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ORIGINAL ARTICLE

Magnetic Resonance Imaging–guided Biopsy of the Breast: A Ten-Year Experience

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ABSTRACT

Introduction: *Magnetic resonance imaging (MRI) is an effective modality for high-risk patient screening, local staging, and disease monitoring in breast malignancies. There is an increasing demand for MRI-guided biopsy of lesions that are occult on mammography or ultrasound. This study summarises our 10-year experience with the procedure. Technical challenges, as well as tips and tricks to achieve procedural success are discussed.*

Methods: *A total of 37 consecutive cases of MRI-guided vacuum-assisted breast biopsies performed at a single centre between August 2012 and August 2023 were retrospectively reviewed. Targets were localised using 1.5-T MRI systems with a dedicated breast coil and localisation device. Biopsies were performed using 10-gauge or 9-gauge needles. Imaging characteristics, histopathological results, and subsequent management for all biopsied lesions were recorded.*

Results: *The mean age of patients was 51.6 years. Technical success was achieved in 35 out of 37 cases (94.6%). In 27 cases (77.1%), the biopsied breast was placed in the ipsilateral coil, and in eight cases (22.9%) it was placed in the contralateral coil for optimal imaging and biopsy access. Between 8 and 24 cuttings were taken for each target. Three cases (8.6%) developed biopsy site haematomas. Of the 35 successfully biopsied lesions, 11 (31.4%) were malignant. Among the malignant lesions, six (54.5%) presented as non-mass enhancement and five (45.5%) as mass enhancement. Four lesions (36.4%) showed restricted diffusion, while seven (63.6%) did not.*

Conclusion: *MRI-guided vacuum-assisted biopsy of the breast is a safe and effective procedure in the hands of experienced interventionists. It is essential for the diagnosis and management of breast lesions occult on conventional imaging.*

Key Words: *Breast neoplasms; Fibroadenoma; Image-guided biopsy; Magnetic resonance imaging; Mammography*

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Ethics Approval: This research was approved by the Central Institutional Review Board of Hospital Authority, Hong Kong (Ref No.: KC/KE-23-0152/ER-2). Informed patient consent was waived by the Board due to the retrospective nature of the research.

中文摘要

磁力共振成像引導乳腺活檢檢查：十年經驗分享

陳卓忻、馮寶恩、張偉彬、郭勁明、麥詠詩、黃嘉敏、羅麗雲、黃皓澧、范德信、梁燕霞

引言：磁力共振成像是乳腺惡性腫瘤高風險患者篩檢、局部分期和病情監測的有效方法。對於乳房造影掃瞄或超聲波檢查中難以發現的病變，磁力共振成像引導下活檢的需求日益增長。本研究總結了我們十年來在該技術上的經驗，並探討其中的技術挑戰以及確保活檢成功的技巧和竅門。

方法：我們對2012年8月至2023年8月期間在同一中心進行的連續37例磁力共振成像引導下真空輔助乳腺活檢病例進行回顧性分析。我們使用配備專用乳腺線圈和定位裝置的1.5 T磁力共振成像系統進行標靶區定位。活檢採用10號或9號穿刺針。我們記錄了所有活檢病變的影像學特徵、組織病理學結果及後續處理。

結果：患者平均年齡為51.6歲。 37例患者中35例（94.6%）技術成功。活檢時27例（77.1%）乳腺置於同側線圈內，8例（22.9%）乳腺置於對側線圈內，以獲得最佳影像及活檢入路。每個目標活檢8至24個乳腺組織。三例（8.6%）出現活檢部位血腫。在35個成功活檢的病灶中，11例（31.4%）為惡性病灶。在惡性病灶中，6例（54.5%）表現為無腫塊強化，5例（45.5%）表現為腫塊強化。四例（36.4%）病灶顯示彌散受限，7例（63.6%）未顯示彌散受限。

結論：磁力共振成像引導下乳腺真空輔助活檢在經驗豐富的介入醫生操作下是一種安全有效的操作，對於常規影像學檢查無法確診的乳腺病變的診斷和治療至關重要。

INTRODUCTION

Magnetic resonance imaging (MRI) of the breast is an effective modality for screening high-risk patients, local staging and monitoring breast malignancies that are occult on radiography and sonography. This article summarises our centre's experience in MRI-guided breast biopsy over the past 10 years, with the aim of reviewing the fundamentals of the procedure and emphasising tips and tricks for technically challenging cases.

MAGNETIC RESONANCE IMAGING–GUIDED BREAST BIOPSY

Indications and Contraindications

MRI of the breast is performed for indications as categorised by the European Society of Breast Cancer Specialists working group, including screening for high-risk patients such as those with a strong family history of breast malignancies or known genetic mutations, e.g., *BRCA1* and *BRCA2*; characterisation of inconclusive findings on mammography or ultrasound; assessment for unknown primary breast cancer; preoperative local staging and surgical planning in patients with biopsy-proven breast malignancy (particularly those considered for breast conserving therapy); and disease monitoring in known breast malignancies, e.g., evaluating treatment response to neoadjuvant chemotherapy.[1] When a suspicious lesion occult on conventional breast imaging (i.e., mammography and ultrasound) is detected on MRI, an MRI-guided biopsy should be performed if a targeted second-look ultrasound is unyielding according to the American College of Radiology (ACR)[2] and the European Society of Breast Imaging[3] recommendations. Absolute contraindications to MRI-guided breast biopsy are the same as for any MRI scan, including the presence of MRI-incompatible metallic or magnetic implants, claustrophobia, contrast allergy, or severe renal impairment.[4] Relative contraindications include thrombocytopenia and coagulopathies.[4]

Magnetic Resonance Imaging Protocol

At our centre, MRI-guided breast biopsy is performed using one of two 1.5-T MRI systems (Achieva XR; Philips Healthcare, Best, the Netherlands, and MAGNETOM Sola; Siemens Healthcare, Erlangen, Germany) with phased-array dedicated breast coils containing four

or seven channels, respectively. The MRI protocol for biopsy differs from the usual diagnostic protocol by using breast coils with fewer channels and prioritising rapid image acquisition with sequences optimised for target localisation.[5] Our protocol consists of T1-weighted pre- and post-contrast sequences acquired in 1-mm section thickness. Gadoterate meglumine is the gadolinium-based contrast medium of choice, administered at the recommended dose of 0.2 mL/kg (or 0.1 mmol/kg) at a rate of 2 mL/s via a pump injector. Dynamic T1-weighted three-dimensional fat-saturated images are acquired, with the first set of post-contrast images obtained 1.5 to 2 minutes after injection, followed by a second set at a 25-second interval, and then at 1-minute intervals up to 4 minutes, as recommended by the ACR guidelines.[2] Subtraction of the unenhanced images is performed.

