VOLUME - 14, ISSUE - 12, DECEMBER - 2025 • PRINT ISSN No. 2277 - 8160 • DOI : 10.36106/gjra

Original Research Paper

Radio-Diagnosis

DIAGNOSTIC PERFORMANCE OF VACUUM-ASSISTED BIOPSY FOR BREAST LESIONS: ULTRASOUND AND STEREOTACTIC APPROACHES

Damini Kashyap	Scientific Assistant B, Department of Radiodiagnosis, Homi Bhabha Cancer Hospital and Mahamana Pandit Madan Mohan Malaviya Cancer Centre, Varanasi (A Unit of Tata Memorial Hospital, Mumbai).
Karan Gupta	Scientific Officer - SB, Department of Radiodiagnosis, Homi Bhabha Cancer Hospital and Mahamana Pandit Madan Mohan Malaviya Cancer Centre, Varanasi (A Unit of Tata Memorial Hospital, Mumbai).
Dr. Satyendra Narayan Singh	Prof. and Head of the Department of Radiodiagnosis, Homi Bhabha Cancer Hospital and Mahamana Pandit Madan Mohan Malaviya Cancer Centre, Varanasi (A Unit of Tata Memorial Hospital, Mumbai).

ABSTRACT The Vacuum-Assisted Breast Biopsy (VABB) represents a significant advancement in percutaneous breast tissue sampling, offering a highly precise, minimally invasive alternative to traditional core needle biopsy techniques. Introduced in 1995 with the Mammotome system, VABB integrates a vacuum mechanism with a rotating cutting device to procure larger, contiguous, and more representative tissue specimens. This technical refinement has been shown to enhance diagnostic accuracy, particularly for complex or heterogeneous lesions, while markedly reducing sampling error and histologic underestimation. The increased volume and integrity of retrieved tissue render diagnostic performance less dependent on the total number of cores obtained. Initially implemented under stereotactic mammographic guidance in 1996, VABB rapidly demonstrated utility in the evaluation of microcalcifications. Its indications soon expanded to ultrasound-guided applications by 1998, facilitating efficient assessment of both palpable and non-palpable masses. Subsequent adaptation of the technique for MRI-guided biopsy further extended its capability to lesions detectable exclusively on advanced imaging sequences, thereby ensuring comprehensive coverage across all major breast imaging modalities. Accumulating clinical evidence underscores the reliability, safety, and diagnostic superiority of VABB, supporting its role as a viable alternative-and in many scenarios a preferred substitute-to surgical excision biopsy. As a versatile, multimodality-compatible technique, VABB provides robust diagnostic support across screening, diagnostic evaluation, and preoperative staging, reaffirming its established and expanding clinical value.

KEYWORDS : Vacuum assisted breast biopsy (VABB), Microcalcifications, core needle biopsy (CNB), breast tumor, ultrasound guided biopsy, stereotactic guided biopsy, fine needle aspiration (FNA), Mammotome

INTRODUCTION

The VABB procedure, which stands for Vacuum-Assisted Breast Biopsy, is a less invasive method that may be used as an outpatient surgery to take tissue samples from the breast in order to detect suspected breast lumps that may be benign or malignant. Imaging techniques like ultrasound, mammography, or magnetic resonance imaging (MRI) are used under the guidance. The procedure is performed by a using a real-time imaging modality to guide the biopsy device precisely to the target area. Additionally, compared to certain other biopsy methods, it enables the collection of bigger, more comprehensive tissue samples, improving diagnostic accuracy. Before the mid-1990s, the diagnostic approach depended largely on two primary percutaneous techniques: fine needle aspiration cytology (FNA) and core needle biopsy (CNB). VABB is designed to overcome the shortcomings of conventional core needle biopsies.

