Wire localisation biopsy of non-palpable breast lesions: reasons for unsuccessful excision

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Summary

Surgical excision following needle-wire localization of nonpalpable, mammographically detected breast lesions is a very valuable diagnostic and therapeutic procedure. No further treatment is usually required after establishing an accurate histological benign diagnosis of indeterminate lesions on preoperative assessment. On the other hand, ductal carcinoma *in-situ* (DCIS) and early invasive cancer, properly excised, may sometimes require further management depending on specific histologic findings.

An uncommon problem of this procedure is the failure to identify, localize or excise the breast lesion. In this review article, factors that contribute to the failed needle localization procedure are presented.

Key words: Mammography; Breast cancer; Wire localisation; Breast biopsy; Breast screening.

Introduction

The establishment of national breast screening programmes worldwide has resulted in the increased detection of asymptomatic, nonpalpable breast cancers [1, 2]. Accurate interpretation of good quality mammography is the major determining factor of an efficient screening programme. The Breast Imaging and Reporting Data System (BI-RADS) classification offers an objective assessment on the level of suspicion of mammographic abnormality [2, 3]. A large proportion of nonpalpable radiologically indeterminate or suspicious lesions require histological definition. This is usually initially achieved by image-guided wide bore needle biopsy under local anaesthetic [4, 5]. When the lesion requires surgical excision for diagnostic or therapeutic indications, an open surgical excision biopsy following wire localisation of the lesion is often recommended.

Non surgical diagnostic or excisional strategies include ultrasound-guided or stereotactic vacuum-assisted breast biopsy, either conventionally [4] or on a digital stereotactic table [6] and the Advanced Breast Biopsy Instrumentation (ABBI) device [7, 8]. All these methods have been reported to be cost effective to varying degrees and enable case selection for surgery, avoiding the need for unnecessary surgery [4, 9]. The mammotome and ABBI systems are minimally invasive techniques, where therapeutic excision can be planned, but in cases of invasive cancer and DCIS accurate data on tumour size and clear resection margins of the specimen cannot be reliably demonstrated. Stereotactic equipment is expensive and the health economics of stereotactic biopsies depend on local organisation of facilities for maximum utilization [10, 11]. Additionally, all these methods have technical limitations that relate to access to the area of interest, usually due to the position of the lesion in relation to the skin, the nipple-areola complex and depth against the thoracic wall [4, 7, 8].

Excising a nonpalpable breast lesion without a localisation procedure could lead either to resection of an excessive amount of breast tissue or to an unsuccessful excision. Preoperative needle localisation was initially introduced in 1965 [12], and offers accurate, targeted excision with minimal trauma and tissue disruption [13]. Surgical excision following needle-wire localisation of non-palpable, mammographically detected breast lesions, when indicated, is a valuable diagnostic and therapeutic procedure. No further treatment is usually required after establishing a benign histological diagnosis on indeterminate lesions on preoperative assessment. When the target lesion is small low-grade ductal carcinoma *in-situ* (DCIS), adequate excision following needle localisation is often therapeutic. For high grade DCIS and impalpable cancer, complete excision after needle localisation is standard primary treatment, following which recommendations on adjuvant therapy can be based on the surgical pathology.

In the majority of cases, women scheduled for wire-localisation surgical procedures will have had a preoperative, cytological or tissue diagnosis achieved by ultrasound guided, mammographic or stereotactic core biopsy. Where localisation for excision is necessary, wire placement is usually planned using the imaging modality that achieved the preoperative diagnostic biopsy. If the target lesion is visible on ultrasound examination [14], the localisation procedure may be achieved more comfortably using ultrasound, but post-localisation mammograms are essential to ensure that the correct area of inter-

Revised manuscript accepted for publication January 18, 2006

est has been localised. Fine microcalcification or areas of subtle architectural distortions are less likely to be visible on ultrasound examination and mammographic or stereotactic localisation may be necessary. Small stellate mass lesions, on the other hand, are more likely to be visible on ultrasound assessment and suitable for ultrasound guided localisation. Following excision of the wire localised lesion, specimen radiographs are mandatory to confirm excision of the target and assessment of the radial margins. The key considerations in the localisation and excision procedure are: a) Radiology selection: suspicious mammographic findings, clustered microcalcification or stellate mass lesions present on both mammographic views, b) The localisation technique: stereotactic, mammographic or ultrasound, c) Selection of the needle-wire system, d) Placement of the needle-wire, e) Excision of the specimen, f) Confirmation of lesion excision by specimen radiography, g) Histological examination of the specimen.

