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ORIGINAL RESEARCH ARTICLE

Outcomes of ultrasound-guided vacuum-assisted excision of breast lesions: A single-center study

Khalid M. Alshamrani[1,2,3]*, Samar Alshehri[2,3,4], Nesreen Abourokbah[2,3,4], and Shaza Alsharif[1,2,3]

[1]College of Applied Medical Sciences, King Saud bin Abdulaziz University for Health Sciences, Jeddah, Saudi Arabia

[2]King Abdullah International Medical Research Center, Jeddah, Saudi Arabia

[3]Ministry of the National Guard - Health Affairs, Jeddah, Saudi Arabia

[4]College of Medicine, King Saud bin Abdulaziz University for Health Sciences, Jeddah, Saudi Arabia

Abstract

This study aims to present ultrasound-guided vacuum-assisted excision (UGVAE) as an alternative therapeutic approach for benign breast lesions. In addition, it evaluates the procedure's performance, associated complications, and clinical outcomes. This single-center, retrospective cohort study, approved by the Institutional Review Board, included 67 female patients who underwent UGVAE for breast lesions using 7 – 10 G needles. The study analyzed various parameters, including patient demographics, imaging features, and follow-up findings. Indications for UGVAE included patient preference, pain, palpable lump, nipple discharge, discordant biopsy results, and interval increase in breast imaging-reporting and data system (BI-RADS) 3 lesions. Lesion size, shape, echogenicity, and location were assessed through ultrasound and mammography. UGVAE was performed by two experienced radiologists, and post-procedure complications were documented. Data were analyzed using the Statistical Package for the Social Sciences and descriptive statistical methods. The mean age of the study population was 41.8 ± 14 years, and the mean lesion size was 1.7 ± 0.85 cm. A previous biopsy of the lesion was recorded in 19.4% of cases, and 7.5% of the patients had a history of breast cancer. The indications for UGVAE included patient preference (22.4%), pain (16.4%), palpable lump (14.9%), and an interval increase in BI-RADS 3 lesions (17.9%). Abnormal mammographic findings were reported in 95.1% of cases. Sonographic features predominantly included circumscribed (94%) and oval (73.1%) lesions. Complete excision was achieved in 80.6% of cases, and hematoma occurred in 13.4% of patients as a post-procedure complication. Histopathological results confirmed all lesions as benign, with fibroadenoma being the most common diagnosis (50.7%). Follow-up imaging showed no significant residual lesion in 46.3% of patients. UGVAE is considered a cost-effective, minimally invasive, and safe alternative to surgical excision for benign breast lesions.

Keywords: Vacuum-assisted; Ultrasound; Benign breast lesions; Breast mass; Breast biopsy

***Corresponding author:**
Khalid M. Alshamrani
(alshamranik@ksau-hs.edu.sa)

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1. Introduction

Benign breast masses are common clinical findings, especially among women of reproductive age and encompass a variety of non-cancerous conditions such as fibroadenomas (FA), cysts, and fibrocystic changes.[1,2] These masses often present as palpable lumps or areas of thickening and are typically discovered during routine breast examinations or imaging studies such as mammography or ultrasound.[3,4] The management of benign breast masses varies depending on factors such as the mass's size, location, symptoms, and any associated risks, including patient age and family history.[2,5] While many benign masses require only monitoring and conservative management, others may necessitate diagnostic procedures, like a biopsy, for further evaluation or interventions such as aspiration or surgical excision, particularly if they are symptomatic, growing, or causing cosmetic concerns.[6,7]

For benign breast masses, the need for follow-up examinations can significantly impact patients both emotionally and financially, often leading to poor compliance with recommended monitoring protocols.[1,8] Regular imaging studies or clinical re-evaluations are crucial for tracking any changes in the mass over time, but the frequency and duration of follow-up can create anxiety, particularly when patients perceive the risk of malignancy as uncertain.[4,9,10] Furthermore, surgical excision, though occasionally necessary for symptomatic or progressively enlarging masses, is a costly procedure that may not be covered by all insurance plans. It can also leave permanent scars on the breast, potentially affecting the patient's body image and quality of life.[11,12] As a result, many patients may be reluctant to undergo excision or adhere to prolonged follow-up schedules, highlighting the need for a patient-centered approach that balances clinical necessity with consideration for psychological, esthetic, and financial factors.[13,14]