The product was swiftly brought to market, starting with the Mammotome® Breast Biopsy System in 1995, developed by radiologist Fred Burbank and medical device engineer Mark Retchard, initially introduced by Biopsys, to address the limitations of core biopsies through an automated biopsy approach. Stereotactic VABB, first introduced by Burbank and Parker in 1996, was the initial guidance method officially recorded for VABB and became a recognized interventional option for acquiring tissue samples from regions with suspicious breast microcalcifications. The adaptability of the system quickly resulted in its growth into additional modalities. VABB guided by the ultrasonography was initially conducted by Zannis et al. in 1998. This growth was commercially aided by the launch of the Mammotome® HH (Handheld) system in 1999, created specifically for procedures guided by ultrasound. The swift implementation of VABB in both stereotactic and ultrasound techniques showcased an instant acknowledgment of the technology's capability to address crucial diagnostic voids within the range of breast lesions that are masses or calcifications. The addition of MRI-guided VABB tackled the ultimate diagnostic challenge is lesions detectable solely through breast MRI. Although breast MRI provides nearly 100% sensitivity for detecting cancer, its specificity can vary, resulting in both true and false positive lesions that need tissue confirmation. MRI-guided VAB was swiftly acknowledged as a precise, rapid, and secure substitute for surgical biopsy in dealing with these difficult MRI-only lesions, guaranteeing that VABB could deliver thorough diagnostic support for all screening and staging situations. VABB shows distinct technical benefits in difficult anatomical and pathological settings. Thanks to the vacuum aspiration and strong rotating cutter, VABB achieves superior histological outcomes, even in dense or hard lesions where conventional core sampling might not succeed. Radiographs of specimens were acquired in every instance containing microcalcifications. If no microcalcifications were found and the other microcalcifications were noted in the breast, the biopsy was deemed unrepresentative, and a repeat biopsy was suggested. Although conventional CNB necessitates at least three to four cores to attain strong diagnostic accuracy, the diagnostic dependability of VABB seems to be unaffected by the quantity of cores taken, indicating the superior quality and amount of tissue obtained with each insertion.

The best way to view the lesion determines the guiding technique that is employed.

1. Stereotactic Guidance:

Stereotactic guided VABB is considered for clusters of microcalcifications, which are small calcium deposits that could be early indicators of breast cancer (usually ductal carcinoma in situ or DCIS) and non-palpable lesions such as masses, asymmetries, or architectural distortions only detectable through mammography or breast tomosynthesis. This biopsy technique allows many samples to be acquired with one incision with minimal scarring, occasionally eliminating small, benign anomalies entirely. Using the American College of Radiology's breast imaging reporting and data system (BI-RADS) vocabulary, the lesions were evaluated prospectively and classified based on their imaging appearance and level of suspicion.

2. Ultrasonography Guidance:

Ultrasound guided VABB is a highly effective, minimally invasive procedure used to obtain large tissue samples from a suspicious area in the breast that is clearly visible on an ultrasound scan. It combines the real-time visualization of ultrasound with the superior tissue collection capabilities of the VABB system equipped with computer software that facilitates easy automatic or manual sample collection. Unlike stereotactic guidance, the breast is not compressed, making the procedure generally more comfortable and Ultrasound uses sound waves, eliminating X-ray exposure.

3. MRI Guidance:

MRI-Guided VABB is the most specialized form of image-guided breast biopsy. It is reserved for lesions that are only visible on Magnetic Resonance Imaging (MRI) and cannot be definitively located using mammography (stereotactic guidance) or ultrasound. These are often referred to as "MRI-only lesions" or "occult lesions" that can detect small, subtle lesions that traditional methods miss. The patient lies prone on a specialized MRI table with the breast positioned in a dedicated breast coil. This coil gently compresses the breast to minimize movement and hold it in place. A small incision is made, and a special MRI-compatible VABB probe is inserted and advanced into the calculated target location. The vacuum-assisted device is activated to collect multiple tissue samples through the single insertion. After the samples are taken, a tiny, MRI-compatible metallic clip is often placed at the biopsy site to mark the location for future imaging follow-up or surgical planning, particularly if the entire lesion has been removed.

