

Technical Notes

Localization of Small Pulmonary Nodules for Thoracoscopic Resection: Use of a Newly Developed Hookwire System

Susumu Kanazawa,¹ Akio Ando,² Kotaro Yasui,¹ Akio Tanaka,¹ Yoshio Hiraki¹

¹Department of Radiology, Okayama University, Medical School, 2-5-1, Shikatacho, Okayama, 700, Japan

²Second Department of Surgery, Okayama University, Medical School, 2-5-1, Shikatacho, Okayama, 700, Japan

Abstract

We developed a stainless steel spring hookwire, 0.28 mm in diameter and 10 mm in length, with a 30-cm-long, 5-0 nylon monofilament suture firmly attached to its funnel-shaped end. A 21-gauge, 10-cm-long cannula was used as an introducer, and a 24-gauge, 10-cm-long blunt-pointed needle as a pusher. The hookwire was successfully placed into the target pulmonary parenchyma under computed tomography guidance in two patients with a small pulmonary nodule. The attached string served as a clear guide at thoracoscopy. Flexibility of the exposed suture through the skin eased wire management after placement. No wire dislodgement occurred.

Key words: Computed tomography—Guidance—Lung biopsy—Lung nodule—Lung neoplasms, surgery

Recent advances in thoracoscopic techniques and equipment have allowed minimally invasive resection of pulmonary nodules [1–3]. However, preoperative localization of a pulmonary nodule is sometimes necessary if the target nodule is too small or too far from the pleural surface to be detected by thoracoscopy. Use of a conventional mammographic needle/wire localization system has been reported as preoperative localization [4–6]. Although the results were generally satisfactory, problems, including wire dislodgement and inadequate wire placement, were encountered [4, 6]. We developed a new hookwire system in order to resolve those kinds of problems and wish to report its application in two patients.

Materials and Methods

The two patients were a 30-year-old woman with a solitary pulmonary nodule 8 mm in diameter and 18 mm from the pleural surface, and a 58-year-old man with a 10-mm pulmonary nodule 12 mm from the pleural surface.

The new stainless steel hookwire (manufactured in cooperation with Akiyama Medical, Tokyo, Japan) was 0.28 mm in diameter and 10 mm long, with a hook angle of about 30° and a 7-mm-long distal limb (Fig. 1). A 30-cm-long, 5-0 nylon monofilament suture was firmly attached to the funnel-shaped proximal end of the wire with an adhesive agent. A 21-gauge, 10-cm-long percutaneous transhepatic cholangiography needle (Hakko, Tokyo, Japan) was used as an introducer needle for the hookwire, and a 24-gauge, 10-cm-long, blunt-pointed needle (manufactured in cooperation with Hakko) was used as a pusher.

The target nodule was located by axial computed tomography (CT) scan using 5-mm collimation. Both patients were placed on the CT table in supine position which allowed the shortest possible direct access route for needle placement. The introducer needle was advanced to place the tip within 1–2 cm of the peripheral pulmonary nodule with CT guidance. The optimal placement of the needle tip was confirmed by CT scanning; then the stylet was removed. Following insertion of the hookwire into the introducer needle, the pusher needle, through which the attached suture of the wire was threaded, was advanced into the introducer needle. Once a CT scan showed the wire just pushed out through the introducer needle (Fig. 2A), both the introducer and pusher needles were withdrawn. The attached suture passed through the pleural space and chest wall to the skin. The skin entry site of the suture and the suture itself were covered with sterile gauze. Another CT scan was obtained to confirm the location of the wire (Fig. 2B). The patient was then taken to the operating room for thoracoscopic resection. The suture was used as a guide to the lesion at thoracoscopy.

Results

The newly developed localization wire was successfully placed within 1 cm of the pulmonary nodule in each of the two patients. The procedure lasted approximately 30 min, and was well tolerated by the patients. No pneumothorax was observed during the procedure. The wire had not become dislodged from the lung parenchyma by the time thoracoscopy was performed.

