Ann Med Res 2021;28(4):668-73

Annals of Medical Research

DOI: 10.5455/annalsmedres.2020.06.656

Original Article

Vacuum-assisted breast biopsy of microcalcifications on the stereotactic prone table and comparison of the histopathologic diagnosis with mammographic features

Veysel Atilla Ayyildiz[1], Onur Taydas[2], Figen Basaran Demirkazik[3], Meltem Gulsun Akpinar[3]

[1]Department of Radiology, Faculty of Medicine, Suleyman Demirel University, Isparta, Turkey
[2]Department of Radiology, Faculty of Medicine, Sakarya University, Sakarya, Turkey
[3]Department of Radiology, Faculty of Medicine, Hacettepe University, Ankara, Turkey

Abstract

Aim: Breast cancer is one of the most important causes of mortality and morbidity in women. With the widespread use of screening mammography, the detection of non-palpable suspected cancerous lesions is increasing. Therefore, the use of vacuum-assisted breast biopsy in the management of breast lesions continues to increase. The aim of this study was to evaluate the histopathological results of suspicious microcalcifications which were diagnosed by vacuum-assisted needle biopsy on a stereotactic prone table and to compare the mammographic features of the microcalcifications with the histopathological results.

Materials and Methods: The study included a total of 119 patients with a median age of 51 years (range, 33-77 years) who underwent stereotactic biopsy on a prone table because of suspicious microcalcifications between March 2010 and July 2014. Retrospective evaluation was made of the preoperative mammographic features, and the BI-RADS (Breast imaging-reporting and data system) scores of the microcalcifications and the vacuum biopsy and / or excisional histopathological results.

Results: Stereotactic vacuum-assisted breast biopsy revealed that 52.1% of the lesions were benign and 47.9% were malignant. After vacuum-assisted stereotactic biopsy 61 patients underwent surgery. In 10 of these (16.3%) the final excisional histopathological diagnosis was benign, and in 51 (83.7%) malignancy was determined.

Conclusion: Vacuum-assisted breast biopsy on a stereotactic prone table is a successful technique with a low failure rate for microcalcifications that are non-palpable and have no ultrasonographic findings.

Keywords: BI-RADS; mammography; microcalcifications; stereotactic vacuum biopsy

INTRODUCTION

Breast cancer is one of the most important causes of mortality and morbidity in women (1). Although the incidence of breast cancer continues to increase, the mortality rate has been reduced by 30% since 1990 (2). This reduction is largely attributed to the development of new therapies and the spread of screening mammography (3).

With the widespread use of screening mammography, the detection of non-palpable suspected cancerous lesions is increasing. Therefore, the use of percutaneous core biopsy in the management of breast lesions continues to increase. Percutaneous biopsy is a faster, cheaper and less invasive method compared to surgical biopsy (4). Percutaneous biopsy does not cause any deformity of the breast due to loss of tissue and there is no scar tissue development. Percutaneous core biopsy eliminates unnecessary surgical interventions for patients with benign lesions (5).

The aim of this study was to evaluate the results of vacuum biopsies performed because of suspicious microcalcifications on mammography and to compare the mammographic features of the calcifications with the histopathological results.

MATERIALS and METHODS

This retrospective study was approved by the Local Ethics Committee and was conducted in accordance with the Declaration of Helsinki. Informed consent was waived because of the retrospective nature of the study.

The study included a total of 119 patients with suspicious microcalcifications who underwent vacuum-assisted

Received: 24.06.2020 **Accepted:** 12.08.2020 **Available online:** 21.04.2021
Corresponding Author: Onur Taydas, Department of Radiology, Faculty of Medicine, Sakarya University, Sakarya, Turkey
E-mail: taydasonur@gmail.com

biopsy on a stereotactic prone table between March 2010 and July 2014 (Figure 1). The median age of the patients was 51 years (range, 33-77 years).