Wire localisation is a two-step procedure requiring placement of the wire prior to surgery [8]. Radiological failure refers to inadequate localisation of the area of interest. Surgical failure is the failure to remove at least a part of the target lesion. Pathological failure may arise when the lesion is excised but is not found by the pathologist. The frequency of failed localisation excision has been reported to be 0%-5% of all wire localised biopsies, as shown in Table 1 [14-22]. Other complications include vasovagal reactions, wire migration, wire transection, pneumothorax, haematoma and infection [23]. The benign versus malignant biopsy rates are also reported to be variable, ranging from 81% versus 19% [21] to 57% versus 43% [14] (Table 1).

Table 1. — *Failure rates of surgical excision biopsy following needle localisation of impalpable breast lesions [14-22].*

Author	No. of biopsies	No. of cancers (%)	No. of misses (%)	Cancer misses	Total misses
Besic *et al.* 2002 [14]	222	96 (43)	0 (0)	0	0
Markopoulos *et al.* 1999 [15]	156	34 (22)	0 (0)	0	0
Jackman *et al.* 1997 [16]	280	111 (40)	7 (2.5)	1	7
Papa *et al.* 1996 [17]	450	131 (29)	19 (4.2)	5	19
Weyant *et al.* 1995 [18]	757	206 (27)	10 (1.3)	2	10
Gisvold *et al.* 1994 [19]	160	64 (40)	4 (2.5)	2	4
Hastrich *et al.* 1992 [20]	213	68 (32)	3 (1.4)	1	3
Stein *et al.* 1991 [21]	200	38 (19)	5 (2.5)	1	5
Aitken *et al.* 1990 [22]	515	139 (27)	14 (2.7)	0	14

Case Selection

The radiologist or the surgeon is sometimes confronted with an awkwardly placed lesion. It is therefore important to confirm the presence of the lesion and its exact location with two orthogonal views [24]. The most common missed lesion is a tiny area of faint microcalcification, followed by poorly defined areas of architectural distortion in the absence of a mass lesion [25]. Some small mass lesions may become palpable during the operation, increasing the biopsy success rate [14, 16, 21]. Multiple localisation procedures within the same breast and inappropriately placed wires are other factors that can lead to biopsy failure [16]. Intradermal calcification, mistakenly thought to be within the breast parenchyma, is an uncommon but important factor for failure. Superficial calcification within 1 cm of the skin surface could be intradermal and should be recognized and managed accordingly [2].

Inaccurate wire localisation and failure of excision are associated with awkward position of the target lesion. Difficult locations for excision include proximity to the nipple, lesions close to the chest wall, or high in the axilla. In some of these cases localisation using the stereotactic technique can be difficult or even impossible [19, 25]. Jackman *et al.* [16] have reported a correlation between the depth of mammographic abnormality of greater than 3 cm within the breast and increased failure rate.

Localisation factors

Mammographic localisation methods may be stereotactic or non-stereotactic [26-28]. Stereotactic mammographic techniques are used to ensure accurate needle placement that is available as either add-on or built-in stereotactic units. In both systems a computer uses trigonometric analysis of measurements taken from two stereoscopic images to determine the location of the lesion. The needle is inserted into the lesion where the coordinates are translated from the measurement unit. Even though the stereotactic method presents less human influence and procedural variability with possibly increased accuracy, several factors are recognized to be related to poor results [25]. Apart from technical errors with patient movement and position, inadequate rotation of the X-ray tube when taking the initial films could result in underestimation of the depth of the lesion.

The commonly used localisation techniques and their respective failure rates are presented in Table 2, showing very small differences among these commonly used methods [26-28]. The placement of the needle-wire within the breast could be achieved either on a prone table or in an upright sitting position. The prone position is much more comfortable and is associated with less vasovagal reactions, while the upright position enables easier access to all sites of the breast [8].

Table 2. — *Localisation techniques and reported failure rates [26-28].*

Localisation method	Failure rate %
Stereotactic localisation	2.0-3.9
Needle inserted parallel to chest wall through a fenestrated grid	1.6
Dye localization and pre-biopsy removal of the needle	1.3-2.2
Freehand localization using fixed or identifiable reference points of measurement	2.2

The definition of successful localisation is not universal. The needle distance of the lesion is measured on both post needle insertion mammograms, and the greater of the two measurements is generally defined as the needle-wire distance from the needle. The ideally placed wire either just penetrates the lesion or has the tip of needle 5 mm - 1 cm within the target lesion [16, 29]. Other authors [15, 25, 26, 30] have accepted a 1 cm - 2 cm distance between the lesion and the wire tip as sufficient for a successful biopsy. Vuorela *et al.* [26] in their series of 153 localisation biopsies, reported 17 cases of unsuccessful localisation (distance more than 1 cm) and 136 cases of acceptable localisation. Their respective rates of failed excision after needle localisation were 23% (n = 4) and 6% (n = 8).