Vacuum-assisted excisional biopsy (VAB) is a specialized technique that utilizes large-bore needles, typically 8G or 11G, to extract larger tissue samples compared to fine-needle aspiration or core needle biopsy. This capability significantly reduces the rate of negative biopsies and minimizes discordance between the biopsy material and surgical specimens.[15] In 2002, the United States Food and Drug Administration authorized VAB for excising benign breast lesions. While VAB allows for the removal of substantial tissue volumes, open surgical excision remains the preferred approach for large, palpable masses.[16] Consequently, the indications and effectiveness of VAB remain topics of debate.[17] VAB is particularly advantageous in diagnosing challenging cases, such as invasive lobular carcinomas, which often grow in an infiltrative pattern rather than forming distinct masses. Accurate diagnosis of these lesions requires larger tissue samples, making VAB the preferred method. Furthermore, VAB is well-suited for sampling lesions situated near delicate anatomical areas, including the thoracic wall or nipple, as its design avoids the use of a forward-moving needle, thereby improving both accuracy and safety.[18] Hematoma is the primary complication associated with minimally invasive procedures, posing a challenge to the use of ultrasound-guided vacuum-assisted systems for benign breast masses.[19] However, the exact mechanism by which vacuum-assisted systems contribute to hematoma formation remains unclear and lacks a definitive explanation.[20]

Conventionally, benign breast lesions, such as FA, are diagnosed using a triple assessment approach, which includes clinical evaluation, imaging (ultrasound, mammography, or magnetic resonance imaging), and pathological examination through core biopsy or, historically, fine needle aspiration cytology. When a lesion is confirmed to be a simple FA, management options typically include reassurance without further intervention for most patients, periodic follow-up with imaging, or surgical excision in cases involving older patients (over 35 years), lesions larger than 3 cm, or complex FA.[21] Research by Dixon *et al.*[22] demonstrated that conservative management is a safe and widely accepted approach for patients under 40 years of age.[22] With advancements in ultrasound technology, current guidelines for managing breast symptoms suggest that, in patients younger than 25 years, biopsy is generally unnecessary if imaging reveals a solid lesion with benign characteristics, such as an ellipsoid shape, a wider-than-tall orientation, well-defined smooth margins, fewer than four gentle lobulations, and a homogeneous internal structure.[21]

Introduced in 1995, ultrasound-guided vacuum-assisted breast biopsy (UGVAB) has emerged as an effective technique for sampling non-palpable lesions identified through mammography.[23] While core needle biopsy is recognized for its precision and sensitivity,[24] its limited ability to capture the invasive characteristics of certain lesions, due to the small sample size, can hinder accurate diagnosis.[25] UGVAB addresses this limitation by obtaining larger tissue samples, thereby enhancing diagnostic accuracy and distinguishing benign from malignant breast lesions.[26] Furthermore, ultrasound-guided vacuum-assisted excision (UGVAE), a related technique, is now widely used not only for the biopsy of breast lesions but also for treating benign breast conditions, solidifying its role as a versatile and valuable tool in breast disease management.[15,27-29]

The available literature on UGVAE remains limited, highlighting the need for further exploration. This study aims to bridge this gap by presenting UGVAE as a viable diagnostic and therapeutic technique for managing benign breast lesions. UGVAE is considered a therapeutic method because it offers a minimally invasive alternative to surgical excision, achieving high rates of complete lesion removal while preserving favorable cosmetic outcomes.[28] Studies have demonstrated that UGVAE provides efficacy comparable to open surgery in terms of lesion clearance while significantly reducing procedural morbidity, recovery time, and the need for general anesthesia.[17,27] Furthermore, research suggests that UGVAE ensures long-term stability with low recurrence rates, making it a reliable option for treating benign breast lesions such as FA and papillomas.[21] In addition, the present study evaluates the procedure's performance, potential complications, and overall outcomes, offering valuable insights into its clinical utility and effectiveness.