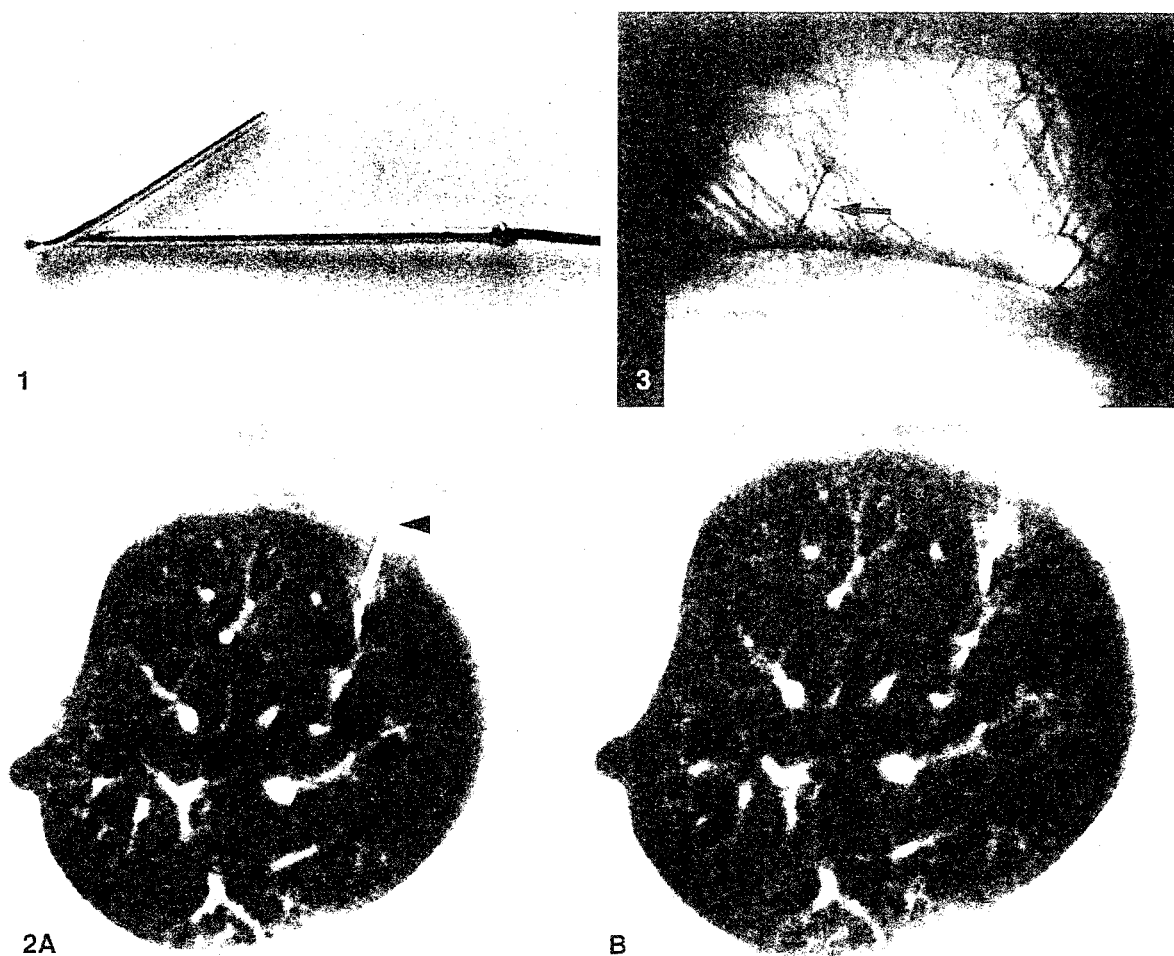


Fig. 1. Magnified photograph of the newly developed hookwire. A 5-0 monofilament nylon suture is firmly attached to the funnel-shaped proximal end.

Fig. 2. A 30-year-old woman with an 8-mm nodule in the left upper lobe. **A** CT scan shows the hookwire (arrow) just pushed out through

the introducer needle (arrowhead). Dye, infused before wire placement, is also depicted. **B** After the needles were withdrawn, the wire (arrow) is accurately placed in the lung.

Fig. 3. Thoracoscopic view demonstrates the intrathoracic suture (arrow) from the lung surface to the chest wall as a clear guide.

The suture served as a clear guide at exploratory thoracoscopy when the involved lung was deflated in the operating room (Fig. 3). The suture tented up the desired portion of the lung and acted as a handle on which the surgeon could exert traction while resecting the specimen. Resection was successfully performed in both patients.

Discussion

Use of a conventional mammographic needle/wire localization system for peripheral pulmonary nodules is usually successful; nevertheless it seems to have two problems. Wire dislodgement is a major one. In their 14 patients Shah et al. [6] reported one patient with wire dislodgement, the cause of which was rolling of

the patient onto the exposed wire before surgery. Plunkett et al. [4] also reported two patients with wire dislodgement among their 18 patients but did not reveal the causes. To prevent dislodgement of the wire, the external end of the wire was looped and taped to the drape; the patient was positioned carefully on the stretcher before transportation [6]. Immediate transportation from the CT suite to the operating room was also recommended to decrease the possibility of wire dislodgement [5]. Despite those precautions, inflexibility of the exposed portion of the wire is inconvenient and possibly causes wire dislodgement. To overcome this disadvantage, we developed a hookwire attached to a thin nylon suture. Flexibility of the exposed suture eased management of the wire after placement. We are convinced that this flexibility helps prevent wire dislodgement after placement.

The other drawback is that more experience is needed to accurately place the conventional wire [6]. In their early experience, Shah et al. reported that the wire was sometimes advanced too much while withdrawing the needle. In our system, overshooting of the wire cannot occur because the pusher needle is as long as the introducer needle. In fact, the hookwire was pushed just out of the tip of the introducer needle and accurately placed in our patients. Furthermore, a sharp bend of the wire and little friction between the needle and the suture enabled stable positioning of the wire while the needles were withdrawn.

Other advantages of our system are that, during the thoroscopic procedure, the suture could be pulled to tent up the desired portion of the lung, acting as a handle during resection, and a guide at thoracoscopy.

Our wire system is not yet mass produced because the number of cases is not large enough. However, our results suggest that this wire system can take the place

of the conventional mammographic needle/wire system as a preoperative localization of pulmonary nodules.

References

1. Wakabayashi A (1991) Expanded application of diagnostic and therapeutic thoracoscopy. *Thorac Cardiovasc Surg* 102:721–723
2. Lewis RJ, Caccavale RJ, Sisler GE (1992) Imaged thoroscopic lung biopsy. *Chest* 102:60–62
3. Coltharp WH, Arnold JH, Alford WC (1992) Videothoracoscopy: Improved technique and expanded indication. *Ann Thorac Surg* 53:776–779
4. Plunkett MB, Peterson MS, Landreneau RJ, Ferson PF, Posner MC (1992) Peripheral pulmonary nodules: Preoperative percutaneous needle localization with CT guidance. *Radiology* 185:274–276
5. Templeton PA, Krasna M (1993) Localization of pulmonary nodules for thoroscopic resection: Use of needle/wire breast-biopsy system. *AJR* 160:761–762
6. Shah RM, Spirn PW, Salazar AM, Steiner RM, Cohn HE, Solit RW, Wechsler RJ, Erdman S (1993) Localization of peripheral pulmonary nodules for thoroscopic excision: Value of CT-guided wire placement. *AJR* 161:279–283