Intraoperative ultrasound for breast lesion localisation during breast conserving surgery (lumpectomy)

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Record Status
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Citation

Authors' conclusions
Until recently, the method of localising nonpalpable breast lesions for breast conserving surgery/lumpectomy have largely been limited to percutaneous mammographically-guided needle localisation procedures (e.g. NLBB). However, despite the fact that wire-guided excision of lesions is the current gold-standard of lesion localisation, the procedure has several persistent problems. Adequate resection of breast lesions, especially non-palpable, is highly dependant on the accurate placement of the wire; however, studies have shown that the miss rates of wire-guided procedures vary from 0% to 22% (Klimberg 2003). Researchers have also highlighted the difficulty faced by breast surgeons when utilising wire-guided localisation, particularly the fact that the surgeon is expected to accurately excise the malignant lesion with adequate margins within a 3-dimensional space with the aid of a 2-dimensional localisation technique. The miss rates of wire-guided excision may be a result of wire or clip migration, with one study demonstrating median clip migration of 1cm from the target lesion (Kass et al. 2002). The potential for wire/clip migration or displacement is further exacerbated by the fact that the patient has to be transferred from the radiology department to the operating theatre. In addition to this, approximately 20% of patients experience vasovagal reactions when subjected to preoperative wire localisation (Klimberg 2003).

In view of these issues, IOUS has been proposed as a potential alternative to wire-guided localisation. It has several desirable traits that address some of the shortfalls related wire-guided localisation: 1) IOUS does not require the patient to undergo uncomfortable preoperative wire insertion, therefore reducing patient anxiety; and 2) IOUS enables real-time visualisation of the lesion, and its accuracy if not subject to the placement of wires/clips which are prone to displacement and migration. Nevertheless, it is important to realise that IOUS is not without risks. Studies have demonstrated that ultrasound is only capable of visualising approximately 40% to 60% of mammographically-detected lesions (Potterton et al. 1994, Kaufman et al. 2002), which markedly hinders its applicability as an intraoperative localisation technique in a large proportion of lesions. Meanwhile, breast surgeons who are not experienced with the use of ultrasound will require guidance from a radiologist during the procedure as a precautionary step to prevent inaccuracy and misinterpretation of ultrasound images.

Randomised controlled trials utilising IOUS for excision of breast lesions have demonstrated that it is superior to wire-guided localisation (non palpable lesions) and standard excision (palpable lesions) in terms of achieving negative margins (Moore et al. 2001, Rahusen et al. 2002). This is further supported by non-randomised comparative studies, where 81% to 93% of patients who underwent IOUS-guided excision achieved negative margins compared to 40% to 82% of patients who underwent preoperative wire-guided localisation (Bennett et al. 2005, Buman and Clark 2005, Rahusen et al. 1999, Snider et al. 1999). In addition to this, IOUS localisation is also associated with equal (Rahusen et al. 2002, Thompson et al. 2007) or lower excision volumes (Snider et al. 1999, Moore et al. 2001, Rahman et al. 2007) while attaining superior margin status compared to wire-guided localisation (Moore et al. 2001, Rahusen et al. 2002, Bennett et al. 2005, Rahusen et al. 1999, Thompson et al. 2007, Rahman et al. 2007). It is interesting to note that IOUS appears to be more beneficial in patients with dense breast parenchyma (Moore et al. 2001)

In an effort to extend the applicability of IOUS-guided localisation, researchers have developed a novel method of visualising lesions that are otherwise not visible with ultrasound. Smith et al. (2001) proposed that iatrogenically induced haematomas within the target lesion will enable the use of IOUS in lesions that are only visible with MRI. Thompson et al. (2007) and Rahman et al. (2007) extended this principle by utilising ultrasound-visible haematomas caused by preoperative biopsy techniques (e.g. VABB) as a physiological surrogate for localising non-ultrasound-visible lesions.
lesions intraoperatively. Both studies presented encouraging results, with IOUS attaining better negative margin rates (Thompson et al. 2007) and margin clearance (Rahman et al. 2007) while maintaining similar (Thompson et al. 2007) or lower (Rahman et al. 2007) resection volumes compared to wire-guided localisation.

When ultrasound was utilised for ex vivo specimen analysis to ensure adequate margins, investigators noted that specimen ultrasonography is less likely to overestimate the margin than specimen mammography (59.9% vs. 66.7%); further consolidating the claim that it is a more accurate technique of margin determination. An interesting outcome of the analysis by Tan et al. (2006) is that if the margin measured with intraoperative specimen ultrasound is at least twice the desired histological margin, the desired result will be achieved in >90% of cases.

Overall, most of the included studies reported that the use of IOUS localisation results in better negative margin rates (Moore et al. 2001, Rahusen et al. 2002, Bennett et al. 2005, Buman and Clark 2005, Rahusen et al. 1999, Thompson et al. 2007, Rahman et al. 2007) and is associated with lower excision weight/volume compared to wire-guided excision or standard excision (Moore et al. 2001, Snider et al. 1999, Rahman et al. 2007). One study did not observe better margin clearance with IOUS localisation (Snider et al. 1999); nevertheless the procedure was still associated with lower resection weight/volume. The application of haematoma-guided ultrasound excision has demonstrated encouraging results as well (Thompson et al. 2007, Rahman et al. 2007), and introduces a novel technique of visualising non-ultrasound-visible tumours without the need for wire or clip insertion. There is some concern that the extra manipulations with the use of IOUS may result in higher wound infection rates, this issue should be carefully monitored due to the paucity of evidence (only one study reported that wound infection rates were not elevated with IOUS, Buman and Clark 2005).

The evidence available provides considerable support for the use of IOUS-guided localisation of nonpalpable breast lesions. It appears to be an attractive alternative to preoperative wire-guided localisation, and addresses many of the inherent shortfalls of wire localisation. However, it is important to caution the fact that breast surgeons should receive adequate training before utilising this procedure. Otherwise, the presence of a radiologist in the operating theatre is highly recommended; at least until the surgeon acquires adequate experience and confidence with the use of ultrasound.