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Predictors of invasive breast cancer and lymph node involvement in ductal carcinoma in situ initially diagnosed by vacuum-assisted breast biopsy: Experience of 733 cases

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ABSTRACT

Objective: To predict presence of invasive component and nodal involvement in women diagnosed preoperatively with ductal carcinoma in situ (DCIS) by vacuum-assisted breast biopsy (VABB).
Materials and methods: We retrospectively analyzed 733 patients with preoperatively diagnosed DCIS, investigating the association of clinical–radiological variables with invasive component and nodal involvement.
Results: Mammographic size >20 mm and residual lesion on post-VABB mammogram were related to invasive component (both $p < 0.0001$) and nodal involvement ($p = 0.001$, $p = 0.03$). Age <40 years was associated with presence of invasive component ($p = 0.003$). By multivariate analysis residual disease was associated with invasive component, and mammographic tumor size >20 mm with nodal involvement, both highly significant.
Conclusions: Older age, lesion <20 mm, and no residual lesion predict absence of invasion and no nodal involvement in VABB-diagnosed DCIS. However it would be imprudent to routinely forego sentinel node biopsy in such patients as non-negligible proportions of them have invasive disease.

Introduction

Improved diagnostic breast imaging has increased the diagnosis rate of ductal carcinoma in situ (DCIS) which now accounts for almost 30% of newly diagnosed breast cancers.[1] DCIS is characterized by proliferation of neoplastic ductal epithelial cells that do not surpass the mammary duct basement membrane and hence do not infiltrate surrounding tissue. Theoretically there should be no nodal invasion.[2] DCIS cells show cytological features, and receptor, Ki-67, and HER2 profiles that are closely similar to invasive breast cancer cells.

DCIS is increasingly diagnosed preoperatively by minimally invasive vacuum-assisted breast biopsy (VABB) under stereotactic or ultrasound guidance; this technique is increasingly replacing automated core biopsy with consequent reduced risk of underestimation.[2] DCIS has a favorable prognosis in 96–98% of cases but can progress or recur as invasive breast cancer; lymph node metastases are generally found in 1.4–3.6% of cases with a final diagnosis of pure DCIS[3–6] and probably derive from microinvasive foci not identified on the VABB specimen or at definitive histology.[7]

The surgical management of DCIS diagnosed preoperatively by core or VABB biopsy is complex, with treatment varying from breast-conserving surgery to mastectomy, depending on lesion extent and estimated risk of local recurrence. Furthermore, because of the low prevalence of lymph node involvement, sentinel node biopsy (SNB) may be overtreatment in DCIS and should not be performed if possible so as to avoid possible axillary morbidity; it should be proposed only if the presence of invasive foci is suspected.[8–10] To provide the chance best of local control using the least aggressive treatment, it is important to identify patients, with preoperatively diagnosed DCIS, who are at most risk having an invasive component, and hence require SNB at the time of definitive surgery.[11,12]

Veronesi et al.[13,14] have proposed replacing the terms lobular carcinoma in situ and DCIS with various grades of lobular and ductal

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intraepithelial neoplasia (LIN and DIN). Pathologists at our Institute have used this classification since February 2005. The classification emphasizes the non-life-threatening nature of these lesions by eliminating the term "carcinoma".[13,14] However the term DIN is still not widely used in the literature, so in this article we use DCIS.

The aim of our study was to identify clinical-radiological factors predicting invasive component and lymph node involvement in patients with a preoperative diagnosis of DCIS obtained by VABB.

Materials and methods

Population and biopsies

Between May 1999 and December 2009, 6738 VABBs performed at our Institute were archived in our electronic database, 5295 were performed under stereotactic guidance. We retrospectively analyzed 1115 cases with a VABB diagnosis of DCIS. We excluded 382 patients who either did not undergo final surgery, underwent surgery at another hospital, had previous ipsilateral surgery, or a previous VABB on the same or contralateral breast.

The most frequent VABB targets were microcalcifications (702/733: 95.8%), as a single cluster (48.1%), as multiple clusters (16.7%) or as diffuse microcalcifications (35.2%); less frequently distortions or lumps were biopsied which may or may not have been associated with microcalcifications.