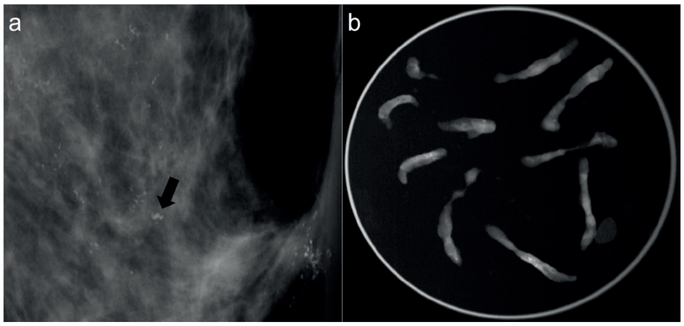

Figure 1. a-b: Magnified MLO radiograph of the right breast (a) showing fine pleomorphic calcifications (arrow). Specimen radiography after vacuum biopsy (b) showing that microcalcifications were sampled

Preoperative mammographic features, BI-RADS scores and, pathology reports of vacuum biopsies and final excisional histopathology diagnosis of the microcalcifications were evaluated retrospectively by two radiologists, one with 20 years of experience and the other with 5 years of experience. There was agreement between them for each case. The microcalcifications were reported according to BI-RADS (BI-RADS 4a, 4b, 4c or BI-RADS 5), in respect of distribution and morphological features. No biopsy was performed on any lesion scored as BI-RADS 3.

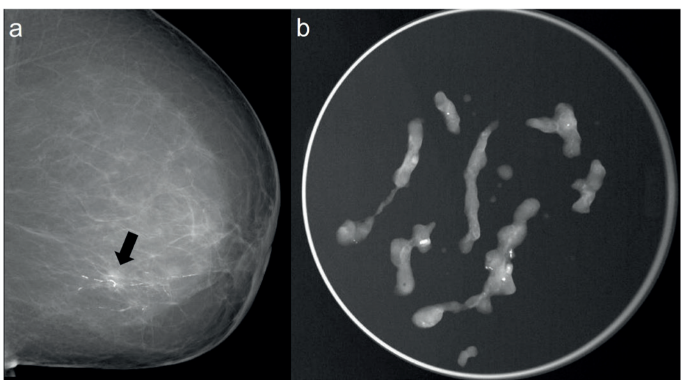

Figure 2. a-b: MLO radiograph of the left breast (a) showing fine linear branching calcifications and spiculated mass (arrow). Specimen radiography after vacuum biopsy (b) showing that microcalcifications were sampled

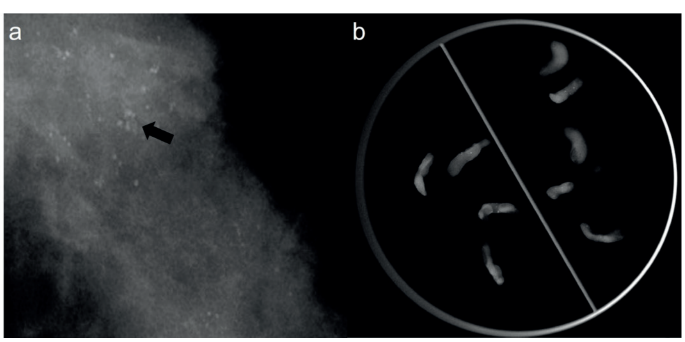

Figure 3. a-b: Magnified MLO radiograph of the right breast (a) showing round punctate calcifications (arrow). Specimen radiography after vacuum biopsy (b) showing that microcalcifications were sampled

Of the 119 microcalcifications, 66 (55.4%) had fine pleomorphic (Figure 1), 19 (15.9%) had fine linear or fine linear- branching (Figure 2), 13 (10.9%) had round-punctate (Figure 3), 13 (10.9%) had heterogeneous (Figure 4), and 8 (6.9%) had amorphous morphology (Figure 5). The regional distribution pattern was determined as group in 64 (53.8%), segmental in 45 (37.8%), linear in 7 (5.9%) and regional in 3 (2.5%). A diffuse distribution pattern was not observed in any case.