Patient Positioning

Optimal patient positioning is crucial for procedural success. The patient is positioned prone with cushion support for the head and neck, and a headset for noise cancellation. Arms are positioned overhead with padding at the sternum, abdomen, and legs for comfort and stability. The targeted breast is placed hanging freely and as deeply and centrally as possible in the dedicated breast coil with the nipple pointing directly downwards.[6] The operator should ensure there are no breast folds resulting from compression at the edge of the coil, as this leads to uneven fat saturation on MRI.[7]

Lesion Localisation

Once the patient is optimally positioned, breast compression is performed using a grid paddle. Pre-contrast MRI is conducted to verify breast placement to ensure the target falls within the multichannel localisation grid.[6] A fiducial marker, either an MRI-visible fish oil capsule or a small plastic marker is affixed to skin of the breast within the grid square, close to, but not directly over, the anticipated location of the target. Contrast is administered and MRI images are acquired as per protocol. Post-processing subtraction images are generated to localise the target.

Following localisation, the biopsy tract is planned either manually or using the computer-assisted localisation software[4,6] (syngo MR XA 51; Siemens, Erlangen, Germany) [Figure 1a]. In the manual approach, an MRI grid worksheet (Figure 1b) with two sets of views, namely, the patient view and the MRI view, is used to select the localisation grid channel and needle tunnel based on calculation of lesion coordinates. The patient view represents a 90° anti-clockwise rotation of the sagittal MRI image, as in reality the patient lies prone. The image section where the hypointense localisation grid contacts the skin surface is taken as the first section (Figure 1c). The number of sections from this point to the target is multiplied by section thickness to determine lesion depth. The thickness of the needle guidance cube block (2 cm) is then added for calculation of overall needle insertion depth. Distances between the fiducial marker and the target along the horizontal and vertical axes are also measured. It is important to verify correct laterality (i.e., left or right breast) and approach (i.e., lateral or medial) when selecting the worksheet as each is different; and to carefully translate the target from the MRI view to the patient view by turning anti-clockwise of the clock face or direction by 90° on the worksheet, as any mistake in these steps will result in inaccurate targeting. Alternatively, the computer localisation software automatically calculates lesion coordinates and indicates the specific square of the multichannel localisation grid, the tunnel within the needle guide cube block, and the required needle insertion depth for accurate targeting.[6]

Biopsy

Following injection of local anaesthesia and skin incision at the expected needle position based on calculated lesion coordinates, a small lockable needle guidance cube block is inserted into the localisation grid channel (i.e., one of the many channels/boxes from the square grid; A1 to F8 in Figure 1a) over the skin incision and secured. The numerically labelled plastic introducer sheath, with its depth stop set to the calculated insertion depth, together with the inner non-ferrous metallic trocar, is inserted into one of the tunnels of the needle guidance cube block, which is best positioned over the skin incision, and the coaxial system is advanced to the calculated lesion depth. The metallic trocar is then replaced with an EnCor MRI-visible obturator (BD Inc, Franklin Lakes [NJ], US) and MRI images are acquired to confirm the alignment of the obturator with the target (Figure 1d and e). The obturator is then removed and the vacuum-assisted biopsy needle is inserted to the same calculated depth. The aperture of the biopsy needle is oriented to face in the direction of the lesion relative to the selected needle tunnel, a technique known as 'directional sampling'.[7] Vacuum-assisted biopsy is then performed (Figure 1f) with the desired number of cuttings and the needle is removed. A post-biopsy MRI scan is acquired to confirm the correct site and adequate sampling of the target.