We divided the lesions according to mammographic size: 250 were <10 mm (34.1%), 215 were 10–20 mm (29.3%) and 268 were >20 mm (36.6%). Lesions were also classified according to the Breast Imaging Reporting and Data System (BI-RADS) of the American College of Radiology as benign (BI-RADS 2), probably benign (BI-RADS 3), suspicious (BI-RADS 4) or highly suggestive of malignancy (BI-RADS 5).[15] A histologic finding of invasive breast carcinoma after surgery was considered an underestimation; all other surgical histological findings were considered to be in agreement with the radiological findings.[16]

Before biopsy coagulation history was obtained and any anticoagulation therapy was suspended (if possible) from 48 h before to 24 h after the procedure. Patients intolerant to local anesthetic were not biopsied. Written informed consent approved was obtained before biopsy.

Biopsies were performed by seven breast radiologists (minimum 2 years' experience), on a digital prone table (Mammotest, Fischer Imaging, Denver, CO; Mammobed or Giotto digital device, IMS, Bologna, Italy) using 11 (96%) or 8 Gauge (4%) vacuum probes (Ethicon Endo-surgery, Breast Care, Norderstedt, Germany).

If microcalcifications were being biopsied, a magnified radiograph of the removed specimen was obtained to check sampling adequacy: if no microcalcifications were present in the samples, they were considered inadequate and the case excluded from the present study.

If the target area was completely excised a nonmagnetic marker clip (MicroMark II Ethicon Endo-surgery, Breast Care, Norderstedt, Germany) was inserted at the biopsy site to facilitate intra-operative localization. Complete or partial removal of the mammographic lesion and correct positioning of any inserted clip were checked on two-view full-field mammograms taken immediately after VABB.

Presence or absence of residual lesion was entered into the database, as were patient characteristics (including age, family history of breast cancer, and menopausal status) and total number of biopsy samples taken. The final histological diagnosis, estrogen (ER) and progesterone (PgR) receptor status, Ki-67 proliferation index, and presence of peritumoral vascular invasion (PVI) were also entered in each patient's record (and served as a guide to adjuvant therapy).

Lymph node examination

Sentinel node (SN) metastases were classified according to the sixth edition of the TNM: isolated tumor cells (ITC) (isolated tumor cells or clusters up to 0.2 mm in maximum diameter) were classified pN0; micrometastases (metastases <0.2 mm ≤2 mm in greatest size were classified as pN1m1; macrometastases were >2 mm (pN1)).[7] When lymph node status was not assessed the case was classified as pNx.

Statistical analysis

We used Fisher's exact test to assess whether categorical patient and tumor characteristics (dichotomized age, family history, menopausal status, presence of residual disease, type of lesion, ER, PgR, Ki-67, and PVI) were related to presence of invasive component and presence of lymph node metastases, as determined at post-operative histological examination. We also used the Mantel-Haenszel Chi-Square test for trend to assess the relations of ordinal variables (age, mammographic lesion size, BI-RADS category, number of biopsy samples taken) to outcomes. We included the variables mammographic lesion size and presence of residual disease in multivariable logistic regression analyses to assess the independent influence of each (adjusted for the other) on presence of invasive component and lymph node involvement. To justify this we evaluated the extent of multicollinearity by calculating a variance inflation factor for the models that considered final invasion (and then lymph node status) as response, and lesion size and presence of residual disease as predictors. Variance inflation factor scores were always less than 1.5, indicating that multicollinearity was not an issue. All p values are two-sided. A p value <0.05 was considered significant. The analyses were performed with SAS software version 8.2 (Cary NC, USA).

Results

The mean age of the 733 patients was 53 years (range 26–78), 33 (4.5%) were under 40 years, 14 (42.4%) of whom had invasive disease at final histology ($p = 0.003$). Mean mammographic lesion size was 23.8 mm (range 2–200 mm). In 28.4% of cases the mammographic target was completely removed by biopsy; in the remaining 71.6% there was residual lesion.

Eight (1.1%) mammographic lesions were BI-RADS 2, 126 (17.2%) were BI-RADS 3, 505 (68.9%) were BI-RADS 4 and 94 (12.8%) were BI-RADS 5. Fifty-nine lesions classified as BI-RADS 3 were biopsied for valid clinical indication or because short-interval imaging follow-up was not possible. The remaining 67 probably benign lesions (BI-RADS 3) and the 8 lesions classified as benign (BI-RADS 2) were biopsied in high risk patients or in those coming from other hospitals.

