ORIGINAL ARTICLE

Localisation of occult breast lesion: a comparative analysis of hookwire and radioguided procedures

Tiffany YC Chu 朱曉青
CY Lui 呂振英
WK Hung 熊維嘉
SK Kei 紀紹綱
Catherine LY Choi 蔡麗賢
HS Lam 林漢城

Objectives For occult breast lesions, to retrospectively compare the performance of radioguided and hookwire methods in terms of ease of localisation and surgical procedures, and the ability to obtain a specimen with a clear margin.

Design Retrospective study.

Setting Regional hospital, Hong Kong.

Patients All patients who underwent occult breast lesion localisation by either ultrasonography- or stereotactic-guided radioguided occult lesion localisation or hookwire localisation from August 2003 to December 2007 were included.

Main outcome measures Demographic data, localisation and operation procedure time, size of specimens and margin clearance.

Results In all, 165 patients (mean age, 52 years) having these procedures were assessed. In 98 instances, the procedure (hookwire=53, radioguided=45) was for diagnostic purposes and in 67 (hookwire=23, radioguided=44) for therapy. Both techniques attained a very high success rate (>95%). For radioguided occult lesion localisation, there was a significantly shorter mean localisation time than for hookwire localisation (18 min versus 31 min; P<0.001), while the mean operating time was similar. Radioguided occult lesion localisation entailed larger specimens and fewer cases with close or involved margins, or recourse to intra-operative re-excision or a second operation, but these differences were not statistically significant. Within the radioguided occult lesion localisation group, there were 42 patients who had a simultaneous sentinel lymph node biopsy (sentinel node and occult lesion localisation), with a 98% success rate although no lymph node metastasis was revealed.

Conclusion Radioguided occult lesion localisation excels in yielding a much shorter localisation time and is as good as hookwire localisation in terms of specimen margin clearance and need for re-excision. It also offers the advantage of enabling simultaneous sentinel lymph node biopsy for invasive cancers. Therefore it is a recommended procedure that should be used more widely.

Key words
Breast neoplasms/radionuclide imaging; Breast neoplasms/surgery; Breast neoplasms/ultrasonography; Mastectomy

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Kwong Wah Hospital, Kowloon, Hong Kong:
Department of Radiology
TYC Chu, FHKCR
CY Lui, FHKAM (Radiology)
HS Lam, FHKAM (Radiology)
Department of Surgery
WK Hung, FHKAM (Surgery)
Department of Radiology, Tuen Mun Hospital, Tuen Mun, Hong Kong
SK Kei, FHKAM (Radiology)
Department of Surgery, Tung Wah Hospital, Sheung Wan, Hong Kong
CLY Choi, FHKAM (Surgery)

Correspondence to: Dr TYC Chu
Email: tiffchu@hotmail.com

Introduction

With increasing awareness of early breast cancer detection among the population, the use of mammography and breast ultrasound in screening has gained prominence in recent years. There are many population-based and opportunistic screening programmes in western countries and in Asia, which evidently perform satisfactorily.[1] As a result, small non-palpable occult breast lesions are detected with increasing frequency. These lesions are initially characterised by percutaneous biopsy. If these turn out to be malignant, in terms of being invasive or in situ, or heterogeneous (such as atypical ductal hyperplasia, radial scar, papillary lesions, or those with imaging-pathologic discordance), diagnostic or therapeutic surgical excision becomes warranted. It is then necessary to accurately localise such occult breast lesions, with the aim to excise the smallest amount of breast tissue and yet remove the entire lesion whilst achieving adequate clear margins.

Hookwire localisation (HWL) has been the gold standard for many years.[2] More recently, radioguided occult lesion localisation (ROLL) has been gaining popularity. In our centre, ROLL was introduced in 2005 and entirely replaced HWL a year later. We designed