2. Methods

2.1. Study design and subjects

This single-center, retrospective cohort study was approved by the Institutional Review Board of King Abdullah International Medical Research Center (approval code: RJ20/052/J; approval date: April 26, 2020). Over a 4-year period, from 2016 to 2020, a total of 991 ultrasound-guided breast biopsies were performed. Among these cases, 67 female patients with a single breast lesion underwent UGVAE for complete lesion excision. All patients who underwent UGVAE during this timeframe were included in the study. The parameters analyzed included patient demographics, imaging characteristics of the lesions (both mammographic and sonographic), as well as pathological and clinical follow-up outcomes. The clinical indications for UGVAE included patient preference, the presence of pain, palpable lumps, nipple discharge, discordant previous biopsy results, or interval changes in breast imaging-reporting and data system (BI-RADS) 3 lesions. Ultrasound examinations were conducted using a Logiq P5 ultrasound system (General Electric Healthcare, United States) equipped with a 7.5 MHz linear array probe. Before imaging, we ensured that patients were not on anticoagulation therapy, particularly newer anticoagulants that may not be detected in standard blood tests. Therefore, we specifically inquired about the use of such medications. In addition, we confirmed that patients were not taking antiplatelet medications. For patients on anticoagulation therapy, we instructed them to discontinue the medication 2 days before the procedure. For other medications that can be detected in blood tests, discontinuation was advised 5 days before the procedure. Similarly, patients taking antiplatelet or anti-aggregation medications were required to stop them 5 days before the examination. Furthermore, all patients underwent a coagulation profile assessment before imaging to ensure their suitability for the procedure. All included lesions were confirmed to be benign, with no high-risk findings. Fine needle aspiration cytology was not performed, as it is no longer a standard practice in breast biopsies.

2.2. Imaging features

Lesion characteristics, such as size, shape, echogenicity, and anatomical location, were evaluated using ultrasound and, where applicable, mammography, following the BI-RADS lexicon for standardized reporting.

2.3. Experimental procedure

UGVAE was performed using 7-gauge and 10-gauge needles by two experienced breast radiologists, each with a decade of experience in breast imaging. The procedure was carried out under continuous ultrasound guidance to ensure precision and accuracy.

2.3.1. Procedure steps

2.3.1.1. Needle placement and tissue extraction

After confirming the correct needle placement, multiple tissue samples were extracted from the target lesion under ultrasound guidance. Complete lesion excision was achieved in most cases, confirmed by the absence of sonographic evidence of the lesion at the end of the procedure.

2.3.1.2. Tissue marker placement

A tissue marker was placed at the excision site to facilitate future imaging correlation. The marker's position was confirmed using ultrasound and/or mammography (Figure 1).

2.3.1.3. Post-excision measures

Following lesion excision, firm pressure was applied to the excision site for 10 min to control bleeding. A pressure dressing was then applied.

2.3.1.4. Sample preservation

All extracted tissue samples were immediately preserved in 10% formaldehyde and sent for histopathological analysis.

2.3.2. Post-procedural care

Comprehensive post-procedural instructions were provided to the patients, including:

2.3.2.1. Dressing care

The pressure dressing was to be removed after 8 h.

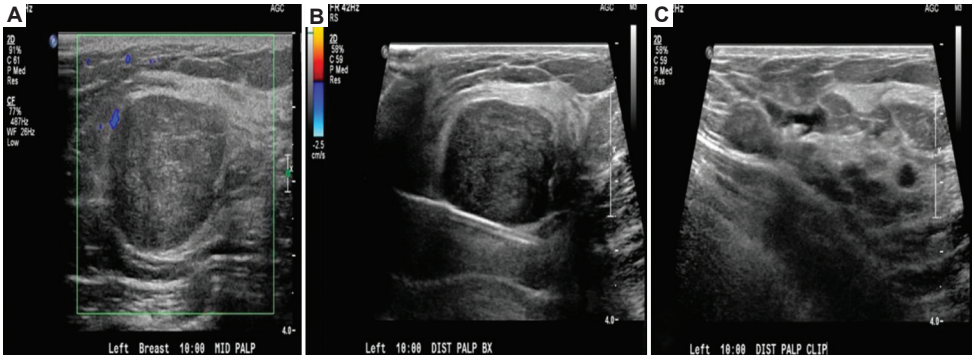


Figure 1. An 18-year-old woman presented with a palpable mass in the left breast. (A) Color Doppler ultrasound revealed a circumscribed, homogeneously hypoechoic mass with posterior acoustic shadowing and rim vascularity. The decision was made to perform a complete excision of the mass under ultrasound guidance. (B) The ultrasound image shows the needle positioned beneath the mass, with the needle apparatus centered on the lesion. (C) Post-procedure, the ultrasound demonstrates the absence of the mass, confirming complete excision, with a marker clip placed at the site.