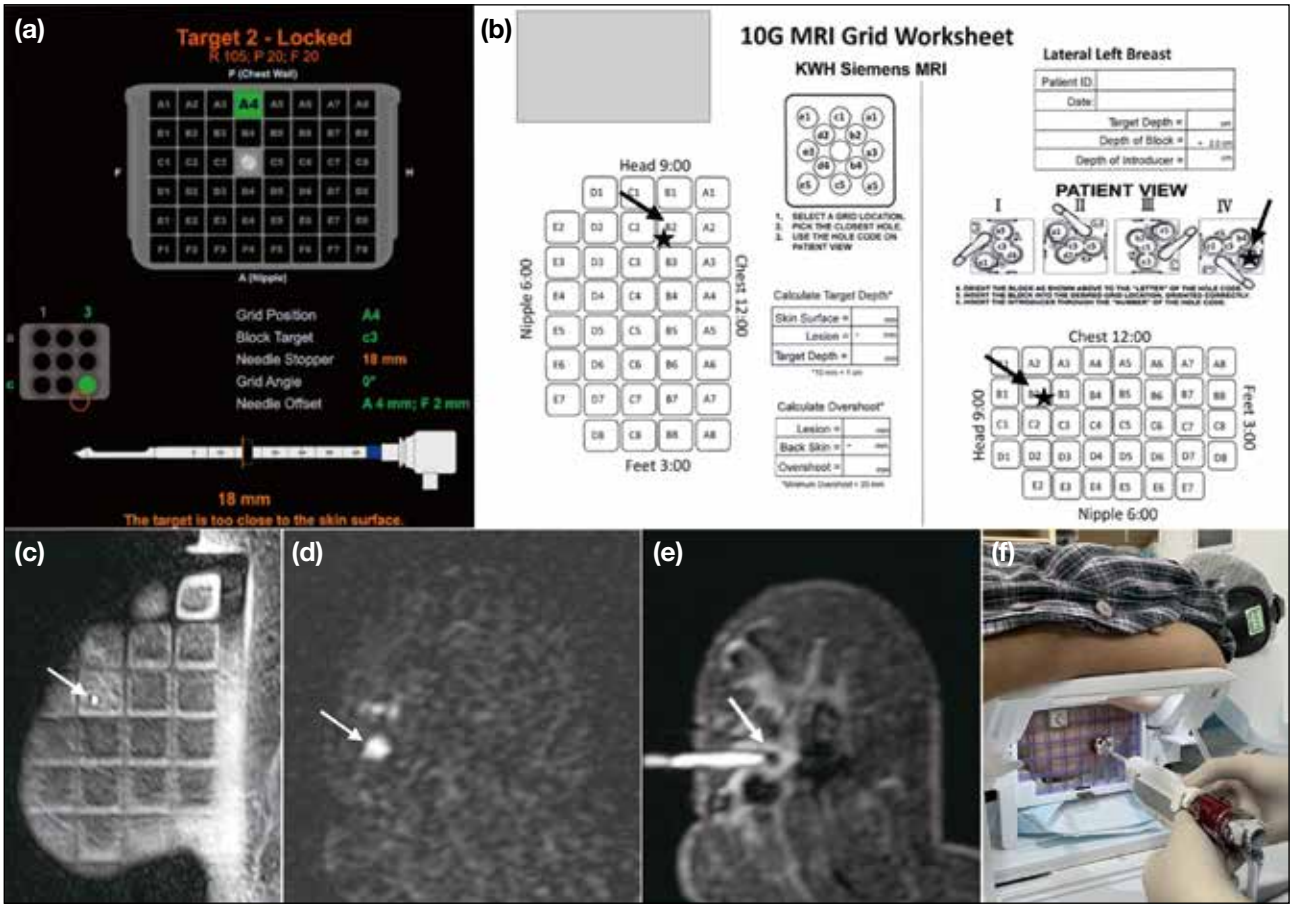

Figure 1. (a) Lesion localisation using computer software. (b) Magnetic resonance imaging (MRI) grid worksheet used for biopsy planning in manual calculation with image view on the left and patient view on the right. Note that the target position is at the left lower corner (black star) in grid square B2 (black arrow) on the image view (left). On the patient view (right) there is a 90-degree rotation from the image view, hence the target is located at the right lower corner (black star) in grid square B2 (black arrow). After careful translation of the target position from image to patient view, the best suited needle insertion tunnel of the needle guidance cube block is selected, which in this case is the one in the right lower corner (black star indicated by black arrow in IV of patient view). (c) Pre-biopsy sagittal image shows the section where the hypointense localisation grid touches the breast surface. The MRI-visible obturator is inserted into the square of the grid where the biopsy trajectory is calculated (white arrow). (d) Target lesion (white arrow) on T1-weighted post-gadolinium subtraction axial image. (e) The obturator is confirmed to align with the target in (d) [white arrow]. (f) The vacuum-assisted biopsy needle is inserted into the lockable needle guidance cube block and held in place for sampling.

After Biopsy

After sampling, an MRI-compatible biopsy marker is inserted via the biopsy tract through the introducer sheath and deployed at the biopsy site. Acquisition of post-marker insertion images is optional and not routinely performed, as haematoma or gas artefacts often obscures the marker.[8] All needles are removed and haemostasis is achieved by manual compression of the breast for at least 15 minutes.

Complications

Bleeding and haematoma formation at biopsy site are the most common complications.[9] Other complications include infection and muscle injury (i.e., injury to the pectoralis muscles). Rare complications include pneumothorax and injury to mediastinal structures, which only occur when biopsy is performed using a freehand approach without a localisation grid.[9]

METHODS

Thirty-seven consecutive cases of MRI-guided vacuum-assisted breast biopsies performed between August 2012 and August 2023 in a single centre were retrospectively reviewed. Target lesions were localised using the Philips or Siemens 1.5-T MRI system with dedicated breast coils and an Invivo (Philips, Amsterdam, Netherlands) or Breast BI 7 Coil (Siemens, Höchberg, Germany) localisation device. Biopsies

were performed using 10-gauge EnCor or 9-gauge Suros (Hologic, Marlborough [MA], US) needles. Imaging characteristics including size, morphology, and enhancement pattern were recorded. Histopathology of all biopsied lesions was obtained with subsequent management documented.

RESULTS

The mean age of patients was 51.6 years (range, 33-76). Technical success was achieved in 35 out of 37 cases (94.6%). In three cases, the original target was not visualised on pre-procedural MRI, resulting in cancellation of the procedure in two cases, while a nearby target was selected in the remaining case.

In 27 cases (77.1%), the lateral approach was adopted and the biopsied breast was placed in the ipsilateral coil. In eight cases (22.9%), the medial approach was used, and the breast was placed in the contralateral coil. A total of 34 lesions were biopsied using a 10-gauge EnCor needle and one lesion was biopsied using a 9-gauge Suros needle. Between 8 and 24 cuttings were taken for each target, with an average of 13 cuttings made. Three cases (8.6%) were complicated by biopsy-site haematomas: two were managed by prolonged manual compression for more than 30 minutes and one required aspiration of the haematoma using the vacuum-assisted biopsy device followed by manual compression. Haemostasis was successfully achieved in all three cases.

