Journal of Medical Radiation Sciences

Open Access

CASE STUDY

Radio-guided occult lesion localisation using iodine 125 Seeds "ROLLIS" to guide surgical removal of an impalpable posterior chest wall melanoma metastasis

Shashini Dissanayake, BMedSc, MBBS,[1] Deepthi Dissanayake, MBBS, FRANZCR, [2] & Donna B. Taylor, MBBS, RANZCR, FRACP(C)[2,3]

[1]Western Hospital, Footscray, Victoria, Australia
[2]Royal Perth Hospital Perth, Perth, Western Australia, Australia
[3]School of Surgery, University of Western Australia, Crawley, Western Australia, Australia

Keywords
Radioactive seed localisation, radio-guided surgery, iodine-125, iodine seed localisation

Correspondence
Donna Blanche Taylor, Radiology, Royal Perth Hospital, Wellington St, Perth, Western Australia 6000, Australia.
Tel: +61 8 9224 2126; Fax: +61 8 9224 2912;
E-mail: donna.taylor@health.wa.gov.au

Funding Information
Dr Taylor is currently supported by a Sylvia and Harold Rowell Clinician Research Fellowship from the Medical Research Foundation of Royal Perth Hospital.

Received: 22 March 2015; Revised: 28 June 2015; Accepted: 10 July 2015

J Med Radiat Sci **62** (2015) 230–233

doi: 10.1002/jmrs.125

Abstract

Cancer screening and surveillance programmes and the use of sophisticated imaging tools such as positron emission tomography-computed tomography (PET-CT) have increased the detection of impalpable lesions requiring imaging guidance for excision. A new technique involves intra-lesional insertion of a low-activity iodine-125 (^{125}I) seed and detection of the radioactive signal in theatre using a hand-held gamma probe to guide surgery. Whilst several studies describe using this method to guide the removal of impalpable breast lesions, only a handful of publications report its use to guide excision of lesions outside the breast. We describe a case in which radio-guided occult lesion localisation using an iodine 125 seed was used to guide excision of an impalpable posterior chest wall metastasis detected on PET-CT.

Introduction

Methods to guide excision of impalpable lesions include hook-wire insertion (HWL), intra-operative ultrasound (IOUS) and radio-guided occult lesion localisation (ROLL) using the injection of ^{99m}Tc-labelled colloidal human serum albumin.[1] A new technique, ROLL using ^{125}I Seeds (ROLLIS) offers many advantages[2] as illustrated in this report. Written permission was obtained from the patient to use their information for this publication.

Case Report

A surveillance F-18 fludeoxyglucose positron emission tomography/computed tomography (FDG PET/CT) scan in a 59-year-old female with a history of metastatic melanoma showed intense uptake within a 3 × 4 mm subcutaneous nodule on the left posterior chest wall (Fig. 1A and B). A previous history of excision of metastatic deposits elsewhere was noted. Clinical exam was normal. Ultrasound (US) showed an oval-shaped well defined hypoechoic vascular mass (Fig. 2).

On the morning of surgery an ^{125}I seed (~2 MBq) was inserted using US (Fig. 3A, B and C). In theatre, the surgeon used a hand-held gamma probe, set to detect the energy from the 27 keV photon emitted by the ^{125}I seed to locate and remove the lesion. Successful removal of seed and lesion was confirmed by absent radioactive counts in the wound, high counts within the specimen and visualisation of the lesion and seed on X-ray

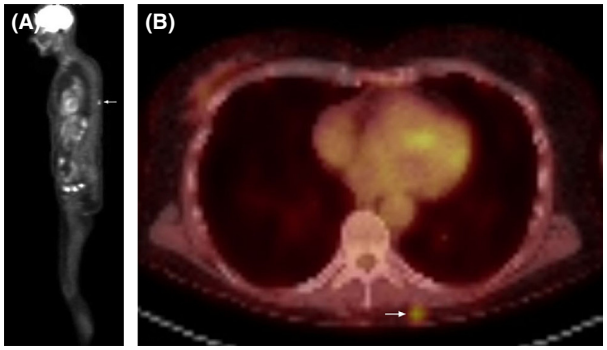

Figure 1. (A) and (B) Whole-body F-18 fludeoxyglucose positron emission tomography/computed tomography (FDG PET/CT) scan shows focus of intense uptake in the left posterior chest wall (arrow).