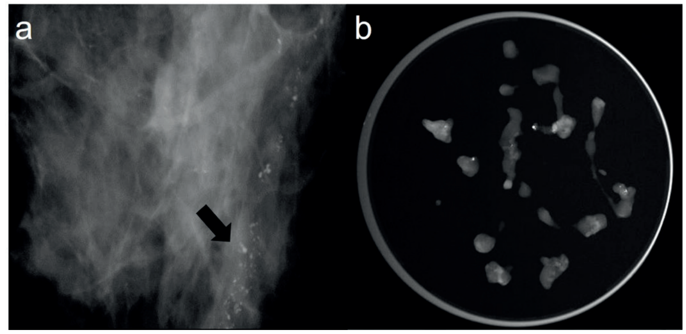

Figure 4. a-b: Magnified MLO radiograph of the right breast (a) showing heterogeneous calcifications (arrow). Specimen radiography after vacuum biopsy (b) showing that microcalcifications were sampled

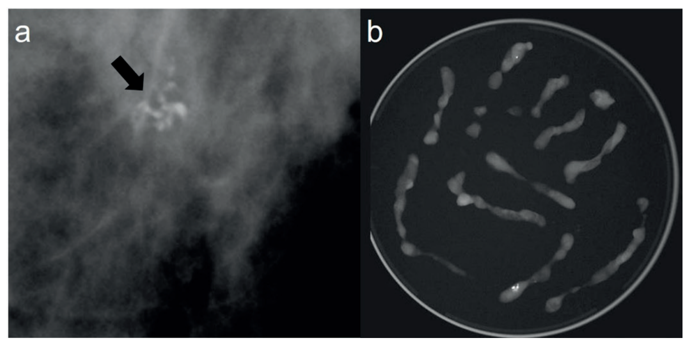

Figure 5. a-b: Magnified MLO radiograph of the right breast (a) showing amorphous calcifications (arrow). Specimen radiography after vacuum biopsy (b) showing that microcalcifications were sampled

BI-RADS 4 microcalcifications were determined in 93 (78.1%) patients, and 26 (21.9%) had BI-RADS 5 microcalcifications. When the subgroups of BI-RADS 4 were evaluated, 11 (9.2%) were scored as BI-RADS 4a, 28 (23.5%) as 4b, and 54 (45.4%) as 4c. The majority (8/11) of BI-RADS 4a had round-punctate morphology, the majority (16/28, 57.1%) of 4b had fine pleomorphic, and the majority (38/54, 70.3%) of BI-RADS 4c had fine pleomorphic morphology. Of those with BI-RADS 5 microcalcifications, 14 (54.4%) had fine linear- fine linear branching morphology (Table 1).

The majority of BI-RADS 4a, 4b and 4c had a group distribution pattern and the majority of BI-RADS 5 had a segmental distribution pattern (Table 2).

All biopsies were performed on the prone table stereotactic vacuum biopsy device (Lorad Multicare Platinum, Hologic, MA, USA) in our hospital by a radiologist with 20 years of experience. The procedures were performed with a 9G vacuum-assisted needle system (ATEC Breast Biopsy and Excision System, Suros Surgical Systems, USA) with a notch of 12 mm or 20 mm, Approximately 10 ml 2% prilocaine hydrochloride solution (Citanest, AstraZeneca, Turkey) was used for local anesthesia during the procedure. It was seen that calcifications were sampled by graphing the tissue pieces obtained immediately after vacuum biopsy. At the end of all the procedures, local compression was applied for approximately 5-10 minutes to prevent possible bleeding complications.

Statistical Package for Social Sciences (SPSS) version 20.0 software (Chicago, IL, USA) was used for statistical analysis. Descriptive statistics were stated as median (minimum – maximum) and mean ± standard deviation values. The Chi-square test was used to compare categorical data. The relationships between the parametric data were investigated using the Student's t-test. A value of p<0.05 was accepted as statistically significant.