Table 1 shows the histology of the lesions and Table 2 shows the malignant diagnoses. Of the 11 malignant lesions, one case (9.1%) yielded a false-negative result from MRI-guided biopsy and proceeded to surgical excision after consensus was reached at the multidisciplinary meeting due to clinical and radiological-histopathological discordance. Histology from the surgical specimen revealed invasive ductal carcinoma (Table 2).

Six malignant lesions (54.5%) presented as non-mass enhancement and five as mass enhancement (45.5%). The size of the malignant lesions ranged from 0.5 cm to 4.3 cm. Four lesions (36.3%) showed restricted diffusion, while seven (63.6%) did not. Nine malignant lesions (81.8%) exhibited a type II enhancement curve and two (18.2%) demonstrated a type III enhancement curve. Ten malignant lesions (90.9%) were classified as BI-RADS (Breast Imaging Reporting and Data System)[10] category 4 and the remaining case (9.1%) as category 5. All but one patient underwent surgery with either mastectomy or breast conserving therapy; the remaining patient declined surgery and remained under regular clinical and radiological follow-up.

Table 1. Histopathological results of biopsied lesions (n = 35).

	No. (%)
Malignancy	11 (31.4%)
Fibrocystic change/sclerosing adenosis	13 (37.1%)
Benign/no evidence of malignancy	6 (17.1%)
Fibroadenoma	2 (5.7%)
Papillary lesion	1 (2.9%)
Lymphocytic mastitis	1 (2.9%)
Radiation effect	1 (2.9%)

Table 2. Histopathological results of the biopsied lesions positive for malignancy (n = 11).

	No. (%)
Ductal carcinoma in situ	6 (54.5%)
Invasive ductal carcinoma	1 (9.1%)
Lobular carcinoma in situ	2 (18.2%)
Invasive carcinoma of no special type	2 (18.2%)

DISCUSSION

MRI-guided vacuum-assisted biopsy of the breast is a technically demanding procedure requiring specialised equipment and a skilled, well-trained team with appropriate experience. Various factors contribute to procedural success. First, patient safety in the MRI suite should be ensured for a smooth procedure. Any equipment entering the suite should be carefully examined for MRI compatibility.[2] A trolley is usually prepared for the transport of equipment in and out of the suite between image acquisition and biopsy, and all metallic devices must be removed during image acquisition. Second, efficiency is essential for successful biopsy owing to limited timeframe between lesion enhancement and contrast washout, while progressive background parenchymal enhancement further obscures targets.[7] It is also important to note that patients are often placed in an uncomfortable position and may move during prolonged procedures, resulting in lesion motion and therefore sampling failure.[7] Meticulous preprocedural planning with review of the diagnostic MRI, education and communication with the patient prior to biopsy to reduce anxiety and manage expectation, particularly regarding the importance to stay still throughout the procedure, and efficient execution of each biopsy step is therefore crucial to achieve procedural success. The

following are tips and tricks accumulated over the years to address challenging cases.

Procedure-related

Compression Technique

Controlled compression of the breast with moderate pressure is performed with a grid paddle and should be adequate for immobilisation with the breast just taut. Inadequate compression increases the risk of mistargeting due to breast and lesion motion throughout the procedure, while excessive compression increases patient discomfort and may impede blood flow to the breast, resulting in reduced or non-enhancement of the target leading to localisation failure.[9]

Thin Breasts

Thin breasts (Figure 2a) present unique challenges. Target lesions may not fall adequately into the breast coil to allow needle access. Optimising patient positioning can markedly improve procedural success, whereby chest pads can be removed from the coil or replaced by thinner pads, and the patient can be tilted into an oblique position, allowing the breast to drop further into the coil lumen.[11] After compression, breast thickness is further reduced (Figure 2b) and may be inadequate to accommodate the standard biopsy needle, therefore compression may be reduced to increase tissue thickness to allow biopsy.[12] Local anaesthesia can also be injected either anterior or posterior to the target to increase distance between skin and the target to accommodate the biopsy needle. A blunt tip needle, half-aperture size needle or petit needle (e.g., 13-gauge) can be employed to minimise chest wall injury or contralateral skin penetration risks.[11]

Lesion Located at The Cross of Localisation Grid Squares

Occasionally, the target may fall onto the intersection of localisation grid squares after injection of local anaesthesia as shown in Figure 1a (red circle). In such cases, directional sampling and appropriate manoeuvring will significantly improve procedural success.[7] The needle guidance cube block is inserted into the A4 square and the biopsy needle is inserted into the tunnel of the cube block indicated by computer software (tunnel c3; highlighted in green), then directional sampling is performed with the aperture of the biopsy needle facing the 7 to 8 o'clock position aiming at the target, while manual pressure is applied by the operator's finger through another grid square (B4 in this case) in attempts to push the breast tissue and hence the target towards the direction of the biopsy needle to aid sampling (Figure 1a). Niketa et al[11] also described a biopsy technique with two diagonally placed entry sites in adjacent holes paired with directional sampling technique to improve sampling success in such cases.

Location of Lesions in the Breast

Anterior Lesions

For anterior lesions, with large breasts, they may touch the table and distort the breast, rendering localisation difficult. Padding can be added to raise the body from the coil so that the target is more easily reached.

