Localizing small pulmonary nodules for resection

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There seems to be increasing interest by caregivers and patients to rapidly diagnose the etiology of small pulmonary nodules (eg., suspected metastases, fungal infiltrates or PTLD). Lesions > 1 cm and those abutting or near to the pleural surface are usually amenable to transthoracic image-guided core or fine needle aspiration (FNA) biopsy. Small and deeply located nodules have in the past required open thoracotomy and lobectomy for diagnosis since the lesions could not be identified by inspection or palpation because they are generally not palpable and they do not distort the lung or pleural surface. In order to assist diagnosis and surgical resection, a nodule can be localized for removal using a minimally invasive approach. A Kopans Breast Lesion Localization Needle (Cook Inc., Bloomington, Indiana) is an excellent tool along with sterile 1% methylene blue (Akorn, Inc., Lake Forest, Illinois) (Figure 1) to visually identify the location of the nodule so that it can be precisely removed thoroscopically. This approach will minimize the amount of tissue removed while maximizing the probability of successfully obtaining the target nodule for histologic diagnosis. The redundant use of methylene blue (MB) in addition to the localization needle, is to ensure that the location of the nodule is identifiable, even if the Kopans wire is dislodged prior to or during the video-assisted thoracoscopic procedure.

**TECHNIQUE**

Preoperatively, high-resolution CT is the method of choice and is used for diagnostic confirmation and route. The procedure is performed under general anesthesia (GA) and the patient is transported to the operating room (OR) directly from the IR suite after needle localization of the pulmonary nodule. Rapid transport to the OR decreases the likelihood of migration of the localization wire and diffusion of the methylene blue. Although a pneumothorax may occur, it is uncommon for it to become symptomatic. If it does become problematic, needle aspiration may be performed with chest tube placement, only required in rare cases.
and then marking with washable ink when cone beam CT with fluoroscopic overlay is utilized. The chest wall is prepared and draped in sterile fashion and 1% lidocaine is slowly injected into the skin at the pre-determined entry site. The “fish hook” localization wire is removed from the needle and the tip submerged in methylene blue (Figure 1). The wire is then reinserted into the Kopans needle, with the tip of the wire positioned at the tip of the needle. Methylene blue dye is an important backup to the hooked wire since the Kopans localization needle is inserted so that the tip is adjacent to and 1-5 mm deep to the nodule (Figure 2). The guide needle is removed after the localization needle is prepped, the dermatotomy is made. Using CT-guidance with the previously determined depth and angle, the Kopans localization needle is inserted into the skin at the pre-determined entry site. The “fish hook” localization wire is removed from the needle since the child is immediately transported to the OR for thoracoscopic removal of the nodule (and Kopans wire). Keep in mind that methylene blue stains skin and clothing and will not readily wash off.

Post-procedural care is provided by the anesthesia and surgical services since the child is immediately transported to the OR for video-assisted thoracoscopic resection of the nodule(s) and Kopans wire. It is important to communicate the position of the wire tip in relation to the nodule to the surgeon, and to advise the anesthesiologist of the potential for pneumothorax following the localization procedure.

In our experience, small asymptomatic pneumothorax (PT) commonly occurs. In most children, the PT is not under tension and does not cause difficulty in either oxygenating or ventilating the child. Although possible, neither pulmonary infection nor empyema has occurred in our patients. Self-limited pulmonary hemorrhage may move or obscure the nodule if this is not achieved. The child is then moved to the stretcher and immediately transported to the OR for thoracoscopic removal of the nodule. Keep in mind that methylene blue stains skin and clothing and will not readily wash off.

CONCLUSION

In conclusion, CT-guided pulmonary nodule localization and marking is a safe technique in children, with a high diagnostic yield and a low complication rate following thoracoscopic resection. Such a minimally invasive alternative to open thoracotomy is emblematic of the successful collaboration possible between surgical and interventional services.

REFERENCES