2.3.2.2. Activity resumption

Patients were encouraged to resume normal activities immediately but were advised to avoid strenuous upper-body activities for 24 h.

2.3.2.3. Special instructions for retro-areolar biopsies

Patients undergoing retro-areolar biopsies were informed about the potential for nipple bleeding.

2.3.2.4. Hygiene restrictions

Showering and swimming were discouraged for 48 h post-procedure.

2.3.2.5. Pain management

Discomfort or a sense of heaviness lasting 24 – 48 h should be managed with paracetamol, while non-steroidal anti-inflammatory drugs were discouraged.

2.3.2.6. Supportive measures

Patients were advised to wear a supportive bra for 2 days to reduce discomfort and support healing.

2.3.2.7. Emergency instructions

In the event of bleeding, patients were instructed to apply firm pressure to the site for 20 min. If the bleeding persisted, they were advised to visit the nearest emergency room.

2.3.3. Post-procedural monitoring and documentation

All post-procedural complications were documented, along with their management strategies.

2.4. Data collection and analysis

Patient demographics and clinical presentations were extracted from medical records through the hospital information system. Imaging features were reviewed using the picture archiving and communication system, and histopathological findings were documented. Final surgical pathology reports, if available, were also reviewed. Statistical analysis was performed using the Statistical Package for the Social Sciences version 18. Descriptive statistics, such as means, standard deviations, ranges, and percentages, were used to summarize patient demographics, imaging characteristics, pathological findings, and clinical outcomes. A Chi-square (χ^2) test was conducted to assess the association between the completeness of lesion excision (complete or partial) and the occurrence of complications. In addition, a point-biserial correlation was used to evaluate the relationship between the completeness of lesion excision and lesion size. Data privacy and confidentiality were strictly maintained, with all identifiers removed from the data collection sheets. The collected data were stored securely in an encrypted Excel file.

3. Results

Table 1 summarizes the characteristics of the subject, lesions, and mammograms. The average age of the study population was 41.8 years (±14 years). The primary indications for UGVAE were patient preference (22.4%; n = 15), interval changes in BI-RADS 3 lesions (17.9%; n = 12), pain (16.4%; n = 11), a palpable lump (14.9%; n = 10), nipple discharge (13.4%; n = 9), a combination of pain and lump (7.5%; n = 5), discordant or biopsy-indicated cases (6%; n = 4), and pain with nipple discharge (1.5%; n = 1). There was no significant preference for lesion laterality, with 47.8% (n = 32) located on the right side and 52.2% (n = 35) on the left. Only 7.5% (n = 5) of patients had a history of breast cancer, while 92.5% (n = 62) did not. A previous biopsy of the excised lesion had been performed in 19.5% of cases (n = 13), while 80.6% (n = 54) had no previous biopsy. Mammography was performed in 61.2% (n = 41) of patients, with 95% (n = 39) showing abnormal findings

Table 1. Characteristics of subjects, lesions, and mammograms

Variable	Total subjects (*n*=67; 1 lesion/subject)
Age in years, mean (SD)	41.8 (14.02)
Study date, oldest–latest	October 2016 –2020
Reason for lesion removal by vacuum-assisted biopsy, *n* (%)	
Patient preference for lesion removal over the follow-up+anxiety and uncertainty	15 (22.4)
Interval increase in size of benign-looking mass on follow-up	12 (17.9)
Pain	11 (16.4)
Lump	10 (14.9)
Nipple discharge	9 (13.4)
Pain+lump	5 (7.5)
Pain+nipple discharge	1 (1.5)
Discordant biopsy result+inconclusive radiological features	4 (6)
Lesion side, *n* (%)	
Right	32 (47.8)
Left	35 (52.2)
Subjects with history of breast cancer, *n* (%)	
Yes	5 (7.5)
No	62 (92.5)
Previous biopsy, *n* (%)	
Yes	13 (19.4)
No	54 (80.6)
Mammogram, *n* (%)	
Normal	2 (3)
Abnormal	39 (58.2)
Not performed	26 (38.8)
Lesion location, *n* (%)	
Retroareolar	26 (38.8)
Medial	15 (22.4)
Lateral	26 (38.8)
Lesion depth to skin, *n* (%)	
Superficial	26 (38.8)
Mid	36 (53.7)
Deep	5 (7.5)
Needle size, *n* (%)	
10 Gauge	57 (85.1)
7 Gauge	10 (14.9)