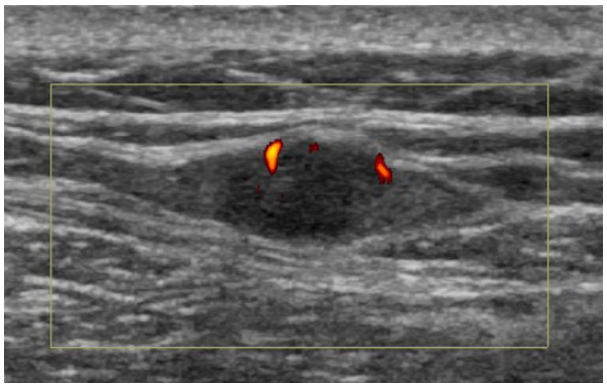

Figure 2. Ultrasound scan of the chest wall shows the hypoechoic lesion with vascularity.

(Fig. 4A). Following tissue fixation, a further grid specimen radiograph (Fig. 4B) demonstrated lesion and seed co-ordinates for the pathologist. Histopathology showed a 6 mm melanoma deposit with negative tumour margins. A follow-up F-18 FDG PET/CT scan showed only faint uptake in the surgical bed consistent with post-operative change (Fig. 5A and B).

Discussion

In parallel with the increasing detection of impalpable breast lesions with screening mammography, the development and increasing use of sophisticated imaging techniques (such as F-18 FDG PET/CT) has led to earlier detection of small lesions in other parts of the body, some of which require pre-operative image-guided localisation for excision. Various methods of doing this have been described, including the use of HWL of pulmonary nodules, musculoskeletal, retroperitoneal and liver lesions[3–6] and ROLL to mark recurrent renal cell carcinoma, papillary carcinoma of the thyroid, retroperitoneal sarcoma, lesions of the popliteal fossa and recurrent thigh rhabdomyosarcoma.[7]

In general, HWL is the most commonly used technique but has been associated with complications including movement of the wire after insertion and wire transection during surgery.[8] Because the wire extends outside the skin, the localisation procedure must be performed on the day of surgery. This makes the surgical and radiology lists interdependent with delays or cancellations in either department inevitably reducing efficient use of resources. For lesions in difficult locations (such as in our patient) the presence of a hook-wire may also be physically awkward and uncomfortable.

Intra-operative ultrasound is being increasingly used by surgeons to guide lesion removal. The great advantages are that this eliminates the need for a separate pre-operative localisation procedure, does not expose the patient or staff to ionising radiation and gives real-time three-dimensional feedback during surgery. However, to use IOUS the lesion must be sonographically visible and US equipment and a suitably trained surgeon available.