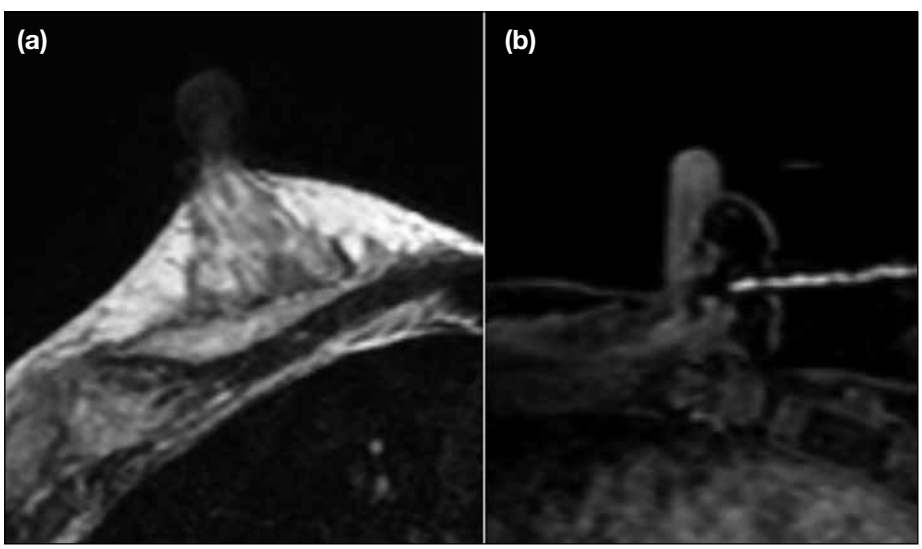

Figure 2. Biopsy techniques in thin breasts. Thin breasts are commonly encountered in the Asian population and pose difficulty due to limited tissue thickness which may not adequately fall into the breast coil lumen. (a) A patient with thin breasts without compression on diagnostic magnetic resonance imaging. (b) Further reduction in breast thickness is noted after compression during biopsy in the same patient. A half-aperture size needle is employed in this case to avoid skin injury.

Posterior Lesions

For lesions close to the chest wall (Figure 3a), removing coil cushion covers brings the chest closer to the coil aperture. The arms can be placed down by the sides of the patient instead of above the head, as this relaxes the pectoralis muscles and allows the breast to sink deeper into the coil (Figure 3b). However, if the target is too close to the pectoralis muscles, the arms should be placed above the head to help retract the muscle away from the coil lumen to avoid muscle injury, which can cause excessive pain and haemorrhage. Tilting the patient into an oblique position may also help the posterior parts of the breast sink further (Figure 3c). On rare occasions, the target may lie posterior to the localisation grid even after these manoeuvres. Performing the biopsy posterior to the grid or by freehand needle insertion without breast compression and localisation grids has been described.[11] The importance of maintaining stability of the needle position in these scenarios is emphasised, as the absence of support from the localisation grid and/or immobilisation of the breast from compression increases the difficulty of targeting.

Medial Lesions

It is difficult to target medial lesions from the medial side due to the increased distance between the biopsy apparatus and the breast when the breast is placed in an ipsilateral coil. The design of the breast coil, with a downward slant from the lateral bar to the sternal bar, also aggravates the difficulty of accessing posteromedial lesions, as the further the biopsy needle travels, the more anteriorly (towards the nipple) the needle tip will be directed due to this angulation.[6] It is thus often helpful to place the targeted breast in the contralateral breast coil (i.e., the right breast in the left breast coil [Figure 4]), which shortens the distance between the biopsy apparatus and the target and reduces the downward angulation the biopsy needle must overcome. This is a less comfortable position for the patient due to the tilting, making it harder to stay still. It is therefore vital for operators to optimise patient comfort before commencement of biopsy to minimise lesion motion. Another limitation to this manoeuvre is that obese patients may not be able to fit through the bore of the MRI.[6]

Superficial Lesions

Injury to the skin is the primary concern in these lesions. If the needle aperture is not completely embedded within the breast during biopsy, air leakage and loss of vacuum effect may ensue, which further lower the rate of successful sampling.[11] This can be tackled by generous injection of local anaesthetic proximal to the target to increase tissue depth to accommodate the biopsy needle.[11] The biopsy needle can also be inserted a few millimetres beyond the target so that the target falls into the proximal part of the needle aperture. Alternatively, smaller-aperture needles may be employed.

Periareolar Lesions

Biopsy around the nipple-areolar complex carries increased risks of haemorrhage and pain as it is a highly vascularised and innervated structure. It also raises

Figure 3. Biopsy techniques for posteriorly located lesions. (a) A posteriorly located BI-RADS (Breast Imaging Reporting and Data System) category 4 lesion (arrow). (b) The patient's arms are placed down by her sides to relax the pectoralis muscles, allowing the posterior breast to sink deeper into the coil. (c) The obturator (arrow) is aiming at the target lesion after patient positioning was optimised. Sampling was successful in this case.