Procedure

The VABB procedure is conducted on an outpatient basis under local anaesthesia and typically requires less than one hour, depending on the imaging guidance used. For ultrasound-guided VABB, patients were positioned supine, whereas for stereotactic-guided VABB, they were seated comfortably in an upright, well-stabilized position. The procedure commenced with administration of local anaesthesia: the biopsy site was infiltrated with 2% lidocaine to raise a superficial wheal, followed by the injection of lidocaine–adrenaline along the anticipated needle track and around the target lesion to optimize analgesia and minimize bleeding. Once adequate anaesthesia was achieved, needle insertion was performed. In ultrasound-guided VABB, the probe was positioned juxta-superiorly, juxta-inferiorly, or directly within the lesion depending on its depth, proximity to the chest wall or skin, and overall dimensions, ensuring precise alignment of the sampling through the lesion. In stereotactic-guided VABB, correct needle placement was confirmed through a second set of paired stereotactic images before tissue retrieval. Vacuum assistance was then applied to secure continuous extraction of tissue cores. For lesions containing micro calcifications, specimen radiography was performed immediately after sampling to confirm the presence of calcifications within the retrieved material. Following tissue acquisition, cold compression was applied along the incision site, needle tract, and lesion for 10–15 minutes to control bleeding. An antiseptic dressing was then placed, hematoma volume was assessed using immediate post-biopsy ultrasound, and an elastic compression bandage was applied around the chest. Patients were observed briefly to monitor for complications. If no adverse events were noted and post-procedure imaging was satisfactory, patients were discharged home the same day.

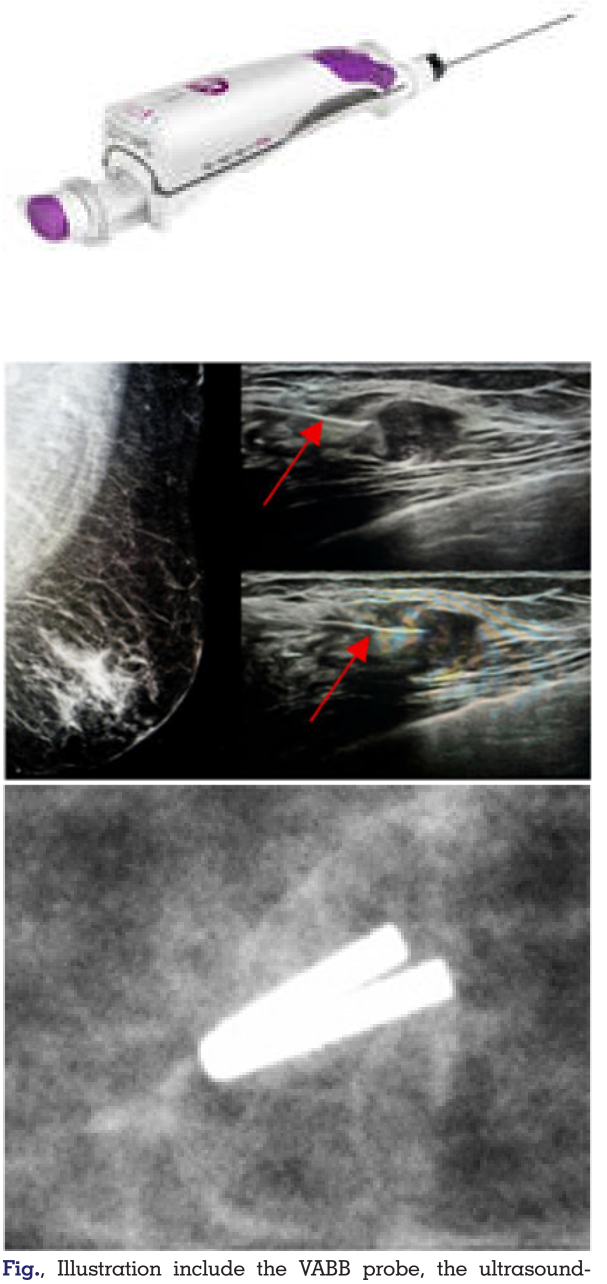

Fig., Illustration include the VABB probe, the ultrasound-guided biopsy needle during tissue acquisition, and the resulting post-procedural metallic clip localization at the biopsy site.