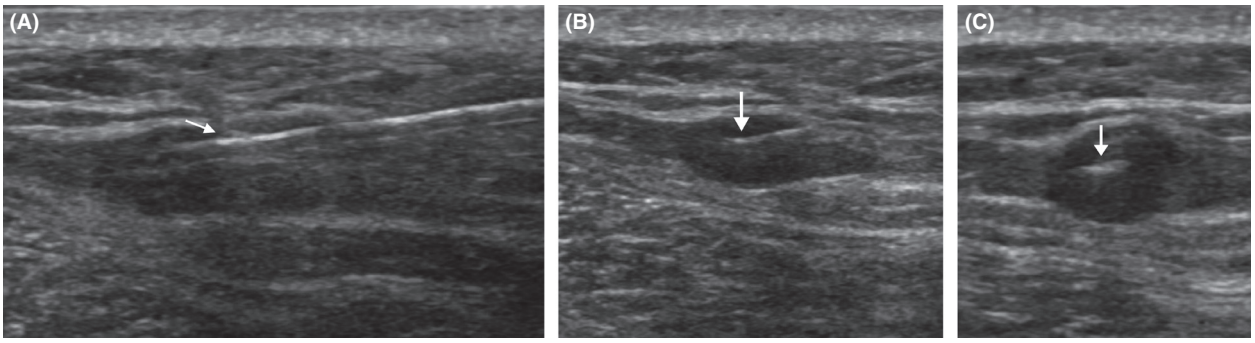

Figure 3. Ultrasound guided seed insertion (A) Long-axis view showing seed deployment needle (arrow) within a hypoechoic posterior chest wall mass corresponding to the lesion seen on the PET-CT study. (B) Long-axis and (C) short-axis views of the lesion taken immediately after seed deployment. The seed is seen as a linear echogenic structure (arrow).

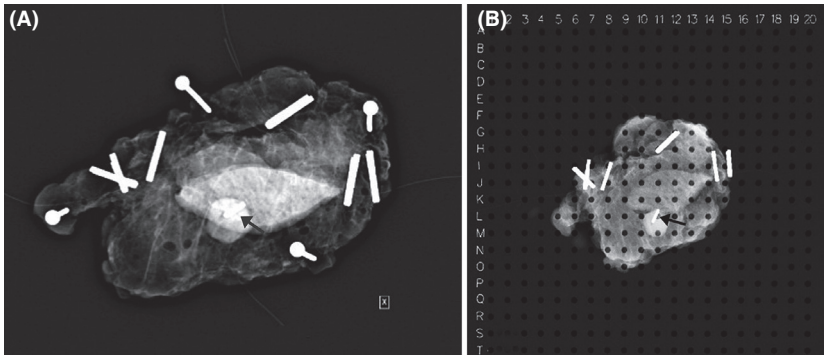

Figure 4. (A) Intra-operative specimen radiograph confirms excision of lesion with seed in situ (arrow). (B) X-ray of specimen in a grid following tissue fixation in formalin shows the co-ordinates for the lesion and ^{125}I Seed (arrow).

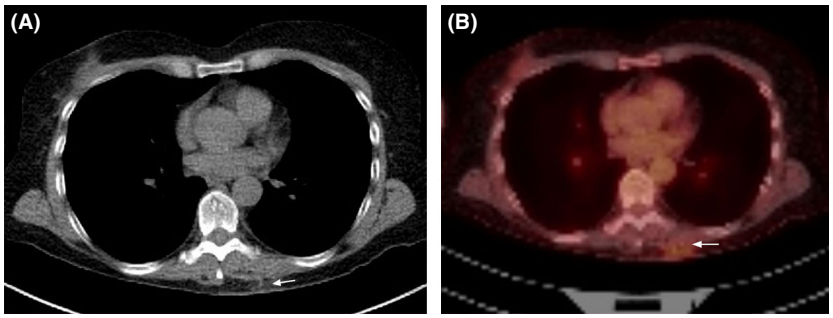

Figure 5. Post-operative (A) CT and (B) F-18 fludeoxyglucose positron emission tomography/computed tomography (FDG PET/CT) images taken at the same slice position. The previous focus of intense tracer uptake is no longer seen. There is minimal uptake in the surgical bed consistent with post-operative change (arrow).