Abbreviation: SD: Standard deviation.

and 5% (n = 2) showing normal findings. Mammography was not performed in 38.8% (n = 26) of patients. Lesion locations were as follows: Retroareolar in 26 cases (38.8%), medial in 15 cases (22.4%), and lateral in 26 cases (38.8%). The lesion depth to the skin was superficial in 26 cases (38.8%), mid in 36 cases (53.7%), and deep in five cases (7.5%). UGVAE was performed using a 10-gauge needle in 57 cases (85.1%) and a seven-gauge needle in 10 cases (14.9%).

The sonographic characteristics of the lesions are summarized in Table 2. The mean size of the excised lesions was 1.7 cm (±0.85 cm), with a range of 0.4 – 4 cm. The shape of the lesions was primarily oval in 49 cases (73.1%), followed by irregular in 11 cases (16.4%) and round in

Table 2. Lesions' ultrasonographic findings

Variable	Total lesions (*n*=67)
Size in cm, mean (SD)	1.7 (0.85)
Shape, *n* (%)	
Oval	49 (73.1)
Round	7 (10.5)
Irregular	11 (16.4)
Margin, *n* (%)	
Circumscribed	63 (94)
Not circumscribed (i.e. irregular, spiculated, or angular)	4 (6)
Echo pattern, *n* (%)	
Homogenous solid	43 (64.2)
Heterogenous solid	9 (13.4)
Complex cystic and solid	5 (7.5)
Complicated cyst	9 (13.4)
Simple cyst	1 (1.5)
Other findings, *n* (%)	
Intraductal	8 (11.9)
Calcification	4 (6)
None	55 (82.1)
BI-RADS, *n* (%)	
2	4 (6)
3	11 (16.4)
4	45 (67.1)
5	2 (3)
6	5 (7.5)
Immediate post-biopsy ultrasound findings, *n* (%)	
No residual	61 (91)
Residual	2 (3)
Hematoma	4 (6)
Excision, *n* (%)	
Complete	54 (80.6)
Partial	13 (19.4)
Post-procedure complications (e.g. pain, hematoma, ecchymosis, or infection), *n* (%)	
Yes (intervention included: Vacuumed, compression, needle aspiration demonstrating clot and compression, and sutures with up to 3 stitches)	10 (14.9)
No	57 (85.1)

Abbreviations: BI-RADS: Breast imaging-reporting and data system; SD: Standard deviation.

seven cases (10.5%). Most lesions were circumscribed (94%; *n* = 63), while a smaller proportion (6%; *n* = 4) were not circumscribed. Most lesions had homogeneous solid echotexture (64.2%; *n* = 43), followed by heterogeneous solid (13.4%; *n* = 9), complicated cyst (13.4%; *n* = 9), complex cystic and solid (7.5%; *n* = 5), and simple cyst (1.5%; *n* = 1). Complete excision of the lesion was achieved in 80.6% of cases (*n* = 54), while partial excision was achieved in 19.4% of cases (*n* = 13). Post-procedural complications occurred in 10 cases (14.9%), including hematoma formation in nine cases (13.4%) and skin loss in one case (1.5%), while no complications were observed in 57 cases (85.1%).