乳腺隱性病灶定位：導絲引導法與放射引導法的比較分析

目的 從定位的難易、手術處理、取得邊界清晰的樣本三方面，比較放射引導定位法和導絲引導定位法。

設計 回顧研究。

安排 香港一所分區醫院。

患者 2003年8月至2007年12月，曾接受以下其中一種乳腺隱性病灶定位術的所有病人：超聲定向放射引導法、立體定向放射引導法或導絲引導法。

主要結果測量 人口統計數據、定位和手術所需時間、腫塊樣本大小、樣本邊界清晰程度。

結果 本研究共評估165位接受上述手術的病人。病人平均年齡52歲。當中98宗手術旨在斷症（導絲引導佔53宗，放射引導佔45宗），67宗手術屬治療（導絲引導佔23宗，放射引導佔44宗）。兩種定位技術的成功率同樣高（>95%）。採用放射引導法定位，所需平均時間明顯地比導絲引導法短（18分鐘比31分鐘；P<0.001），而手術平均時間則相若。放射引導法可取得較大的腫塊樣本，而邊界接近腫塊或在腫塊以內的情況較少，在手術中作再次切除或要進行第二次手術的個案也較少，但兩種方法之間的差異並不顯著。在放射引導法一組中，42位病人接受即時乳腺癌前哨淋巴結活檢，成功率達98%，並無發現癌細胞淋巴腺轉移。

結論 放射引導法是優秀的乳腺隱性病灶定位法，定位時間大幅減少，而取得邊界清晰的樣本及需要再切除腫塊的情況，和導絲引導法同樣良好，而且還可即時為病人作乳腺癌前哨淋巴結活檢。因此，建議在為病人作乳腺隱性病灶定位時，應增加採用放射引導法。

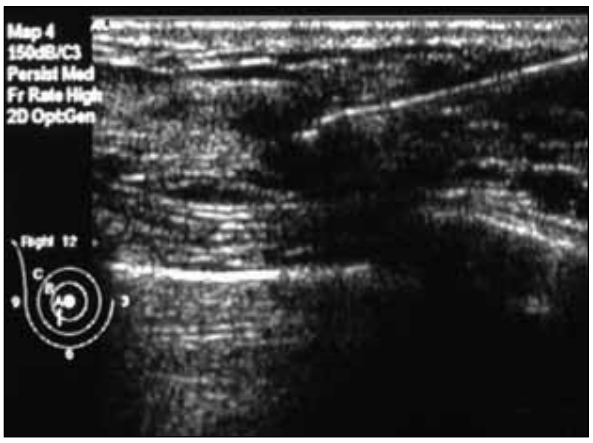

FIG 1. Ultrasound-guided radioguided occult lesion localisation performed with needle tip inserted into the lesion
Syringe containing radioisotope would be connected and injected

A video of radioguided occult lesion localisation is available at <www.hkmj.org>.

a retrospective study to compare the performance of HWL and ROLL procedures, in terms of ease of localisation and subsequent surgery, and the ability to achieve a clear margin so as to avoid intra-operative re-excision or second operations.

Methods

From August 2003 to December 2007, all patients undergoing occult breast lesion localisation procedures (under ultrasound or stereotactic guidance) were assessed. They were carried out with either a diagnostic or therapeutic intent. For patients in whom previous biopsy did not yield a definite diagnosis or there was radiological-pathological discordance, excision with a diagnostic intent was performed. If previous biopsy yielded malignancy, wide local excision with a therapeutic intent was performed. All these procedures were carried out on the same day as any surgery by radiologists specialised in breast imaging.

For HWL, a wire (Echo-Coat; STS Biopolymers, Henrietta [NY], US) was inserted with local anaesthesia under ultrasound or stereotactic guidance. Usually the shortest route was chosen. The position of the guidewire was confirmed radiologically and additional wires were inserted if localisation was unsatisfactory. Post-procedural mammography was performed and the wire then taped to avoid migration. When surgery was performed, the wire was cut a few centimetres from the skin entry site. Skin incision was centred over the tip of wire, which was mapped with post-insertion films, rather than by resorting to the skin entry site. Using a diathermy, a skin flap was elevated and the subcutaneous fat above the breast parenchyma was dissected. The lesion was then removed surgically and a specimen mammogram obtained. Further excision was performed if the latter did not contain the index lesion or the margin was deemed inadequate.