Radio-guided techniques such as ROLL have been effectively used for breast and non-breast lesions.[7,9] As with the use of hook-wires, however, the insertion procedure must be performed within 24 h of surgery due to the short half-life of ^{99m}Tc (6 h). The inherently non-radio-opaque nature of ^{99m}Tc labelled colloids also means that confirming accuracy of placement of the injection is difficult unless a contrast agent or marker clip is also used.[10]

^{125}I seeds are radiopaque 4.5 × 0.8 mm titanium cylinders containing approximately 2 MBq of iodine-125 adsorbed onto a silver wire. Because they are solid and radiopaque, accuracy of placement can easily be confirmed using US, X-ray or CT. Experience with ROLLIS to localise impalpable breast lesions has shown that ^{125}I seeds rarely migrate.[11] The seed acts as a point source of radio-activity, giving precise real-time feedback as to the location of the lesion in three dimensions.[12] All of this helps to make surgery easier.

^{125}I has a physical half-life of 60.14 days, which means the seed can be inserted several days (and in the case of patients undergoing neoadjuvant chemotherapy many months)[13] before surgery. This has been shown to improve the utilisation of radiology resources,[14] theatre lists,[15] and patient convenience.[16] The radiation exposure to patient, family and staff from the use of ^{125}I seeds is minimal[17] however the seed is a regulated sealed source of radioactivity, therefore its whereabouts must always be tracked. To minimise the risk of seed loss, good multidisciplinary communication and a seed handling protocol are essential.

Whilst there are meta-analyses evaluating the use of ^{125}I seeds to localise breast lesions,[2,18] there are only a few reports describing the use of this technique outside the breast. Fleming et al.[19] used ROLLIS to localise a cluster of in-transit melanoma nodules in the lower leg of a 73-year-old man and Grotz et al.[20] used it in eight patients; two with in-transit melanoma metastases. Straver et al.[21] used seeds to mark malignant axillary nodes prior to neoadjuvant chemotherapy, and Jackson et al.[22] to localise a PET-positive node in a patient with an unknown primary. The use of ^{125}I seeds to guide excision of pulmonary nodules has also been trialled.[23]

In conclusion, this case report provides another example of the successful use of ROLLIS as a relatively simple and accurate method to guide the excision of an impalpable lesion, other than in the management of breast cancer.