Pathological and clinical follow-up findings are presented in Table 3. All UGVAE procedures yielded benign

Table 3. Pathological and clinical follow-up findings

Variable	Total subjects (*n*=67; 1 lesion/subject)
Benign pathology results, *n* (%)	
Papilloma	17 (25.4)
Fibroadenoma	34 (50.7)
Lipoma	1 (1.5)
Pseudoangiomatous stromal hyperplasia	1 (1.5)
Fibrocystic changes and adenosine	11 (16.4)
Scar	1 (1.5)
Fat necrosis	1 (1.5)
Tubular adenoma	1 (1.5)
Clinical follow-up, *n* (%)	
Imaging	31 (46.3)
Clinic	23 (34.3)
Surgery	4 (6)
No follow-up	9 (13.4)

histopathological results, which were distributed as follows: FA (50.7%; $n = 34$), papilloma (25.4%; $n = 17$), fibrocystic changes and adenosis (16.4%; $n = 11$), tubular adenoma (1.5%; $n = 1$), lipoma (1.5%; $n = 1$), pseudoangiomatous stromal hyperplasia (1.5%; $n = 1$), scar tissue (1.5%; $n = 1$), and fat necrosis (1.5%; $n = 1$). At our institution, UGVAE costs approximately 5000 Saudi Arabian Riyal (SAR) (i.e., ~ €1,280), compared to 15,000 SAR (i.e., ~ €3,840) for a surgical lumpectomy. Over a follow-up period of 6 – 12 months, imaging follow-up (ultrasound, mammography, or both) revealed no significant residuals in 46.3% of cases ($n = 31$). Clinical follow-up, conducted by the referring physician, showed a satisfactory outcome and normal clinical examination in 34.3% ($n = 23$). Four patients (6%) required subsequent surgeries, all of which confirmed benign, concordant pathology results with no residual lesion. Nine patients (13.4%) were lost to follow-up. There was no statistically significant association between the completeness of lesion excision (complete or partial) and lesion size or the occurrence of complications ($p>0.05$).

4. Discussion

The minimally invasive breast biopsy system has revolutionized the diagnosis and management of benign breast conditions, offering a more advanced and efficient approach. Lesions classified as probably benign often require follow-up, which can lead to significant anxiety for patients.[30] This study demonstrates that UGVAE is an effective method for managing benign breast lesions. It is a minimally invasive procedure with cosmetic advantages and has been shown to be safe,[31] as none of the patients in this study experienced major complications following the procedure.

UGVAE is generally well tolerated by patients, making it a favorable option for managing breast lesions. In the present study, patient preference accounted for 22.4% of the indications for UGVAE. Similarly, a separate study involving 134 patients reported that 94% preferred VAB over surgical intervention and indicated they would recommend the procedure to others.[32] In addition, 85% of patients were fully satisfied with the cosmetic outcomes, and 54% reported experiencing no pain during the procedure.[32] Overall, most patients tolerated the procedure well and expressed satisfaction with the results, underscoring its acceptability and effectiveness as a minimally invasive option.[32]

The primary limitations of the ultrasound-guided vacuum-assisted system are post-procedural complications, which have hindered its broader use in managing breast conditions. The most frequently reported complication is hematoma formation.[29] In this study, 10 patients (14.9%) developed small hematomas and minor skin loss, which were effectively managed with conservative measures, including hematoma aspiration, compression, and skin sutures. Similar rates of post-procedural hematoma, ranging from 9.4% to 10%, have been reported in other studies.[29,33]

Over a follow-up period of 6 – 12 months, imaging or clinical evaluations revealed no residual lesions in 81% of the patients in this study. These results align closely with those reported in a comprehensive study by Lee *et al.*,[34] where 84.9% of patients showed no residual or recurrent lesions.[34] However, the complete removal of masses observed on ultrasound does not always equate to complete histological clearance. In a study of 162 patients, residual tissue was identified in 16 cases during the second follow-up, even though none was detected in the first follow-up.[31] This suggests that very small residual tissue may not be immediately visible on post-excision ultrasound.[35] Consequently, a slight margin of additional excision might be necessary, even when imaging indicates the lesion has been fully removed, to ensure complete removal at the histological level.[36-38] In addition, UGVAE offers the advantage of being more cost-effective compared to surgical approaches.[34] UGVAE is completed within a relatively short time frame. Although the duration was not documented in the present study, existing literature indicates that it typically takes approximately 30 min.