Of the mammographic lesions classified as BI-RADS 3, 4 and 5, 22 (17.5%), 99 (19.6%) and 25 (26.6%), respectively, were considered underestimated. A mean of 14.7 biopsy samples was taken (range 3–38) per patient, <10 in 131 patients, 10–19 in 474, and ≥20 in 128 patients. Underestimation rates were unrelated to number of biopsy samples (close to 20%, in each of the sample number categories). Underestimation rates were 20.2% and 20% for both 8G and 11G needles.

Pure DCIS was confirmed at definitive histology in 480 (65.5%); in another 20 (2.7%) cases DCIS was associated with lobular carcinoma in situ or atypical ductal hyperplasia. In 148 (20.2%) cases the histological diagnosis was invasive carcinoma. In 85 (11.6%) cases, only biopsy site changes were found, suggesting that DCIS had been completely excised at biopsy; for these follow-up is at least 24 months and none have recurrences. The definitive histological result agreed with the BI-RADS assessment in 79.8% of cases.

A total of 552 (75.3%) cases underwent SNB: SNB only was performed in 502 (90.9%) (411 with in situ and 91 with invasive component at final diagnosis); SNB was followed by axillary dissection in 37 (6.7%) (1 in situ and 36 invasive at final diagnosis). In 13 (2.4%) axillary dissection was performed without prior SNB (4 in situ and 9 invasive); in four cases with confirmed pure DCIS, axillary dissection without prior SNB was performed because of preoperative clinical or radiological indications of lymph node involvement, supported by fine needle aspiration.

Nodal status was negative (pN0) in 524 (71.5% of total series) and positive (pN+) in 28 (3.8%). Among the pN+ cases, 3 (0.4%) had a definitive histology of DCIS and 25 (3.4%) had invasive carcinoma. The axilla was not investigated at breast surgery in 181 cases (pNx): 169 of these were confirmed as pure DCIS while 12 had invasive component. When estimating the influence of factors on node positivity we merged the pNx and pN0 categories since none of the 181 pNx patients had axillary recurrence after 2 years.

The results of the univariate and multivariate analyses of clinical and radiological predictors of invasive breast cancer and nodal involvement are shown in Tables 1 and 2, respectively. By univariate analysis, age <40 years ($p = 0.003$), mammographic size >20 mm ($p < 0.0001$) and presence of residual lesion ($p < 0.0001$) were associated with presence of invasive component. In addition, mammographic size >20 mm ($p = 0.001$) and presence of residual lesion ($p = 0.03$) were significantly associated with lymph node involvement.

The multivariate analyses showed that presence of residual disease after VABB was significantly associated with invasive component at final histology (OR 4.33; 95% CI 2.15–8.73), while mammographic size >20 mm was significantly associated with lymph node positivity (OR 4.93; 95% CI 1.10–22.1).

Table 3 shows the results of the univariate analysis of the influence of biological variables at definitive histology on the presence of invasive component and lymph node positivity. The variables chosen are known to influence breast cancer prognosis. Ki-67 overexpression, and presence of PVI were significantly associated with invasive disease ($p = 0.001$; $p < 0.0001$, respectively) and nodal involvement ($p = 0.005$ and $p < 0.0001$ respectively). ER and PgR were not significant predictors in this cohort.

Discussion

DCIS is heterogeneous group of pathological entities of variable malignant potential whose natural histories are not yet clearly understood.[17] The introduction of more sensitive diagnostic screening techniques has resulted in the detection of more of these pre-invasive lesions with favorable prognosis and high cure rate.[18] However there is increasing concern that mammographic

Table 1
Univariate analysis of predictors of invasive disease and nodal involvement after initial diagnosis of DCIS on VABB.