Unsuccessful localisation is associated with not releasing the breast compression before engaging the wire tip, a problem usually associated with needle localisation systems with a retractable tip by design. If the tip of such a needle system is engaged while the breast is being compressed, the needle may withdraw as compression is released and the tip may end up proximal to the lesion [31].

The importance of the control film after needle placement and before the wire is engaged within the breast has been reported by Vuorela *et al.* [25]. Any re-adjustment of the needle depth before the wire is deployed could increase the rate of a successful localisation biopsy [30]. Complete excision of a nonpalpable lesion suspicious of malignancy may sometimes be better achieved when the target is marked by more than one wire, which delineates the mammographic borders of the lesion [14].

Wire system related factors

The most commonly used needle-wire systems are the Kopans, Homer and Hawkins needles and their variations. The choice between each reflects personal preference and personal experience.

The Kopans system allows for a moderate amount of traction on the wire during surgery. The disadvantage is that the wire cannot be repositioned and suboptimal wire placement is directly related to increased failure rate [32].

The Homer system is easy to use, has a retractable wire, but the needle and the wire are relatively easy to pull out with moderate traction. Despite that risk, very good results may be achieved by the Homer system with reported failure rates of less than 1% [33].

The Hawkins system has a tip that is withdrawn into an outer cannula once the barb is deployed [31]. The barb exits from the cannula at an acute angle, allowing for moderate traction at surgery and has greater anchoring strength than the Kopans system. As the wire design allows the needle to be repositioned, this system is reported to have a high success rate [16]. The disadvantage of the Hawkins system is that it is difficult to use with small breasts.

Surgical factors

Large surgical resection specimens are obviously related to less missed localisation excisions. Jackman *et al.* [16] reported increased success rate when the specimen was bigger than 10 cm^3, while Besic *et al.* [14] showed excellent results when the weight of the specimen was more than 50 g. On the other hand, Gallagher *et al.* [34] reported only a 1% miss rate with a median volume of the specimens of 6.0 cm^3. The optimum specimen size provides adequate excision of the target lesion while leaving a good cosmetic result. Women with larger breasts tolerate larger volume losses with less visible deformity. Current breast surgery guidelines of the European Society of Surgical Oncology (ESSO) and the British Association of Surgical Oncology (BASO) recommend that at least 80% of diagnostic biopsy specimens, subsequently proven to be benign, should weigh less than 20 g [35].

The surgeon's experience with localisation breast biopsy procedures is an important performance indicator of successful outcome [16]. However, experienced surgeons have also reported higher miss rates, probably as a result of including many difficult localisation procedures in their case series [18]. Although surgical excision under local anaesthetic has been reported to be a factor associated with missed biopsy following localisation [17], other authors who routinely use local anaesthesia present equivalent results in biopsies performed under general anaesthesia [36]. Successful surgical excision following needle localisation is directly related to confirmation of the target lesion within the specimen mammogram at the first attempt. Markopoulos *et al.* [15] while reporting a negligible miss rate, was only successful in removing the target at the first attempt in 87.2% of cases, with up to four attempts necessary to achieve successful localisation in the remaining cases.

Incomplete excision of a nonpalpable breast malignancy is not uncommon. Some authors have presented low rates of positive margins [15], while Besic *et al.* [14], and Al-Sobhi *et al.* [37], have reported 34% and 79% involved margins, respectively, requiring re-excision surgery. Further excision margins may be taken at the time of surgery based on the specimen mammogram. The pathological disease, however, may extend beyond the mammographic abnormality, a variable beyond the control of the surgeon and radiologist.