Table 1. Morphological features and BI-RADS scores of microcalcifications

BI-RADS	Round punctate		Amorphous		Heterogeneous		Fine pleomorphic		Fine linear and fine linear branching		Total
	n	%	n	%	n	%	n	%	n	%	n
4a	8	72.7	-	-	1	9.1	2	18.2	0	-	11
4b	4	14.3	2	7.2	5	17.8	16	57.1	1	3.6	28
4c	1	1.8	5	9.3	6	11.2	38	70.3	4	7.4	54
5	-	-	1	3.8	1	3.8	10	38.0	14	54.4	26

Table 2. Distribution patterns and BI-RADS scores of microcalcifications

BI-RADS	Grouped		Segmental		Linear		Regional		Total
	n	%	n	%	n	%	n	%	n
4a	8	12.5	3	6.7	-	-	-	-	11
4b	24	37.5	4	8.9	-	-	-	-	28
4c	30	46.8	19	42.2	4	57.2	1	33.3	54
5	2	3.2	19	42.2	3	42.8	2	66.7	26

RESULTS

Due to the small number of microcalcifications with segmental, regional and linear distribution patterns, these were evaluated in a single pattern of "non-grouped" distribution. According to this classification, while the majority of BI-RADS 4 microcalcifications (66.6%) had "grouped" distribution, the majority of BI-RADS 5 patients (92.3%) had "non-grouped" distribution. The difference between the distribution patterns of BI-RADS 4 and BI-RADS 5 microcalcifications was statistically significant (p <0.05).

After vacuum assisted biopsy, 62 (52.2%) of 119 microcalcifications were reported to be benign and 57 (47.8%) were reported to be malignant pathologies (Table 3).

Of the microcalcifications classified as BI-RADS 4, 38.8% were proved to be malignant after vacuum biopsy. According to the subgroups, all of BI-RADS 4a were benign, 17.9% of 4b were malignant and 57.5% of 4c were malignant. Of the microcalcifications classified as BI-RADS 5, 80.7% were detected as malignant after vacuum biopsy. There was a statistically significant difference between these two groups (p <0.05).

Table 3. Histopathological diagnosis of microcalcifications after vacuum-assisted biopsy

	n	%
Benign	**62**	**52.2**
ADH	8	6.7
Other benign pathologies	54	45.5
Malignant	**57**	**47.8**
In situ carcinoma	**45**	**37.9**
DCIS	43	36.3
LCIS	1	0.8
DCIS+LCIS	1	0.8
Invasive carcinoma	**12**	**9.9**
IDC	8	6.7
Mixed invasive (ductal+lobular) carcinoma	2	1.6
Mixed invasive (ductal+mucinous) carcinoma	1	0.8
Mucinous carcinoma	1	0.8
Total	**119**	**100**

ADH: Atypical ductal hyperplasia; DCIS: Ductal carcinoma in situ; LCIS: Lobular carcinoma in situ; IDC: Invasive ductal carcinoma

A total of 61 patients underwent surgery after vacuum biopsy, comprising 10 (16.3%) with benign and 51 (83.6%) with malignant histopathological diagnosis. Thirty (49.3%) of the in situ carcinomas were DCIS, 1 (1.6%) was LCIS, 1 (1.6%) DCIS + LCIS and 1 (1.6%) was DCIS + papillary carcinoma in situ (PCIS). Thirteen (21.5%) of the invasive carcinomas were IDC, 2 (3.2%) were ILC, 1 (1.6%) was mixed invasive (ductal + lobular) carcinoma and 2 (3.2%) were mixed invasive (ductal + mucinous) carcinoma.

After vacuum biopsy, 42 patients with in situ carcinoma were operated on; 9.5% of cases (4/42) had benign histopathological diagnosis and 66.7% (28/42) were diagnosed as in situ carcinoma and 23.8% (10/42) were invasive carcinomas (Table 4). It was concluded after surgery that DCIS was completely removed by stereotactic biopsy in 4 patients. Nine cases with a preoperative diagnosis of DCIS were upgraded to invasive carcinoma, and 1 patient with DCIS + LCIS was upgraded to ILC after surgery. Invasive carcinoma was detected in 10 of 42 in situ carcinomas after surgery with a stage upgrade rate of 23.8%.