Sizes of probes

The diameter of Vacuum-Assisted Breast Biopsy (VABB) probes is classified according to the Gauge (G) system, in which a lower gauge number corresponds to a larger needle diameter. Thus, an 8-gauge (8G) probe is substantially wider than an 11-gauge (11G) probe. VABB employs wide-bore needles to obtain larger, more representative tissue specimens, a factor known to reduce the likelihood of histopathological underestimation, particularly in lesions where sampling adequacy is critical for accurate diagnosis. In clinical practice, VABB systems typically utilize probe sizes ranging from 7G to 13G, with the choice of gauge influenced by the design of the biopsy device, lesion characteristics, and the imaging modality used for guidance. Owing to their larger diameter, lower-gauge probes (e.g., 7G or 8G) allow retrieval of higher-volume tissue cores compared with higher-gauge probes (e.g., 11G or 13G). For stereotactic-guided VABB, 8G and 11G probes are the most commonly cited, as these sizes offer an optimal balance between maximizing tissue yield—particularly for micro calcifications—and maintaining procedural precision. Ultrasound-guided VABB is predominantly employed for sampling solid breast masses such as fibro adenomas or imaging-suspicious nodules. In this context, both diagnostic sampling and complete percutaneous excision of small benign lesions can be achieved, with probe selection tailored to lesion size, depth, and proximity to critical structures.

The size of the VABB probe is directly related to the procedure's goals-

Probe Gauge (G)	Sample volume	Primary indication / typical use
Small 12G, 13G	Smaller tissue volume	Biopsy of small, superficial, or retro areolar lesion or in thin breast where a larger probe might be difficult to position. offers good patient tolerability and a notable improvement in tissue volume.
Medium 9G, 10G, 11G	High volume tissue sampling	Diagnostic biopsy of suspicious lesions and sampling microcalcifications.
Large 7G-8G	Maximum tissue volume per core	Excising benign lesions, greatly cutting down on the number of cores required and perhaps speeding up the process.

Diagnostic And Therapeutic Indications

Vacuum-Assisted Breast Biopsy (VABB) demonstrates high diagnostic accuracy for evaluating imaging-detected abnormalities, including masses, architectural distortion, and clusters of microcalcifications. Owing to its ability to retrieve larger and more contiguous tissue specimens, VABB provides sufficient material for thorough histopathological assessment, enabling reliable differentiation among benign, high-risk, and malignant lesions. The technique is particularly advantageous for lesions smaller than 5 mm, for which conventional core needle biopsy (CNB) may yield insufficient samples and potentially result in false-negative outcomes. Additional clinical indications for VABB include ultrasound-detected microcalcification clusters, complex cystic lesions, suspected intraductal papilloma's, and cases in which fine-needle aspiration cytology (FNAC) or CNB has produced inconclusive or inadequate results. VABB is also beneficial in the diagnostic workup of inflammatory breast cancer—characterized by the absence of a discrete mass—where it offers superior tissue acquisition compared with FNAC or CNB. Furthermore, VABB may be performed to obtain diagnostic confirmation prior to administering neoadjuvant chemotherapy in BI-RADS 5 and 6 lesions.

In 2002, the U.S. Food and Drug Administration approved VABB for the percutaneous removal of benign breast lesions. Its therapeutic application is particularly relevant for symptomatic, non-suspected malignant lesions such as fibroadenomas and recurrent cysts, with complete excision achievable for lesions up to approximately 2.5–3.0 cm in diameter. This approval reflects VABB's capacity to procure substantial tissue volumes, thereby offering a minimally invasive alternative to surgical excision. Fibroadenomas, the most common benign breast lesions—especially in young women—traditionally required surgical excision to confirm benignity and alleviate patient discomfort or uncertainty. VABB now provides an effective, less invasive therapeutic option for their management.