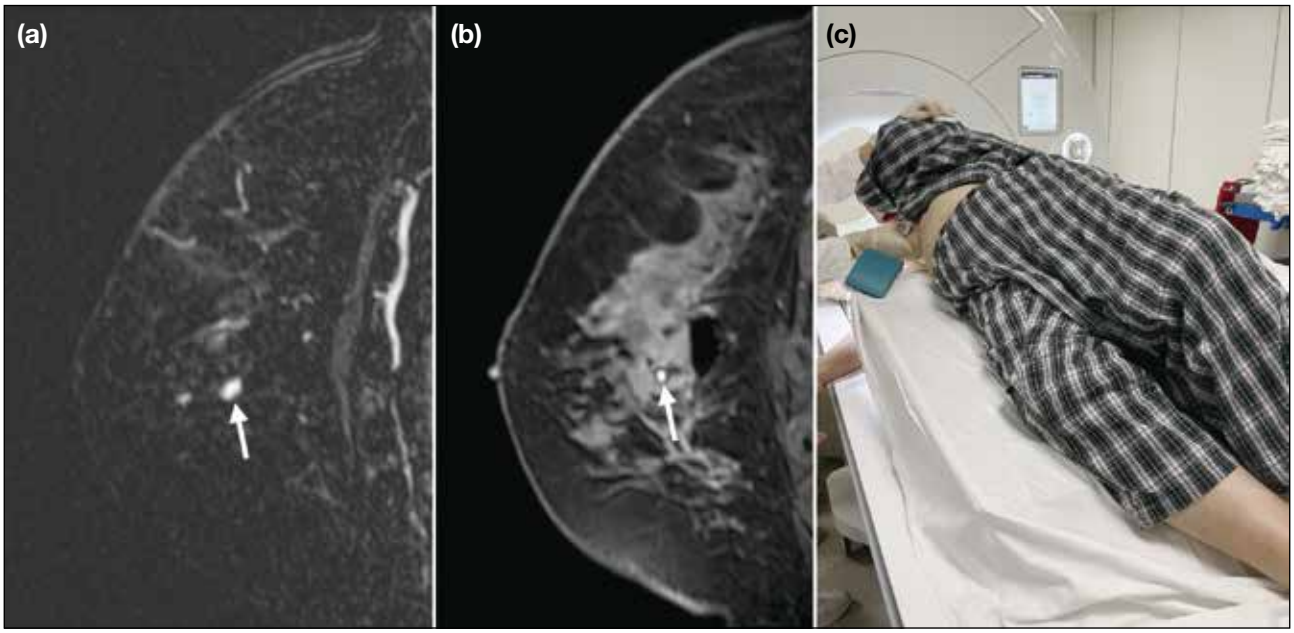

Figure 4. Biopsy techniques for medially located lesions. The patient was initially positioned with her right breast placed in the right breast coil. She had a target lesion located in the right inner breast (a) [arrow]. However, simulation for biopsy found that the target would be difficult to approach from the medial side as the large distance between the biopsy apparatus and the target rendered positioning of the biopsy needle (b) [arrow] suboptimal. The patient was then repositioned obliquely, with her right breast placed in the left breast coil (c). The biopsy was completed smoothly with successful sampling.

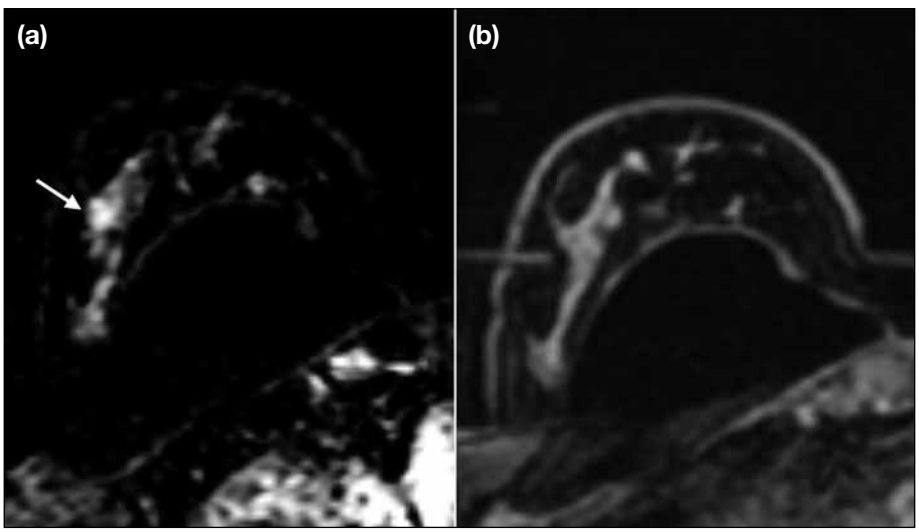

Figure 5. Biopsy techniques in patients with breast implants. A patient with breast implants and a BI-RADS (Breast Imaging Reporting and Data System) category 4A lesion in the right outer breast (a) [arrow]. The presence of breast implants often limits tissue depth for sampling, especially when the target is located close to the implant. This can be resolved by using needles with a blunt tip or half aperture, as in this case (b).

cosmetic concerns. In these cases, the nipple-areolar complex can be manually rolled away from the expected site of skin incision and biopsy needle entry to avoid injury to the complex.[11]

Breast Implants

Breast implants are increasingly common, and their presence renders biopsy difficult. The operator must exercise extra caution not to puncture the capsule, which may result in implant rupture. Adequacy of breast parenchymal thickness should be assessed according to the expected biopsy trajectory and if there is inadequate tissue depth, half-aperture needles can be employed.[7] If the target is located too close to the implant, blunt-tip needles may minimise the risk of implant puncture (Figure 5), or alternatively, fine needle aspiration can

be performed instead.[12] Injection of local anaesthetic between the target and the implant also allows tissue dissection and increases the distance between the two, providing more room for tissue sampling.

Non-visualisation of the Target in Pre-biopsy Magnetic Resonance Imaging

Non-visualisation of the target (Figure 6) in preprocedural MRI has been reported in approximately 8% to 13% of cases.[13] Several factors should be taken into consideration before abandoning biopsy. The diagnostic MRI should be carefully reviewed to identify the sequences in which the target is best visualised. For instance, the lesion may be T2-hyperintense or shows restricted diffusion on diffusion-weighted images (Figure 7), and if it is not well delineated in the standard pre-biopsy MRI sequences, these additional sequences should be performed. This is also helpful when other non-target lesions are conspicuous in these sequences and can be identified as landmarks. Sometimes, the lesion may not be identified due to inherent differences between the breast coils used in diagnostic and pre-biopsy protocols, as the latter includes a smaller number of channels, which may lower the image quality. It is also important to bear in mind that the breast is compressed using a grid paddle in preprocedural MRI, whereas no compression is applied during diagnostic MRI. Enhancement dynamics of the target may therefore differ as blood inflow may be impeded by compression of the breast, preventing lesion enhancement and resulting in a false-negative scan.[7] In such cases, the operator should verify that compression pressure is not excessive and reduce it if necessary. Another tip is to prolong post-contract image acquisition, e.g., at 1-minute intervals for up to 5 minutes, as lesion enhancement may be delayed due to compression of the breast.[6] Non-visualisation can persist after these manoeuvres due to several factors, including fluctuation in background parenchymal enhancement related to hormonal cycles and transient infective or inflammatory process.[7] In such events, the biopsy should be cancelled. However, non-visualisation of the target during biopsy does not preclude malignancy, which has been found in approximately 3.5% of such cases upon follow-up imaging.[14] It is therefore prudent to perform a follow-up MRI within 6 months upon cancellation of biopsy according to ACR recommendations.[2]