In 1 patient with Paget's disease, although the microcalcifications were sampled by vacuum biopsy, the pathological examination revealed chronic inflammation and fibrocystic changes. However, the final postoperative diagnosis was DCIS in this patient. Another patient reported to have benign changes after vacuum biopsy was operated on because of incompatibility between the radiological findings and the pathological diagnosis and the final diagnosis was micro-invasive carcinoma and DCIS. Therefore, the false negative rate of vacuum biopsy was 3.2% (2/61) in this series. None of the patients who had undergone vacuum-assisted breast biopsy on the prone table developed major complications. No abscess or collection formation requiring drainage after the procedure were detected.

No statistically significant difference was found between the areas of microcalcifications in patients with stable stages and patients with upgraded stages after surgery (t = 1,439; p> 0.05). The number of calcifications (mean 21.9) in tissue fragments removed by vacuum biopsy in cases with stage elevation was statistically significantly higher than in patients without stage elevation (mean 12.9) (t = 3,358; p = 0.001).

Table 4. Comparison of the postoperative histopathological results of patients with ADH, in situ carcinoma and atypical papilloma after vacuum biopsy

Histopathological Results After Vacuum Biopsy	Postoperative Final Histopathological Diagnosis of Microcalcifications								
	Benign		ADH		In situ carcinoma		Invasive carcinoma		Total
	n	%	n	%	n	%	n	%	n
ADH	3	50	3	50	-	-	-	-	6
In situ carcinoma	4	9.5	-	-	28	66.7	10	23.8	42
Atypical papilloma	-	-	-	-	2	100	-	-	2

ADH: Atypical ductal hyperplasia

DISCUSSION

The use of percutaneous stereotactic breast biopsy since the 1990s has played an active role in the diagnosis and management of breast diseases. Vacuum-assisted stereotactic breast biopsy is an important biopsy technique for accurate diagnosis of suspected calcifications that can only be seen on mammography (6). It is an alternative method to excisional biopsy because of its less invasive nature and lower total cost (7). The biopsy results in a significant proportion of suspicious calcifications are of benign breast pathologies. In the current series, approximately 50% of calcifications were reported as benign. With this method, benign calcifications can be diagnosed with the least possible invasive method without surgical excision. In addition, a preoperative diagnosis of malignant calcifications can be made with this method, and proper staging and management of breast cancer is possible, and the number of surgeries required can be reduced (8,9).

In the current study, patients with microcalcifications only and patients with microcalcification and nodular mass were evaluated. After the vacuum biopsy, 52.1% of the microcalcifications were diagnosed as benign and 47.9% were malignant. The in situ carcinoma rate after vacuum biopsy was 37.9% in this study. After surgery, 48.8% of patients were diagnosed as benign and 51.2% as malignant. In a study by Tonegutti et al. (10), 42% of cases were reported as malignant or borderline lesions and 58% as benign lesions. Of the malignant or borderline lesions, 16% were reported as invasive lesions, 13% as micro-invasive lesions, 44% as in situ lesions and 27% as borderline lesions (10).

The incidence of ADHs after stereotactic vacuum biopsy with 9G needle in the current study was found to be 6.7% of all lesions. In a study of 851 patients, Burak et al. (11) reported a prevalence of ADH of 5.4% after vacuum biopsy. In a study by Eby et al. (12), the frequency of ADH after stereotactic vacuum biopsy was 13.7% with 9G needle and 14.8% with 11G needle. Jackman et al. (13) reported a 5% incidence of ADH in breast biopsies with 11G and 14G needles. A higher incidence of ADH may be associated with the volume of tissue taken with a 9G needle, because the amount of tissue taken in vacuum biopsy with a 14 G needle is 36.8 mg, and it is 132.7 mg with a 9 G needle (14,15). In a recent study by Schiaffino et al. (16), it was reported that conservative approach could be considered in selected patients who were excised via vacuum biopsy and diagnosed as ADH and had no residual calcification left. Therefore, vacuum biopsy may be a definitive treatment method in a selected patient group. Surgical excisional biopsy is indicated after the diagnosis of ADH after stereotactic biopsy, with a mean stage increase of 39% in these lesions (17). However, none of the 6 cases which were diagnosed as ADH preoperatively in the current study was upgraded to in situ or invasive carcinoma.