Complications

Vacuum-Assisted Breast Biopsy (VABB) is widely regarded as a minimally invasive, safe, and highly reliable modality for the evaluation of suspicious breast abnormalities and, in appropriately selected cases, for the percutaneous removal of small benign lesions. Although the procedure demonstrates an excellent safety profile, it is not entirely devoid of risks, as with any image-guided intervention. The most commonly encountered complication is post-procedural hematoma formation, which results from localized bleeding within the soft tissues and presents as swelling, bruising, and varying degrees of discomfort. The likelihood and extent of hematoma development may be influenced by the probe gauge—larger-caliber instruments are associated with a marginally higher risk—as well as patient-specific factors such as the use of anticoagulant or antiplatelet therapy. In the vast majority of cases, hematomas are mild and are effectively managed through immediate manual compression, application of a firm pressure dressing, and intermittent cold packs.

Localized pain or tenderness is another anticipated post-biopsy symptom, typically emerging once the effect of the local anaesthetic subsides. Although VABB is performed with adequate anaesthesia and continuous imaging guidance, some individuals may experience transient discomfort during tissue sampling. Post-procedural pain is usually mild and responds well to simple analgesics such as acetaminophen, while avoiding medications that may exacerbate bleeding. Minor bleeding from the incision site is occasionally observed but generally resolves promptly with direct compression. More serious complications—such as inadvertent injury to the chest wall or pneumothorax—are exceedingly rare owing to precise needle placement under imaging guidance. Nevertheless, these remain theoretical considerations for lesions located deeply or in close proximity to the pectoral musculature. Overall, VABB maintains a favourable complication profile, with significant adverse events occurring infrequently.

CONCLUSION

Vacuum-Assisted Breast Biopsy (VABB) has emerged as a highly versatile and widely utilized percutaneous technique, compatible with multiple imaging modalities, including ultrasound, stereotactic mammography, and magnetic resonance imaging (MRI). This adaptability establishes VABB as a reliable and definitive method for tissue sampling, particularly in cases where imaging studies reveal suspicious abnormalities that require histopathological evaluation. Its precision and ability to obtain substantial tissue volumes make it a preferred alternative to conventional diagnostic approaches. When compared with traditional open surgical biopsy, VABB offers several distinct advantages. It is minimally invasive, results in significantly less tissue trauma, and is associated with improved cosmetic outcomes.

Moreover, it accelerates the diagnostic process by reducing the interval between lesion detection and pathological confirmation, thereby enabling more timely clinical decision-making. The procedure is also cost-effective, reducing both healthcare expenditures and patient recovery time relative to surgical excision. In addition to its diagnostic utility, VABB possesses therapeutic potential. Small benign lesions, including fibroadenomas and selected cystic masses, can be excised entirely through this approach, eliminating the need for more invasive surgical interventions. By combining diagnostic accuracy with the capacity for complete lesion removal, VABB represents a dual-purpose, minimally invasive strategy that enhances patient care, optimizes procedural efficiency, and is increasingly recognized as an integral tool in contemporary breast disease management.