Acknowledgements

Dr Taylor is currently supported by a Sylvia and Harold Rowell Clinician Research Fellowship from the Medical Research Foundation of Royal Perth Hospital. We thank Ms Barbara Taylor for assistance with manuscript preparation. The use ^{125}I seeds for lesion localisation in Australia currently requires TGA approval via the Special Access Scheme or within the confines of an Ethics Committee approved clinical trial.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Dua SM, Gray RJ, Keshtgar M. Strategies for localisation of impalpable breast lesions. *Breast* 2011; **20**: 246–53.
2. Ahmed M, Douek M. Radioactive seed localisation (RSL) in the treatment of non-palpable breast cancers: systematic review and meta-analysis. *Breast* 2013; **22**: 383–8.
3. Morrison WB, Sanders TG, Parsons TW, Penrod BJ. Preoperative CT-guided hookwire needle localization of musculoskeletal lesions. *Am J Roentgenol* 2001; **176**: 1531–3.
4. Kagalwala DZ, Shankar S, Zota V, Sandor A, Litwin DE. Preoperative computed tomography-guided hookwire needle localization of a peritoneal multilocular inclusion cyst. *J Comput Assist Tomogr* 2005; **29**: 602–3.
5. Sato M, Watanabe Y, Tokui K, et al. Laparoscopic hepatic surgery guided by hookwire localization. *Surg Endosc* 2000; **14**: 296.
6. Mullan BF, Stanford W, Barnhart W, Galvin JR. Lung Nodules: improved Wire for CT-guided Localization 1. *Radiology* 1999; **211**: 561–5.
7. Bitencourt AGV, Lima ENP, Pinto PNV, Martins EBL, Chojniak R. New applications of radioguided surgery in oncology. *Clinics* 2009; **64**: 397–402.
8. Bronstein AD, Kilcoyne RF, Moe RE. Complications of needle localization of foreign bodies and nonpalpable breast lesions. *Arch Surg* 1988; **123**: 775–9.
9. Sajid MS, Parampalli U, Haider Z, Bonomi R. Comparison of radioguided occult lesion localization (ROLL) and wire localization for non-palpable breast cancers: a meta-analysis. *J Surg Oncol* 2012; **105**: 852–8.
10. Landman J, Taylor D, McCarthy M, Troedson R. Is ^{99m}Tc MAA a suitable radiopharmaceutical for radioguided localisation of impalpable breast prior to surgical excision? Australian and New Zealand Society of Nuclear Medicine 42nd Annual Scientific Meeting, Melbourne, 2012.
11. Alderliesten T, Loo CE, Pengel KE, Rutgers EJ, Gilhuijs KG, Vrancken Peeters MJ. Radioactive seed localization of breast lesions: an adequate localization method without seed migration. *Breast J* 2011; **17**: 594–601.
12. Jakub JW, Gray RJ, Degnim AC, Boughey JC, Gardner M, Cox CE. Current status of radioactive seed for localization of non palpable breast lesions. *Am J Surg* 2010; **199**: 522–8.
13. van Riet YE, Maaskant AJ, Creemers GJ, et al. Identification of residual breast tumour localization after neo-adjuvant chemotherapy using a radioactive 125 Iodine seed. *Eur J Surg Oncol* 2010; **36**: 164–9.
14. Sharek D, Zuley ML, Zhang JY, Soran A, Ahrendt GM, Ganott MA. Radioactive seed localization versus wire localization for lumpectomies: a comparison of outcomes. *Am J Roentgenol* 2015; **204**: 872–7.
15. Dauer LT, Thornton C, Miodownik D, et al. Radioactive seed localization with ^{125}I for nonpalpable lesions prior to breast lumpectomy and/or excisional biopsy: methodology, safety, and experience of initial year. *Health Phys* 2013; **105**: 356–65.
16. Gray RJ, Pockaj BA, Karstaedt PJ, Roarke MC. Radioactive seed localization of nonpalpable breast lesions is better than wire localization. *Am J Surg* 2004; **188**: 377–80.
17. Pavlicek W, Walton HA, Karstaedt PJ, Gray RJ. Radiation safety with use of I-125 seeds for localization of nonpalpable breast lesions. *Acad Radiol* 2006; **13**: 909–15.
18. Pouw B, de Wit-van der Veen L, Stokkel MP, Loo CE, Vrancken Peeters MJ, Valdés Olmos RA. Heading toward radioactive seed localization in non-palpable breast cancer surgery? A meta-analysis. *J Surg Oncol* 2015; **111**: 185–91.
19. Fleming MD, Pockaj BA, Hansen AJ, Gray RJ, Patel MD. Radioactive seed localization for excision of non-palpable in-transit metastatic melanoma. *Radiol Case Rep* 2006; **1**: 54–7.
20. Grotz TE, Tortorelli CL, Degnim AC, Boughey JC, Whaley DH, Jakub JW. The use of radioactive seed localization for non-palpable non-breast lesions. *J Surg Rad* 2010; **1**: 90–5.
21. Straver ME, Loo CE, Alderliesten T, Rutgers EJ, Vrancken Peeters MT. Marking the axilla with radioactive iodine seeds (MARI procedure) may reduce the need for axillary dissection after neoadjuvant chemotherapy for breast cancer. *Br J Surg* 2009; **97**: 1226–31.
22. Jackson L, Bourke AG, Abdul Aziz F, Taylor D. Radioactive seed localisation to guide removal of impalpable lymph nodes (Radioguided Occult Lesion Localisation using Iodine-125 seeds, "ROLLIS"). *BMJ Case Rep* 2014; **2014**. doi: 10.1136/bcr-2013-203267.
23. Gobardhan P, Djamin R, Romme P, et al. The use of iodine seed (I-125) as a marker for the localisation of lung nodules in minimal invasive pulmonary surgery. *Eur J Surg Oncol* 2013; **39**: 945–50.