The low diagnostic rate of vacuum-assisted biopsy is less frequent than core biopsy. In the series of Jackman et al. (13), the missing diagnostic rate for DCIS with a 14 G core biopsy needle was significantly higher than that of stereotactic vacuum-assisted biopsy (20% vs. 11.2%). Other authors have reported the incidence of invasion during surgery to be between 16% and 35%, and the frequency of invasion was obtained with the help of vacuum assisted biopsy technique (18,19). In the current study, 10 of 42 cases of DCIS (23.8%) diagnosed preoperatively were upgraded to invasive carcinoma postoperatively. These data suggest that stereotactic vacuum-assisted biopsy has lower deficiency rates compared to core biopsy, and that obtaining large tissue volumes reduces incomplete diagnosis (17). Vacuum biopsy under stereotactic guidance has a low false negative rate ranging from 1.3% to 3.3% (20, 21). The false-negative diagnosis rate in the current study was 3.2%, which was consistent with the rates in literature.

In a study of Ames et al. (22), the calcification clusters in an area with a diameter less than 11 mm had a probability of invasion of 18% whereas the probability of invasion was 35% in calcifications in an area of 60 mm and more in diameter. In addition, the possibility of invasion of calcification specimens containing more than 40 calcifications was found to be 15% (22). In the current study, no statistically significant difference was found between the patients with stable stage and calcification area measured on mammography before the vacuum biopsy in patients with stage elevation ($t = 1,439$; $p > 0,05$). However, in cases with stage elevation, the number of calcifications (mean 21.92) in the removed tissue fragments was statistically significantly higher than that of those without stage elevation (mean 12.96) ($t = 3.358$; $p = 0.001$).

The complication rate is very low and unexpected complications are usually minor complications in stereotactic guided needle biopsies. Reported complications include bruising, pain, hematoma and abscess formation. The incidence of abscess or hematoma requiring surgical drainage has been reported to be 0.1% (23). In the current study, stereotactic breast biopsies performed on the prone table did not show any abscesses or collections that would require surgical drainage. There were no major complications requiring hospitalization.

This study had some limitations. These were primarily the low number of patients, evaluation of a single percutaneous sampling method, needle type and retrospective nature of the study. In addition, pathology specimens taken by biopsy and pathology specimens taken by surgery were evaluated by different pathologists. There is a need for further prospective studies of stereotactic vacuum-assisted biopsy performed under mammography with larger patient populations, a greater number of different lesion types and different needles and diameters in order to compare the higher diagnostic accuracy with other methods.

CONCLUSION

In conclusion, with the increasing prevalence of screening mammography, the frequency of microcalcifications, which can not be detected in examination and ultrasonography, but can only be seen in mammography, has increased. Vacuum-assisted breast biopsy is a unique method for biopsy from microcalcifications, which cannot be detected especially in ultrasonography and can only be detected in mammography. The results of the current study showed that stereotactic vacuum biopsy performed on the prone table is a successful method with low negative and incomplete diagnosis rates in the diagnosis of microcalcifications.

Competing interests: The authors declare that they have no competing interest.
Financial Disclosure: There are no financial supports.
Ethical approval: Hacettepe University, GO 13/543-08.