Postprocedural Haematoma

Manual compression is applied to the biopsied breast for haemostasis for at least 15 minutes. A pressure dressing or tight breast wraps can be used to facilitate further compression afterwards. A sizeable biopsy site haematoma may sometimes be seen on post-biopsy MRI. In such cases, the vacuum-assisted biopsy needle can be re-inserted through the co-axial system and switched to aspiration mode for evacuation of the haematoma before deployment of the biopsy marker (Figure 8). This often reduces pain as well as minimises the risk of marker displacement. In cases of uncontrolled bleeding with suspected arterial injury, thrombin injection into the biopsy cavity may be helpful for haemostasis control.[11]

Radiological-Histopathological Discordance

Unlike ultrasound-guided biopsy where there is real-time visualisation of the biopsy trajectory and lesion, or in stereotactic- or tomosynthesis-guided core biopsy

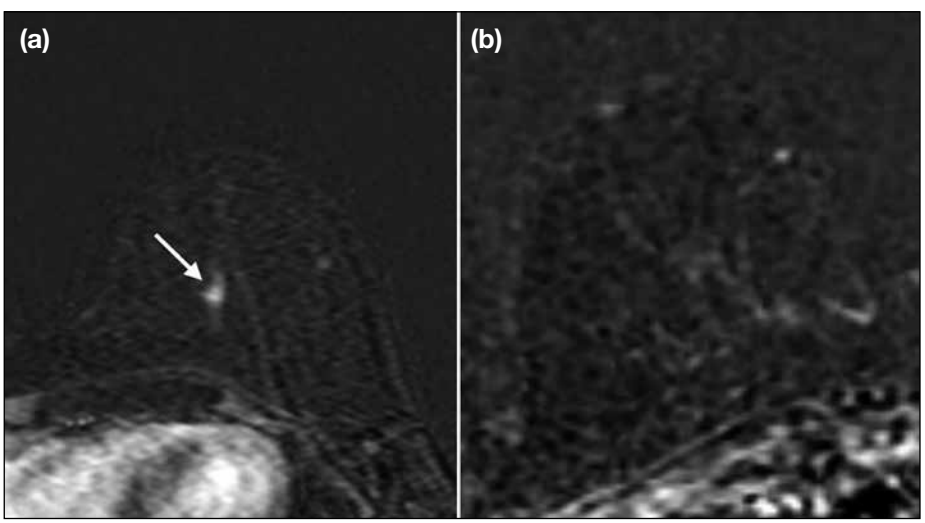

Figure 6. Non-visualisation of target in pre-biopsy magnetic resonance imaging (MRI). (a) Enhancing target in the left inner breast (arrow). (b) The target was not well delineated in the pre-biopsy MRI despite adjustment of compression pressure and acquisition of delayed post-contrast images; therefore, the biopsy was abandoned. A follow-up scan performed 7 months later also shows the lesion was no longer visualised (not shown).

