ionic iodinate contrast medium) was injected



SURGICAL TECHNIQUE

- General anesthesia; single-lung ventilation, lateral decubitus
- Camera was introduced VII i.c.s.; a second thoracoscopic incision or utility thoracotomy in IV-V i.c. s. for introduction of gamma probe
- The identification of the nodule was based on the maximum signal intensity by both a numeric and acoustic signal
- This area was grasped, confirmed by the probe, and resected



CLINICAL and RADIOLOGICAL CHARACTERISTICS

Variable	Number
Patient population	262
Male/Female	176/86
Median age (range)	63 years (35-79)
Mean nodule size (range)	9.3 mm (2.5-30)
Mean pleural distance (range)	10 mm (0-40)
Nodule morphology (%)	
Non-solid	166 (63.4%)
Partially solid	64 (24.4%)
Solid	32 (12.2%)
Radiological complications	63 (24%)
Asymptomatic pneumothorax	25 (9.6%)
Pneumothorax with/without	36 (13.7%)
Mild allergic reaction to c.m.	2 (0.7%)
Radiotracer confirmation at scintigraphy	
Correct	240 (91.6%)
Extracavitary	14 (5.4%)

SURGICAL and PATHOLOGICAL CHARACTERISTICS

Variable	Number
Patient population	262
Time of the surgical resection	
Same day of injection	105 (40.1%)
Day after injection	157 (59.9%)
Pulmonary resection technique	
Thoracoscopy	212 (80.9%)
Intentional Thoracotomy	42 (16.0%)
Converted Thoracoscopy	8 (3.1%)
Histology (%)	
Benign	16 (6.1%)
Malignant	246 (93.9%)
Primary lung cancer	218 (83.2%)
Metastasis	28 (10.7%)

PROCEDURAL LIMITATIONS

- Inherent risk of pneumothorax during percutaneous radiotracer injection
- Risk of allergic reactions due to the use of iodinate contrast medium

CONCLUSIONS

- According to our experience, preoperative radiotracer localization of small or indistinct pulmonary lesions is simple and feasible, and with a high rate of success of detection both with thoracoscopy and thoracotomy
- This technique appears safe and effective, as evidenced by the acceptable rate of minor adverse events after the radiotracer injection, and by the high rate of malignancy in resected nodules

