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Values of pathological analysis of lost tissue fragments in the vacuum canister during a vacuum-assisted stereotactic biopsy of the breast

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Objective: Determine values of pathological analysis of the canister content during a vacuum-assisted breast biopsy (VABB).

Methods: Approval was obtained from the ethical committee. Prospective radiological and pathological analyses of the canister content collected during 231 VABBs performed on 231 patients were carried out. χ^2 test was used to determine predictors on canister pathology.

Results: The canister pathology was reported separately in 212 cases. It showed only blood in 78/212 (37%) cases and benign (including high-risk lesions) and malignant results in, respectively, 113/212 (53%) and 21/212 (10%)

cases. Respective specimen analysis was benign, including high-risk lesions in 162/212 cases (76%) and malignant in 50/212 (24%) cases. Microcalcifications were documented on canister X-ray in 70/231 (30%) cases. There was significant association between the canister and the specimen pathology ($p < 0.0001$). In none of the cases was microcalcifications seen exclusively in the canister content or pathological upgrading found in the canister content compared with the specimen.

Conclusion: Small tissue fragments and microcalcifications may be lost in the canister during a VABB. Nevertheless, our results did not show any significant value

for systematic analysis of the canister content.

Advances in knowledge: There is no added diagnostic value to retrieval and analysis of tissue lost in the canister during a VABB.

KEY POINTS

1. Stereotactic vacuum-assisted breast biopsy (VABB) is an approved alternative to surgical biopsy of microcalcifications.
2. Prospective analysis of the canister content showed that tissue and microcalcifications could be lost during a VABB.
3. No significant added value to final pathological result from analysis of the canister content.

Stereotactic-guided needle percutaneous biopsy has been increasingly used as an alternative for image-guided needle localisation and surgical biopsy of non-palpable breast lesions.

Many advances have been made to increase the accuracy of these percutaneous diagnostic methods. These include using larger needles instead of 14-gauge needles, adding vacuum on the automated device and determining a standard of performance. In fact, there are clear recommendations about the biopsy being performed by an experienced radiologist who has done at least 15 biopsies [1,2], retrieving an optimal number of samples [3–5] and ensuring the presence of microcalcifications on specimen radiographs. When the abnormality targeted is non-calcified, no such proof exists to ensure an accurate sampling.

Furthermore, no specific data exist about the risk of losing material into the vacuum device. A previous article reported five cases, in which lost calcifications in the vacuum tubing were retrieved from canister debris, raising the hypothesis that valuable material might be lost during a vacuum-assisted percutaneous biopsy [6].

This current study was undertaken (1) to determine if valuable tissue can be lost in the vacuum canister during a VABB and (2) to determine values of pathological analysis of the canister content.

METHODS AND MATERIALS

This study was prospectively designed to evaluate the canister debris at each stereotactic VABB performed between June 2007 and November 2008. Approval was

obtained from the ethical committee. Every patient prior to the procedure signed an informed consent form.

The biopsy was performed with patients lying prone on a stereotactic table (StereoGuide; LORAD, Danbury, CT) while using a stereotactic 11-gauge vacuum-assisted device (Mammotome®; Biopsy/Ethicon Endo-Surgery, Cincinnati, OH). An average of 12 samples was obtained. After each biopsy, the canister content was poured into a small container and submitted separately from the specimen for pathological analysis. In case microcalcifications were targeted, a radiograph of the canister debris was obtained in addition to the specimen radiograph (Figure 1). This was done while placing the container horizontally on the compression paddle, 20 cm above the bucky (Figure 2).

The pathological analysis was done by one of the breast pathologists at our institution, who had more than 10 years experience in breast pathology, and reported prospectively.

Of the 231 stereotactic biopsies performed during that period, 19 were excluded because the pathological analysis of the canister debris was not reported separately from the specimen pathology. Final specimen pathology was divided into benign, including high-risk lesions (atypia, lobular neoplasia and papilloma), and malignant (ductal carcinoma *in situ* and invasive cancer), whereas final canister pathology was divided into blood, benign (including high-risk lesions) and malignant.

Factors hypothesised to affect the outcome of the canister content included degree of bleeding during the procedure (mild, moderate, profuse), number of additional vacuum use (none, one, two or more), referring to any additional manual use of the suctioning function each time the samples retrieved from the aperture of the needle were absent or small, specimen quality (fragmented *vs* firm), amount of microcalcifications retrieved in the specimen (whole cluster, significant microcalcifications present, few or no microcalcifications) and the presence or absence of microcalcifications on the canister content radiograph.