For ROLL, the radioisotope used in our centre was 0.2 mL 0.5 mCi Technetium (Tc)-99m labelled sulphur colloid, with particle size of 100 to 200 nanometres. The lesion was targeted under ultrasound or by stereotactic guidance, and a 22G needle was inserted into its centre. The position of the needle tip was confirmed, the radioisotope syringe connected and the tracers injected (Figs 1 and 2). There was no recourse to scintigraphy or additional mammography. The patient was operated on within 4 to 6 hours. The surgeon marked the breast lesion with a hand-held gamma probe and later excised it; subsequently the surgical bed was checked for any residual radioactivity. Further surgical exploration was feasible if residual activity remained high or appeared indicated based on the results of the specimen radiograph/ultrasound.

For all patients who underwent these localisation procedures, relevant information was

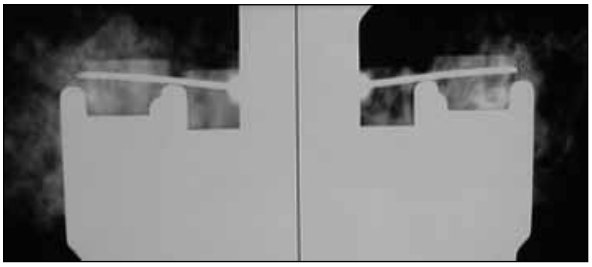

FIG 2. Lesion is identified on a pair image in the course of stereotactic radioguided occult lesion localisation
The position of the needle tip is confirmed and then the radio-isotope can be injected

retrieved from the patient records and radiology reports. This included demographic data, results of imaging and previous biopsies, the localisation procedure time and its technical success, the operating time, the size of respective specimens and the extent of margin clearance. In addition, any resort to intra-operative re-excision or second operation was also documented.

Localisation time was defined as the interval from the beginning of the procedure until the wound was dressed and the patient readied for discharge from the lesion localisation room. Technical success (in terms of satisfactory localisation) was determined by the on-duty radiologist at the end of procedure, and immediately documented in the radiology report. The operating time was defined as the interval from skin incision to skin closure and was documented in the operation record in each and every case. Specimen size was calculated as the product of all three dimensions while a clear margin was defined as more than 1 mm of margin clear of any lesional involvement.

Localisation and operating times of HWL and ROLL were compared by Student's *t* test and clear margin rates by the Fisher's exact test. A P value of 0.05 was considered significant.

Results

A total of 167 patients were identified for this analysis, but two were excluded because of insufficient data retrieval. The mean age was 51 years in the HWL group and 52 years in the ROLL group.

In all, 98 patients underwent diagnostic localisation, and in 67 cases it was for therapy. Among the procedures for diagnostic localisation, 53 had HWL and 45 entailed ROLL. For those having therapeutic procedures, 23 had HWL and 44 entailed ROLL. Of the latter 44 patients, 42 also had simultaneous sentinel node and occult lesion localisation (SNOLL).

Both procedures had a high technical success rate (HWL 99%, ROLL 97%). Regardless of intent, the mean localisation time was much shorter in those having ROLL than HWL (18 min vs 31 min; P<0.001), although the mean operating time was comparable for both procedures (HWL 52 min, ROLL 48 min; P=0.188) [Table 1].

Specimen sizes were similar in both diagnostic groups (HWL 44.5 cm^3, ROLL 50.7 cm^3; P=0.373), but for therapeutic intent they were larger in the ROLL

TABLE 1. Comparison of performances of hookwire localisation (HWL) and radioguided occult lesion localisation (ROLL)

	HWL (n=76)	ROLL (n=89)	P value
Age (years)	51	52	0.508
Success rate	75 (99%)	86 (97%)	0.625
Mean localisation time (min)			
Overall	31	18	<0.001
Diagnostic intent	29	19	<0.001
Therapeutic intent	33	17	<0.001
Mean operating time (min)	52	48	0.188
Need for further intra-operative excision	22/75 (29%)	25/86 (29%)	1.000
Involved or close margin in first specimen for malignant lesions	12/38 (32%)	9/55 (16%)	0.129; 0.071 (1-tailed)
Need for second operation for malignant lesions	12/38 (32%)	9/55 (16%)	0.129; 0.071 (1-tailed)
Size of specimen (cm^3)			
Overall	48.2	66.0	0.005
Diagnostic intent	44.5	50.7	0.373
Therapeutic intent	56.4	81.6	0.028
SNOLL* success rate	-	41/42 (98%)	-
Lymph node involvement	-	0/42 (0%)	-