Specimen mammogram

False-negative specimen films are unusual, but have been reported in several studies [16, 18, 21]. Jackman *et al.* [16], in their series of 280 cases, reported seven false-negatives out of 14 negative specimen films, while Weyant *et al.* [18] in their series of 757 cases, presented eight false-negatives out of 18 negative specimen radiograms. The commonest lesions that could not be visualised on specimen X-ray despite being identified on pathological assessment, are non-calcified masses or subtle areas of architectural distortion on the diagnostic mammograms. When the specimen X-ray does not show the abnormality, a useful manoeuvre is to flatten the tissue or rotate it 90° and to retake the specimen film. If the lesion is still not obvious, Stein *et al.* [21] advocate the use of an immediate postoperative mammogram, and among the 5.5% of their cases with a negative specimen radiograph, 2.5% represented surgical failure with the lesion visible within the breast. In the remaining 3%, the lesion had been removed even though not identified on the specimen film.

False-positive specimen mammograms are uncommon. In these cases, the lesion failed to be excised, but was mistakenly thought to be present on the specimen radiograph. Hasselgren, *et al.* [38] reported three false-positive mammograms in 103 women with microcalcification and no palpable mass. A rare finding on the specimen film is an incomplete wire, usually a missing wire tip, indicating a retained wire fragment within the breast [23]. Such incidents are more common with deeply sited wires in contact with the chest wall. The surgeon could avoid accidentally cutting the wire by using sharp dissection or cutting diathermy. If the wire fragment still cannot be found, the patient should be informed promptly after surgery and scheduled for a postoperative mammogram to verify the presence or absence of the fragment.

Histological factors

Careful orientation of the specimen is essential for histological evaluation of surgical margins in cases of DCIS and invasive breast cancer [15]. A copy of the specimen radiograph should accompany the specimen to the histopathology laboratory.

Benign histology of the target lesion when the preoperative tissue diagnosis was cancer is rare. When fine needle aspiration cytology was used to diagnose non-palpable screen detected lesions Besic *et al.* [14] reported a false-positive cytology rate of 4%, and a false-negative rate of 25%. It is not possible to reliably

differentiate between *in situ* and invasive cancer on cytology. Core needle biopsy, therefore, has a significant advantage over cytology and potentially allows the planning of axillary staging surgery at the same surgical procedure. The false-negative rate of needle biopsy in the preoperative assessment of screen detected lesions has been reported at approximately 3% [39].

The finding of atypical ductal hyperplasia on preoperative stereotactic core biopsy is an indication for open surgical biopsy because there is a 30%-50% risk of malignancy in these lesions. Liberman *et al.* [40] reported 25 cases of atypical ductal hyperplasia among 264 nonpalpable lesions (9%). Surgical biopsy was recommended in all 25 cases but was finally performed in 21. The histopathological findings of the surgical specimens were benign without atypia in four (19%), atypical ductal hyperplasia in six (29%) and ductal cancer in 11 (52%), including three invasive and eight *in-situ* tumors.

What to do if the resection specimen does not contain the target lesion

In extremely rare cases the lesion is not detectable on pathology, even though it is present on specimen mammogram. The specimen X-ray should be reviewed in conjunction with the pre-biopsy and post-localisation films. If the abnormality is present the specimen needs to be re-examined and further pathological sections taken. The pathologist should look for evidence of the previous needle biopsy that might be evident within the tissue block.

The postoperative breast may be difficult to examine. When tolerated, the ipsilateral mammogram should be repeated at a suitable interval after surgery. If the original target was visible on ultrasound this could be repeated as part of reassessment of the retained lesion.

The value of magnetic resonance imaging (MRI) may be limited if the target consists of calcification only, but may be more useful in the presence of a small mass lesion [4]. The optimal time for MRI examination, if the repeat mammogram and ultrasound fail to localise the retained lesion, is probably at least six weeks after surgery. As the target lesion is likely to be screen detected and therefore representative of early cancer or DCIS, a delay in therapeutic excisional surgery is unlikely to influence the natural history of the disease.

Should these further investigations not demonstrate the missed lesion, follow-up assessment is recommended three months after the initial surgery.

Conclusion

The identification of screen detected abnormalities require preoperative assessment by a combination of clinical and radiological examination with pathological confirmation by needle biopsy where indicated. When wire localisation for excision is indicated the majority of lesions are accurately located and successfully excised. Failure of localisation, excision or identification of the excised lesion occurs in 2%-4% of cases. Factors contributing to a failed procedure include a poorly placed needle, wire migration, awkwardly sited targets, tiny areas of faint microcalcification and surgical technique. When the resected specimen does not contain the expected abnormality despite extensive pathological review, appropriate investigation to re-evaluate the breast is necessary. If the abnormality is relocated within the breast careful planning is required for subsequent surgical excision.

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