Figure 1. Vacuum-assisted breast biopsy of a cluster of microcalcifications in a 62-year-old female. (a) Radiograph of the specimen demonstrating the presence of microcalcifications; (b) radiograph of the vial containing the canister debris demonstrating one microcalcification (arrow) and some densities related to blood clots and/or material lost. Final pathological analysis of the specimen demonstrated ductal carcinoma *in situ*, whereas pathological analysis of the canister debris showed benign findings.

(a)

(b)

Figure 2. Technique for X-ray of the canister debris collected in a small vial.

Statistical analysis

All statistical analyses were conducted using SAS software (v. 9.1; SAS, Cary, NC). A simple χ^2 test was used to evaluate the association between each predictor and the final canister pathology result. Spearman's rank-order correlation was performed to determine the level of agreement or consistency in the rankings of two variables: final specimen pathology vs canister pathology as well as X-ray of the specimen vs X-ray of the canister debris. Multivariate multinomial logistic regression was further employed to determine the predictors that might affect the final canister pathology outcome.

For all analyses, results were considered as statistically significant if the p -value was ≤ 0.05 .

RESULTS

Radiological results

Of the 231 VABs performed in 231 patients, the abnormality sampled was a cluster of microcalcifications in 224 cases (224/231, 97%), a mass in 5 cases (5/231, 2%) and distortion in 2 cases (2/231, 1%).

Specimen radiograph was not done for the 7 non-calcified lesions (7/231, 3%), but it showed the whole cluster in 59 cases (59/231, 25%), significant microcalcifications in 127 cases (127/231, 55%) and few and no microcalcifications in 31 (14%) and 7 (3%) cases, respectively (Table 1).

Canister content radiograph was not done in the 7 non-calcified lesions biopsied (7/231, 3%), but it showed microcalcifications in 70 cases (70/231, 30%) and the absence of microcalcifications in the remaining 154 cases (154/231, 67%) of calcified lesions (Table 2).

Table 1. Results of the X-ray of specimen

Specimen X-ray	Frequency (%)
Not done	7 (3)
Whole cluster	59 (25)
Microcalcifications significantly present	127 (55)
Few microcalcifications	31 (14)
No microcalcifications	7 (3)
Total	231 (100)

Pathological results

Of the 231 VABs, 19 were excluded because the final canister pathology was not reported separately. Of the 212 cases, specimen pathology was benign, including high-risk lesions in 162 cases (162/212, 76%) and malignant in 50 cases (50/212, 24%), whereas pathological analysis of the canister content showed only blood in 78 cases (78/212, 37%), benign pathology including high-risk lesions in 113 cases (113/212, 53%) and malignant pathology in 21 cases (21/212, 10%). If we match the pathological results of the specimen with the canister content, none of the debris lost from the biopsy-proven benign lesions (benign pathological result of the specimen) showed malignancy, whereas a malignant finding was found in the debris of the canister from 21 of the 50 biopsy-proven malignant lesions (malignant pathological result of the specimen; [Table 3](#)).

Statistical analysis results

The canister radiograph did not show microcalcification in any of the cases where the specimen radiograph showed few or no microcalcifications. Furthermore, none of the canister pathology analyses showed upgrading of the diagnosis compared with the specimen pathology. There was, however, significant association between the canister and the specimen pathology ($p < 0.0001$), and a strong correlation was found between the final pathology and the canister pathology when excluding the “blood” category (Spearman’s correlation was 0.70; 95% confidence

limits 0.6014–0.8034); this means that when the ranking in the specimen pathology increases, the ranking in the canister pathology increases as well.

On the other hand, the Spearman’s rank correlation between “the specimen X-ray” and “the canister X-ray” was 0.001, showing a very low correlation between these two variables, which means that the loss of microcalcifications in the canister was not related to the number of microcalcifications retrieved from the specimen.

We have hypothesised that the quality of the samples retrieved might affect the canister content whereby fragmented samples might be more easily lost in the canister than firm ones, and the use of more manual suctioning during the procedure might determine a higher risk of losing tissue material in the canister; these variables, in univariate analysis, were not found to significantly affect the canister content ($p > 0.5$; [Table 4](#)). The presence, however, of microcalcifications on the canister debris radiograph was significantly associated with the tissue material lost instead of only blood being present in the canister ($p = 0.005$; [Table 4](#)).

As in univariate analysis, multivariate multinomial logistic regression (table not shown) did not demonstrate any significant association between the variables (degree of bleeding, additional suction use and amount of microcalcifications present on specimen radiograph) and the canister pathology outcome.