* SNOLL denotes sentinel node and occult lesion localisation

TABLE 2. Summary of recent research on success rates and margin clearance of radioguided occult lesion localisation (ROLL)[7-13]

Authors	Year of publication	Success rate of ROLL	Margin clearance
Feggi et al[13]	2001	73/73 (100%)	73/73 (100%)
Gray et al[10]	2001	44/44 (100%)	33/44 (75%)
Rönkä et al[7]	2004	64/64 (100%)	60/64 (94%)
Nadeem et al[9]	2005	65/65 (100%)	54/65 (83%)
Thind et al[8]	2005	68/68 (100%)	57/68 (84%)
Monti et al[12]	2007	955/959 (99.6%)	882/955 (92%)
Lavoué et al[11]	2008	72/72 (100%)	61/72 (85%)

group (HWL 56.4 cm^3, ROLL 81.6 cm^3; P=0.028). However, there was no documentation of the original lesion size to ascertain whether the difference in specimen sizes was attributable to larger lesions in those having the ROLL procedure.

On resorting to further intra-operative excision, HWL and ROLL had performed similarly (HWL 29%, ROLL 29%). However, HWL yielded a higher rate of inadequate margin clearance (due to an involved margin or less than 1 mm from malignant tissue); for which reason more of the corresponding patients underwent re-operation (HWL 32%, ROLL 16%), although this difference was not statistically significant (P=0.129; Table 1).

In our study, 42 out of 44 patients having therapeutic ROLL procedures underwent SNOLL, in whom invasive carcinoma or high-grade ductal carcinoma in situ was diagnosed in percutaneous biopsies. All except one (98%) were technically successful. The remainder failed to localise the sentinel node and thus level-I and -II axillary dissection was performed instead. No sentinel node involvement was revealed in frozen sections and after subsequent pathological examination.

Discussion

For years, HWL has been the traditional localisation procedure in patients undergoing lumpectomy or wide local excision of clinically occult breast lesions.[2,3] Radioguided occult lesion localisation was pioneered in 1996 at the European Institute of Oncology, Milan. Inspired by the rationale for sentinel node biopsy, ROLL was carried out by injecting Tc-99m labelled isotope intra-tumourally. Particles used were large enough to be retained at the injection site, so that localisation by a gamma probe and subsequent surgical excision could be performed.[4]

Radiation safety to patient and staff in ROLL procedures has been secured. Technetium-99m has a short half-life of 6 hours and low-dose gamma radiation is used. Cremonesi et al[5] calculated the effective dose for a patient, which is 9.25 μSv, less than half the dose of a chest X-ray (0.02 mSv). Radiation due to additional mammograms needed for HWL (1-2 mSv) may exceed that involved for 100 to 200 ROLL procedures.[5] Finger doses to breast surgeons and radiologists are also minimal, as stated by Rampaul et al[6] and amount to 9.3±3.3 mSv and 0.5±0.1 mSv, respectively. For a surgeon performing 100 procedures per annum, a finger dose of 1 mSv is received, which is well below the annual limit of 150 mSv. Effectively no contamination is detected in wastes and porters receive no radiation.[6] Therefore no additional protection measures are required.

Apart from additional mammograms that may be needed and the resulting greater discomfort and higher radiation doses to patients, HWL has a number of other drawbacks. Negotiating the wire through a very dense breast can be technically difficult for radiologists. The hookwire may be imprecisely placed or even displaced in fatty breasts, which is of particular concern when a patient has to move from one centre to another for surgery. The wire can also become transacted, or even harm one of the handling staff. To the patient, the HWL procedure is more uncomfortable and cosmetically unsatisfying with wires sticking out from the breasts. The pathologist may find the wire difficult to dissect, with possible subsequent damage to the specimen. There have even been cases in which erroneously placed hookwire tips have been retained after breast surgery. Last but not least, control of the tumour margin by the surgeon appears more difficult with HWL.