REFERENCES

1. Taydas O, Durhan G, Akpinar MG, et al. Comparison of MRI and US in Tumor Size Evaluation of Breast Cancer Patients Receiving Neoadjuvant Chemotherapy. Eur J Breast Health 2019;15:119-24.
2. Guarneri V, Conte PF. The curability of breast cancer and the treatment of advanced disease. Eur J Nucl Med Mol Imaging 2004;31:149-61.
3. Hortobagyi GN, de la Garza Salazar J, Pritchard K, et al. The global breast cancer burden: variations in epidemiology and survival. Clin Breast Cancer 2005;6:391-401.
4. Fajardo LL. Cost-effectiveness of stereotaxic breast core needle biopsy. Acad Radiol 1996;3:21-3.
5. Burbank F. Mammographic findings after 14-gauge automated needle and 14-gauge directional, vacuum-assisted stereotactic breast biopsies. Radiology 1997;204:153-6.
6. Gumus H, Gumus M, Devalia H, et al. Causes of failure in removing calcium in microcalcification-only lesions using 11-gauge stereotactic vacuum-assisted breast biopsy. Diagn Interv Radiol 2012;18:354-9.

7. Lee CH, Egglin TK, Philpotts L, et al. Cost-effectiveness of stereotactic core needle biopsy: analysis by means of mammographic findings. Radiology 1997;202:849-54.
8. Yim JH, Barton P, Weber B, et al. Mammographically detected breast cancer. Benefits of stereotactic core versus wire localization biopsy. Ann Surg 1996;223:688-97; discussion 97-700.
9. Lee SH, Jung YJ, Jung HJ, et al. Stereotactic vacuum-assisted breast biopsy under lateral decubitus position. Ann Surg Treat Res 2016;90:16-20.
10. Tonegutti M, Girardi V. Stereotactic vacuum-assisted breast biopsy in 268 nonpalpable lesions. Radiol Med 2008;113:65-75.
11. Burak WE, Jr., Owens KE, Tighe MB, et al. Vacuum-assisted stereotactic breast biopsy: histologic underestimation of malignant lesions. Arch Surg 2000;135:700-3.
12. Eby PR, Ochsner JE, DeMartini WB, et al. Is surgical excision necessary for focal atypical ductal hyperplasia found at stereotactic vacuum-assisted breast biopsy? Ann Surg Oncol 2008;15:3232-8.
13. Jackman RJ, Birdwell RL, Ikeda DM. Atypical ductal hyperplasia: can some lesions be defined as probably benign after stereotactic 11-gauge vacuum-assisted biopsy, eliminating the recommendation for surgical excision? Radiology 2002;224:548-54.
14. Kocjan G. Fine needle aspiration cytology. Cytopathology 2003;14:307-8.
15. Poellinger A, Bick U, Freund T, et al. Evaluation of 11-gauge and 9-gauge vacuum-assisted breast biopsy systems in a breast parenchymal model. Acad Radiol 2007;14:677-84.
16. Schiaffino S, Massone E, Gristina L, et al. Vacuum assisted breast biopsy (VAB) excision of subcentimeter microcalcifications as an alternative to open biopsy for atypical ductal hyperplasia. Br J Radiol 2018;91:20180003.
17. Liberman L. Percutaneous image-guided core breast biopsy. Radiol Clin North Am 2002;40:483-500, vi.
18. Meyer JE, Smith DN, Lester SC, et al. Large-core needle biopsy of nonpalpable breast lesions. Jama 1999;281:1638-41.
19. Jackman RJ, Burbank F, Parker SH, et al. Stereotactic breast biopsy of nonpalpable lesions: determinants of ductal carcinoma in situ underestimation rates. Radiology 2001;218:497-502.
20. Zuiani C, Mazzarella F, Londero V, et al. Stereotactic vacuum-assisted breast biopsy: results, follow-up and correlation with radiological suspicion. Radiol Med 2007;112:304-17.
21. Pfarl G, Helbich TH, Riedl CC, et al. Stereotactic 11-gauge vacuum-assisted breast biopsy: a validation study. AJR Am J Roentgenol 2002;179:1503-7.
22. Ames V, Britton PD. Stereotactically guided breast biopsy: a review. Insights Imaging 2011;2:171-6.
23. Burbank F, Parker SH, Fogarty TJ. Stereotactic breast biopsy: improved tissue harvesting with the Mammotome. Am Surg 1996;62:738-44.