REFERENCES

1. Park HL, Hong J. Vacuum-assisted breast biopsy for breast cancer. Gland surgery. 2014 May;3(2):120.
2. Feuer EJ, Wun LM, Boring CC, Flanders WD, Timmel MJ, Tong T. The lifetime risk of developing breast cancer. JNCI: Journal of the National Cancer Institute. 1993 Jun 2;85(11):892-7.
3. Fu SM, Wang XM, Yin CY, Song H. Effectiveness of hemostasis with Foley catheter after vacuum-assisted breast biopsy. Journal of Thoracic Disease. 2015 Jul;7(7):1213.
4. Greenberg R, Skornick Y, Kaplan O. Management of breast fibroadenomas. Journal of general internal medicine. 1998 Sep;13(9):640-5.
5. Zografos GC, Zagouri F, Sergentanis TN, Nonni A, Michalopoulos NV, Kontogianni P, Koulocheri D, Dimitriadis IE, Bramis J, Patsouris E. Diagnosing papillary lesions using vacuum-assisted breast biopsy: should conservative or surgical management follow?. Oncology Research and Treatment. 2008 Nov 20;31(12):653-6.
6. Kim MJ, Kim EK, Kwak JY, Son EJ, Park BW, Kim SI, Oh KK. Nonmalignant papillary lesions of the breast at US-guided directional vacuum-assisted removal: a preliminary report. European Radiology. 2008 Sep;18(9):1774-83.
7. PARK HL, KANG SS, KIM DY, SHIM JY. Is surgical excision necessary for a benign phyllodes tumor of the breast diagnosed and excised by ultrasound-guided vacuum-assisted biopsy device (mammotome)?. Journal of the Korean Surgical Society. 2007:198-203.
8. Cassano E, Urban LA, Pizzamiglio M, Abbate F, Maisonneuve P, Renne G, Viale G, Bellomi M. Ultrasound-guided vacuum-assisted core breast biopsy: experience with 406 cases. Breast cancer research and treatment. 2007 Mar;102(1):103-10.
9. Sebag P, Tourasse C, Rouyer N, Lebas P, Denier JF, Michenet P. Value of vacuum assisted biopsies under sonography guidance: results from a multicentric study of 650 lesions. Journal de radiologie. 2006 Jan 1;87(1):29-34.
10. Sebag P, Tourasse C, Rouyer N, Lebas P, Dénier JF, Michenet P. Value of vacuum-assisted biopsies under sonographic guidance: results from a multicentric study of 650 lesions. Clinical Imaging. 2006 Jul 1;30(4):298.
11. Dennis MA, Parker S, Kaske TI, Stavros AT, Camp J. Incidental treatment of nipple discharge caused by benign intraductal papilloma through diagnostic Mammotome biopsy. American Journal of Roentgenology. 2000 May;174(5):1263-8.
12. Govindarajulu S, Narreddy S, Shere MH, Ibrahim NB, Sahu AK, Cawthorn SJ. Preoperative mammotome biopsy of ducts beneath the nipple areola complex. European Journal of Surgical Oncology (EJSO). 2006 May 1;32(4):410-2.
13. Layfield LJ, Chrischilles EA, Cohen MB, Bottles K. The palpable breast nodule. A cost-effectiveness analysis of alternate diagnostic approaches. Cancer. 1993 Sep 1;72(5):1642-51.
14. Sperber F, Blank A, Metser U, Flusser G, Klausner JM, Lev-Chelouche D. Diagnosis and treatment of breast fibroadenomas by ultrasound-guided vacuum-assisted biopsy. Archives of Surgery. 2003 Jul 1;138(7):796-800.
15. Johnson AT, Henry-Tillman RS, Smith LF, Harshfield D, Korourian S, Brown H, Lane S, Colvert M, Klimberg VS. Percutaneous excisional breast biopsy. The American journal of surgery. 2002 Dec 1;184(6):550-4.
16. Sie A, Bryan DC, Gaines V, Killebrew LK, Kim CH, Morrison CC, Poller WR, Romilly AP, Schilling K, Sung JH. Multicenter evaluation of the breast lesion excision system, a percutaneous, vacuum-assisted, intact-specimen breast biopsy device. Cancer: Interdisciplinary International Journal of the American Cancer Society. 2006 Sep 1;107(5):945-9.

Available Websites:

17. http://www.nlm.nih.gov/medlineplus/ency/article/000912.htm
18. https://doi.org/10.1002/cncr.11887
19. https://doi.org/10.1016/j.carj.2017.08.004