In this study, the analysis revealed no statistically significant relationship between the initial sonographic size of the lesion and the occurrence of residual lesions that

ultimately necessitated lumpectomy. This finding suggests that the size of the lesion, as measured through ultrasound, may not be a determining factor in predicting whether residual tissue remains following the procedure. Similarly, the study found no significant association between the development of complications, such as hematoma or skin changes, and the presence of residual lesions, indicating that complications during or after the procedure are not necessarily linked to incomplete excision. These findings contrast with the results of several studies that have reported a significant correlation between lesion size and residual lesions.[30,31,35] Such studies suggest that larger lesion sizes may contribute to incomplete removal, potentially influencing the need for further surgical intervention. However, it is worth noting that other studies align with our findings,[32,39] reporting no statistically significant relationship between these variables. This discrepancy highlights the need for further research to clarify the factors influencing residual lesions and the role of procedural variables in determining clinical outcomes.

A notable limitation of this study was its relatively small sample size, which can be attributed to the specific referral protocols in place at our institution. These protocols may have restricted the inclusion of a broader and more diverse patient population, potentially affecting the generalizability of the findings. Furthermore, the follow-up period for this study ranged from 6 to 12 months. While this period is sufficient to observe immediate outcomes and early complications, it may not have been long enough to capture late-onset complications or long-term recurrence rates.

To address these limitations, future research would benefit from larger, multicenter trials that include a more diverse patient population. Such studies would enhance statistical power and provide a more comprehensive understanding of the procedure's efficacy and safety. In addition, extending the follow-up duration in subsequent studies would allow for the evaluation of long-term outcomes, including the durability of lesion removal, late complications, and overall recurrence rate. These steps are essential to further validate the findings and establish robust evidence supporting the broader clinical application of this procedure.

5. Conclusion

UGVAE has emerged as a cost-effective and safe alternative to traditional surgical methods for the removal of benign breast lesions. Its minimally invasive nature offers several advantages, including reduced procedural time, minimal scarring, and faster recovery, making it a preferred option for both patients and clinicians. Moreover, UGVAE minimizes the physical and psychological burden often associated with surgical interventions, providing a cosmetically favorable outcome while maintaining clinical efficacy. By offering a reliable and less invasive solution, UGVAE holds significant potential to redefine the management of benign breast conditions, particularly in settings where cost and patient comfort are critical considerations.

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Conflict of interest

The authors declare no conflicts of interest related to this research.

Author contributions

Conceptualization: All authors
Data curation: Khalid M. Alshamrani
Formal analysis: Khalid M. Alshamrani
Investigation: Samar Alshehri
Methodology: Khalid M. Alshamrani, Samar Alshehri
Resources: Khalid M. Alshamrani, Samar Alshehri, Nesreen Abourokbah
Software: Samar Alshehri
Supervision: Khalid M. Alshamrani, Samar Alshehri
Validation: Nesreen Abourokbah
Visualization: Khalid M. Alshamrani
Writing – original draft: All authors
Writing – review & editing: All authors

Ethics approval and consent to participate

Ethical approval for data collection and study conduct was obtained from the King Abdullah International Medical Research Center Ethics Committee (KAIMRC) (approval code: RJ20/052/J; approval date: April 26, 2020). KAIMRC is the research arm of King Saud bin Abdulaziz University for Health Sciences and the Ministry of National Guard – Health Affairs. This study was carried out independently, without financial support from public, commercial, or not-for-profit funding agencies. In addition, the study adhered to the ethical principles outlined in the Declaration of Helsinki. Informed consent for participation was not required due to the retrospective nature of the study, which involved the use of anonymous archival records. Data collection was performed using a data collection

sheet as the primary instrument, and no direct patient identifiers were included. Therefore, a consent form was not necessary.

Consent for publication

Consent for publication from participants was not required due to the retrospective nature of the study, which utilized anonymous archival records.

Availability of data

The data presented in this study are available upon request from the corresponding author, subject to privacy considerations.

Further disclosure

An educational exhibit poster based on this manuscript was presented at the European Congress of Radiology (ECR) 2021 (Online event, Vienna, Austria, March 3 – 7, 2021), titled Ultrasound Guided Complete Lesion Excision (UG-VAE) – Single Institution Experience. It was also electronically archived in the ECR Electronic Presentation Online System (EPOS™) with the DOI: 10.26044/ecr2021/C-11831.

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