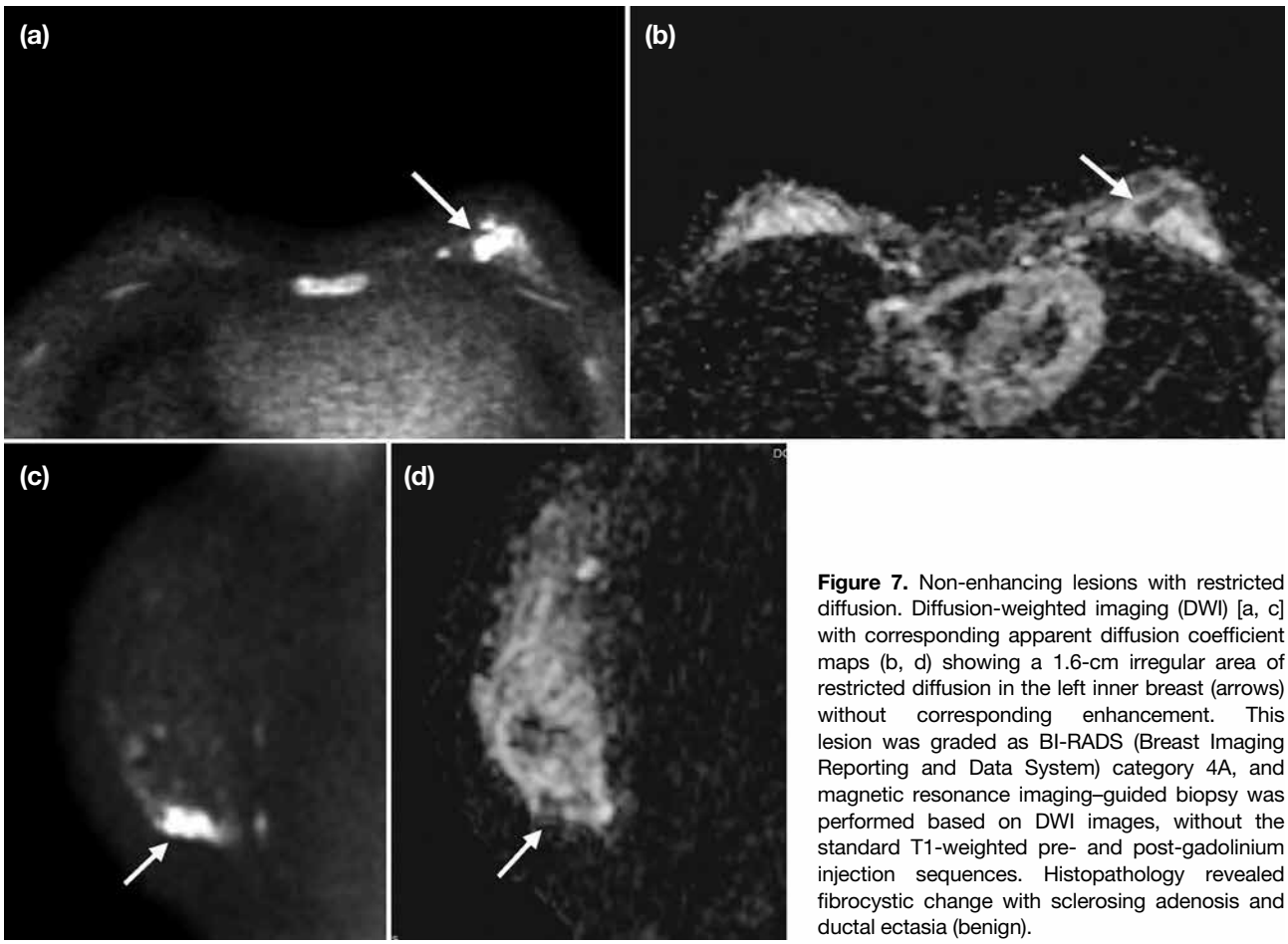

Figure 7. Non-enhancing lesions with restricted diffusion. Diffusion-weighted imaging (DWI) [a, c] with corresponding apparent diffusion coefficient maps (b, d) showing a 1.6-cm irregular area of restricted diffusion in the left inner breast (arrows) without corresponding enhancement. This lesion was graded as BI-RADS (Breast Imaging Reporting and Data System) category 4A, and magnetic resonance imaging–guided biopsy was performed based on DWI images, without the standard T1-weighted pre- and post-gadolinium injection sequences. Histopathology revealed fibrocystic change with sclerosing adenosis and ductal ectasia (benign).

where specimen radiographs confirms the presence of calcifications, there is no direct method to assess targeting accuracy in MRI-guided vacuum-assisted biopsy. Radiological-histopathological concordance is therefore of utmost importance to avoid missing any malignancies in cases of suspicious imaging findings with negative biopsy results.[15,16] It is the operator's responsibility to review the histology results and report any discordance to the surgical team, for which the next appropriate step of management entails a repeated or excisional biopsy.

CONCLUSION

MRI has become an indispensable component of breast imaging due to its high sensitivity in lesion detection. However, its limited specificity, with significant overlap of MRI characteristics between malignant and benign lesions, highlights the importance of radiological-histopathological correlation. It is therefore vital for breast radiologists to understand the fundamentals of MRI-guided vacuum-assisted biopsy in the face of its growing demands to achieve technical success and guide the management of breast lesions occult on mammography and ultrasound. MRI-guided vacuum-assisted biopsy of the breast is a safe, feasible, and effective procedure with high diagnostic yield in the hands of experienced interventionists.

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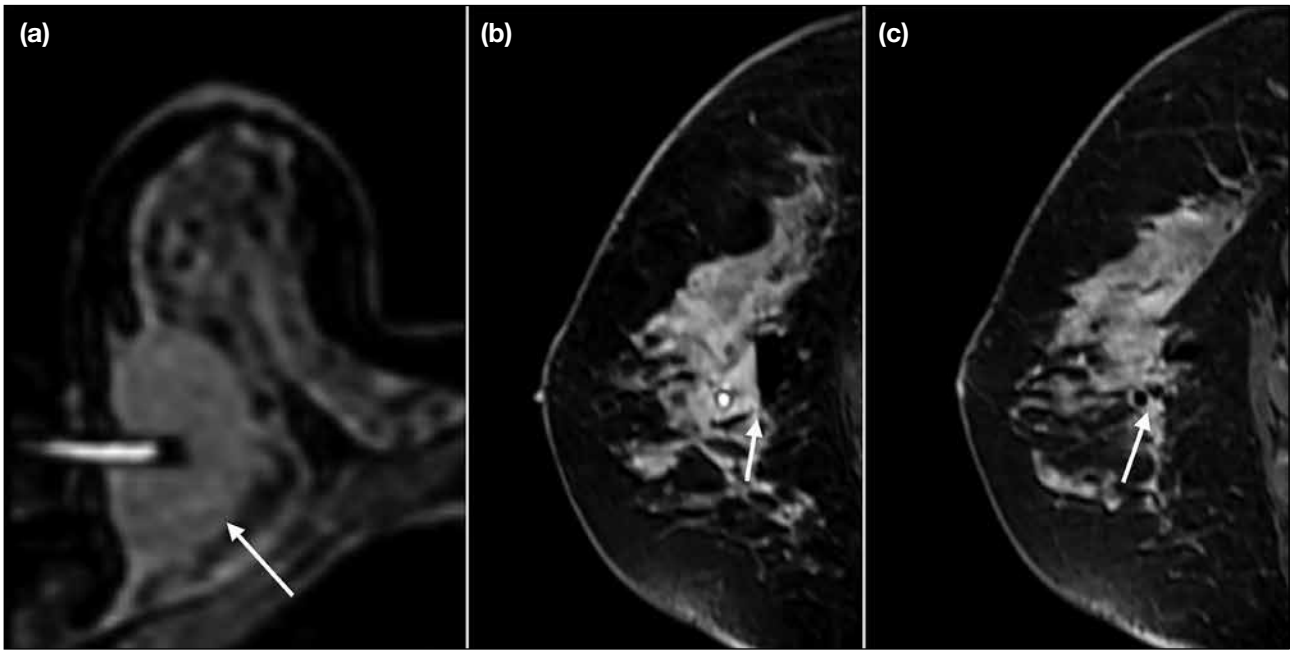

Figure 8. Postprocedural haematoma. (a) A large biopsy site haematoma (arrow) on a postprocedural image. (b) Another case complicated by a biopsy site haematoma. A cavity with an air-blood level (arrow) is seen as a vertical line in this prone patient. (c) Aspiration of the haematoma was performed in the case shown in (b) with the vacuum-assisted biopsy device. Post-aspiration image shows marked reduction in the size of the cavity (arrow).

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