	All	Disease type		[a]p	Nodal status			[a]p (pN+ vs. pNx + pN0)
		In-situ only	Invasive		pNx	pN0	pN+	
All	733	585 (79.8%)	148 (20.2%)		181 (24.7%)	524 (71.5%)	28 (3.8%)	
Age (years)								
<40	33	19 (57.6%)	14 (42.4%)		4 (12.1%)	26 (78.8%)	3 (9.1%)	
≥40	700	566 (80.8%)	134 (19.1%)	0.003	177 (25.3%)	498 (71.1%)	25 (3.6%)	0.13
Age (years)								
<40	33	19 (57.6%)	14 (42.4%)		4 (12.1%)	26 (78.8%)	3 (9.1%)	
40–49	239	192 (80.3%)	47 (19.7%)		56 (23.4%)	174 (72.8%)	9 (3.8%)	
50–59	254	200 (78.7%)	54 (21.3%)		65 (25.6%)	178 (70.1%)	11 (4.3%)	
60–69	171	144 (84.2%)	27 (15.8%)		43 (25.2%)	123 (71.9%)	5 (2.9%)	
≥70	36	30 (83.3%)	6 (16.7%)	0.015	13 (36.1%)	23 (63.9%)	–	0.11
Family history								
Missing	19	14 (73.7%)	5 (26.3%)		–	18 (94.7%)	1 (5.3%)	
No	476	380 (79.8%)	96 (20.2%)		116 (24.4%)	341 (71.6%)	19 (4.0%)	
Yes	238	191 (80.3%)	47 (19.7%)	0.92	57 (23.9%)	173 (72.7%)	8 (3.4%)	0.84
Menopausal status								
Missing	8	7 (87.5%)	1 (12.5%)		5 (62.5%)	3 (37.5%)	–	
Pre-menopause	277	217 (78.3%)	60 (21.7%)		58 (20.9%)	207 (74.7%)	12 (4.3%)	
Post-menopause	418	338 (80.9%)	80 (19.1%)		112 (26.8%)	290 (69.4%)	16 (3.8%)	
Peri-menopause	30	23 (76.7%)	7 (23.3%)	0.61	6 (20.0%)	24 (80.0%)	–	0.74
Mammographic tumor size								
<10 mm	250	223 (89.2%)	27 (10.8%)		99 (39.6%)	148 (59.2%)	3 (1.2%)	
10–20 mm	215	176 (81.9%)	39 (18.1%)		55 (25.6%)	153 (71.2%)	7 (3.3%)	
>20 mm	268	186 (69.4%)	82 (30.6%)	<0.0001	27 (10.1%)	223 (83.2%)	18 (6.7%)	0.001
Residual disease								
No	210	198 (94.3%)	12 (5.7%)		92 (43.8%)	115 (54.8%)	3 (1.4%)	
Yes	523	387 (74.0%)	136 (26.0%)	<0.0001	89 (17.0%)	409 (87.2%)	25 (4.8%)	0.03
Type of lesion								
Distortion	5	5 (100%)	–		1 (20.0%)	4 (80.0%)	–	
Lump	3	2 (66.7%)	1 (33.3%)		1 (33.3%)	2 (66.7%)	–	
Calc[b]	702	561 (79.9%)	141 (20.1%)		175 (24.9%)	501 (71.4%)	26 (3.7%)	
Distortion + Calc[b]	9	7 (77.8%)	2 (22.2%)		2 (22.2%)	7 (77.8%)	–	
Lump + Calc[b]	14	10 (71.4%)	4 (28.6%)	0.61	2 (14.3%)	10 (71.47%)	2 (14.3%)	0.31
BI-RADS								
2	8	6 (75.0%)	2 (25.0%)		3 (37.5%)	5 (62.5%)	–	
3	126	104 (82.5%)	22 (17.5%)		39 (31.0%)	83 (65.9%)	4 (3.2%)	
4	505	406 (80.4%)	99 (19.6%)		133 (26.3%)	354 (70.1%)	18 (3.6%)	
5	94	69 (73.4%)	25 (26.6%)	0.17	6 (6.4%)	82 (87.2%)	6 (6.4%)	0.21
Total samples per patient								
1–9	131	104 (79.4%)	27 (20.6%)		33 (25.2%)	92 (70.2%)	6 (4.6%)	
10–19	474	379 (80.0%)	95 (20.0%)		114 (24.1%)	342 (72.2%)	18 (3.8%)	
≥20	128	102 (79.7%)	26 (20.3%)	0.97	34 (26.6%)	90 (70.3%)	4 (3.1%)	0.55

[a] Excluding missing categories.
[b] Calc: microcalcification.

Table 2
Multivariate analyses of radiological predictors of invasive disease and nodal involvement after initial diagnosis of DCIS on VABB.