Technically, our centre has very high success rates for both HWL and ROLL procedures. Similar research from elsewhere also yielded successful localisation after nearly all ROLL procedures (Table 2[7-13]). Data from a recent study indicate that both radiologists and surgeons are more at ease with ROLL than HWL procedures,[14] and patients too enjoy more subjective comfort and better postoperative cosmetic results with the former.[8]

In our study, time to localisation with ROLL was significantly shorter than with HWL procedures (18 vs 31 minutes), which is an objective indication of the ease with which the former was performed. However, the duration of the operation was not significantly shorter. Our data are analogous to those from other publications,[8-10] which also tend to corroborate the reliability of our findings.

With regard to the specimen size, ROLL is comparable to HWL when carried out with diagnostic intent, but superior when performed for therapy. These results do not concur with other western publications, which showed ROLL to result in reduced excision volume because of better lesion centring.[9,10,14] When compared with conservative breast surgery (where no localisation is required), ROLL

is similar in terms of specimen size with respect to tumour dimensions and attainment of a clear margin.[7] The discrepancy we encountered could be partially explained by the lack of available data regarding the original size of the lesions in our retrospective study, and it is unclear whether this could have impacted specimen size. Therefore the seemingly lower rate of second operations in the ROLL group could be explained either by larger resection margins around bigger tumour specimens, or due to the method itself. As this was a retrospective study, there were no data regarding patient satisfaction (including subjective cosmetic outcomes) with the two procedures.

Many studies have reported good margin clearance with ROLL, which ranged from 75 to 100% (Table 2). In a recent publication, the free margin clearance rate was 84% after ROLL compared with 60% after HWL.[8] In our study, the clear margin percentage of 84% was similar to that detailed in other publications. Our results also showed ROLL to be at least comparable, if not superior to HWL, in terms of margin clearance and need for second operations.

Sentinel node localisation can be performed together with ROLL. Filtered Tc-99m labelled sulphur colloid with a particle size of smaller than 100 nanometers is injected instead. Tracers flow via the lymphatics and accumulate in the sentinel nodes. Subsequent scintigraphy can be performed as usual. The application of a radioisotope in SNOLL has revolutionised the original two-step procedure into one with very promising results. This was shown in our study (success rate, 97%), as well as in other research reporting success rates of 90% to nearly 100%.[11,12]

No matter how well ROLL can be performed, it cannot entirely replace HWL for large lesions. Problems have also been encountered with ROLL used for stereotactic-guided procedures, in which minor errors in depth (z axis) can result in inaccurate injections of isotope in a compressed breast. This is a particular concern with very thin breasts, in which the tracers could end up in a different quadrant after the breasts are released. Ductal migration of isotope is an uncommon problem with ROLL. It occurred in 4% of patients in a Nottingham study,[15] but to our knowledge there is no other similar report. In our centre, localisation was less accurate for lesions near the nipple, also possibly due to ductal migration of tracers. Another constraint is the timing of surgery, which has to be performed within 4 hours of ROLL completion, lest the tracer count is not high enough to enable accurate gamma probe–guided excision. Therefore, the wire technique is still needed whenever isotope localisation fails.

Our study had several limitations. It was a retrospective study and did not entail randomisation. There was no reliable measurement of the original lesion size, particularly the area of microcalcification in the mammograms. Nor could we obtain data regarding the relative acceptance of the techniques from the perspective of patients. In addition, HWL and ROLL were performed in two different timeframes; with experience radiologists and surgeons are more likely to perform better in later timeframes. Also as our hospital was both a service and training centre, localisations were carried out by different radiologists with variable amounts of experience (eg breast radiologists in-training to consultants with over 20 years of experience). Yet a high standard was maintained for these procedures, due to cautious monitoring, dedicated supervision, and positive feedback from the surgical colleagues. Whilst access to radioguided localisation may also be a limitation, we expect the technique will become increasingly spotlighted and more widely used.

Conclusion

Radioguided occult lesion localisation is a very useful procedure, which is highly appreciated by radiologists, surgeons, and patients alike. It also has the particular advantage of facilitating simultaneous sentinel node scintigraphy. We highly recommend it for wider use.

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Corrigendum

"Diagnostic challenges of human brucellosis in Hong Kong: a case series in two regional hospitals" (August 2010;16:299-303). On page 302, the caption of the Figure should have read "Radiograph of the lumbar sacral spine of patient No. 5" rather than "Gram stain of *Brucella melitensis* (original magnification, x 1000)" as printed. We regret the error.