DISCUSSION

Of the technical advances in percutaneous needle biopsies, the use of a larger needle diameter, 8- or 11-gauge instead of 14-gauge, and adding vacuum assistance, has permitted larger samples to be obtained. This allowed improved calcification retrieval [2,7], lower false-negative rates [8], lower rebiopsy rates [9] and lower frequency of histological underestimation [7], even though the indication for surgical excision of high-risk lesions remains [10]. The issue of possible loss of valuable diagnostic tissue in the vacuum tubing system and canister while using these devices has not been previously addressed.

The results of our study demonstrate that tissue, as well as microcalcifications, may be lost in the vacuum canister. However, the pathological analysis of the canister

Table 2. Results of the X-ray of canister debris

Canister X-ray	Frequency (%)
Not done	7 (3)
No microcalcifications	154 (67)
Microcalcifications present	70 (30)
Total	231 (100)

Table 3. Canister pathology outcome compared with final pathology

Final pathology	Canister pathology			
	Blood, <i>n</i> (%)	Benign + high risk ^a , <i>n</i> (%)	Malignant ^b , <i>n</i> (%)	Total
Benign + high risk lesions ^a	67 (41.4)	95 (58.6)	0 (0)	162
Malignant ^b	11 (22)	18 (36)	21 (42)	50
Total	78	113	21	212

^aHigh-risk lesions include atypia, papilloma and lobular carcinoma *in situ*.

^bDuctal carcinoma *in situ* and/or invasive carcinoma.

debris in our study did not add any significant diagnostic information to the final result obtained from the pathological analysis of the specimen; hence, there was no upgrading of the diagnosis in any of the cases. Furthermore, microcalcifications were not exclusively found in the canister when they were absent in the specimen in any of our cases, and we have found a poor correlation between the amount of microcalcifications retrieved from the specimen and the loss of microcalcifications in the canister debris, as shown by their respective radiographs.

We have hypothesised that profuse bleeding occurring during a VABB, and thus the need for additional manual suctioning, and samples retrieved being fragmented would be predictors of tissue loss in the canister debris. None of these factors correlated significantly with valuable tissue loss. We therefore did not find any specific scenario for the stereotactic-guided vacuum-assisted biopsy, where analysis of the canister content would

be recommended. Hence, systematic collection and submission of this material for pathological analysis would not be useful.

In our study, only seven non-calcified anomalies were submitted to a stereotactic VABB because most of the masses are sampled in our centre under ultrasound guidance. In these cases, unlike biopsy of a calcified anomaly, where the specimen X-ray obtained routinely at the end of the procedure ensures adequate targeting and the presence of valuable diagnostic material to be sent for pathological analysis, no such proof exists except for the breast images obtained after sampling. The small number of non-calcified anomalies in this study does not allow us to conclude when these non-calcified anomalies are sampled under stereotactic guidance.

Our study has some limitations. First, our sample is small; this may lead to lack of statistical power and to our estimates being unreliable, especially the few cases

Table 4. Univariate analysis for factors as predictors on canister pathology outcome

Independent variables	Canister pathology, <i>n</i> (%)			χ^2 <i>p</i> -value
	Blood	Benign	Malignant	
Vacuum use				
None	11 (14.10)	7 (6.36)	2 (10.00)	0.088
1–2	29 (37.18)	62 (56.36)	11 (55.00)	
>2	38 (48.72)	41 (37.27)	7 (35.00)	
Sample quality				
Firm	47 (60.26)	60 (53.57)	11 (55.00)	0.65
Fragmented	31 (39.74)	52 (46.43)	9 (45.00)	
Container X-ray				
No microcalcifications	59 (78.67)	71 (64.55)	9 (42.86)	0.0052
Microcalcifications present	16 (21.33)	39 (35.45)	12 (57.14)	

(only seven) that were not calcified. Therefore, a larger sample study might be useful to further validate the results of this study. Second, we did not flush the tubing with saline to try to retrieve any material stuck in the tubing system. We aimed for the least manipulation possible, so that our results may reflect the daily practice and be reproducible. Third, the canister X-ray might not be of the same resolution as the specimen radiograph, which could lead to underestimation of the microcalcifications in the canister debris. Fourth, the study was limited to a type of 11-gauge vacuum-assisted needle (Mammotome), and the results may not be applicable to other types of devices, especially those using a saline irrigation system during the procedure.

CONCLUSION

Although the tissue material can be lost in the vacuum device connected to a needle during a percutaneous biopsy, our study showed no significant additional value of the pathological analysis of the canister debris. Therefore, collection and analysis of the debris in the canister did not enhance the final diagnosis, especially in cases where microcalcifications were targeted and confirmed on the specimen radiograph.

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