	Disease type (invasive component vs. in-situ only)		Nodal status (pN+ vs. pNx + pN0)	
	Univariate OR (95%CI)	Multivariate OR (95%CI)	Univariate OR (95%CI)	Multivariate OR (95%CI)
Mammographic tumor size				
<10 mm	1.00	1.00	1.00	1.00
10–20 mm	1.83 (1.08–3.11)	1.05 (0.59–1.88)	2.77 (0.71–10.9)	2.43 (0.54–10.9)
>20 mm	3.64 (2.26–5.86)	1.72 (0.99–2.99)	5.93 (1.72–20.4)	4.93 (1.10–22.1)
Residual disease on mammogram after VABB				
No	1.00	1.00	1.00	1.00
Yes	5.80 (3.14–10.7)	4.33 (2.15–8.73)	3.46 (1.03–11.6)	1.35 (0.31–5.94)

screening may result in overdiagnosis and ultimately overtreatment of low-grade DCIS – a condition that may remain dormant over a long period and may never proliferate beyond the milk duct.[19] The surgical management of these conditions – including whether or not the axilla should be staged – is controversial and it is important to find out as much as possible of the patient's condition before proceeding to surgery.[20]

Our study, on a large group of patients pre-operatively diagnosed with DCIS by VABB, found that mammographic size greater >20 mm and presence of residual disease on post-VABB mammogram were significantly associated with presence of invasive component and N+ on definitive histology. Although only presence of residual disease was significantly associated with invasive component, and only mammographic size was significantly associated with lymph node positivity by multivariate analysis.

Age <40 was also significantly associated with presence of invasive disease in accord with experience with invasive breast cancer, and with another study which found younger patients with DCIS generally had unfavorable prognostic factors and were at greater risk of adverse events.[21] Family history, menopausal status, type of lesion, BI-RADS classification and total number VABB samples taken had no significant influence on presence of invasive component. Note, however, that percentage with invasive component (and percentage of pN+) tended to increase with BI-RADS category.

Previous studies[22–29] have found that a palpable lesion (vs. nonpalpable), radiological mass (vs. nonmass), type of lesion (mass vs. calcifications), type of biopsy (VABB, core biopsy, excisional biopsy), pathologic findings on biopsy (presence of microinvasion, intermediate or high nuclear grade, comedonecrosis) (Table 4) predict invasion. In our series, the type of lesion was not a significant predictive factor because almost all targets were microcalcifications (only 1.1% masses). Most of these previous studies, (except[27]) used techniques other than VABB, such as excisional biopsy or automated gun and some also included DCIS with microinvasion on the biopsy.

The 2001 study of Jackman et al.[22] analyzed 1326 stereotactic biopsies diagnosed as DCIS from 16 hospitals: 953 VABBs (14 and 11 G) and 373 core biopsies (14 G). They found that factors significantly related to underestimation were lesion type (mass vs. calcifications), biopsy device (core biopsy vs. VABB) and number of specimens obtained (≤10 vs. >10). In our study the underestimation rate was unrelated to the number of specimens obtained.

We had a total underestimation rate of 20.2%. This is at the upper limit of the range reported for VABB[22,30–34] and may related to the fact that 95.8% of target lesions were microcalcifications only. Among the underestimated cases, 17.7% consisted of microcalcifications in multiple clusters, and 57.5% were diffuse: such cases could not be completely removed by biopsy so that residual invasive foci could only be identified at definitive histology. In such cases we often biopsy microcalcifications in a quadrant different to that of the main lesion, to understand whether a particularly wide excision may be necessary. In 11.6% of cases no lesion (only biopsy site change) was found on final histology, indicating complete removal of targeted lesions by VABB.

The low rate of axillary involvement (1.4–3.6%) reported in the literature[6,8,11] suggests that SNB can be avoided in many patients with DCIS. However our results show that although both mammographic size <20 mm and no residual disease were associated with low rates of nodal involvement, we found that an invasive component was present in 28.9% of cases <20 mm (similar the 30.6% of cases with lesion >20 mm). A non-negligible proportion of cases without residual disease (5.7%) also had invasive component. These data, in conjunction with the overall underestimation rate of 20.2%, suggest it may be prudent to consider performing SNB when VABB reveals DCIS. Of course, patients must be fully informed of the risks and benefits of SNB.

In recent years tumor biological characteristics such as ER, PgR, Ki-67, HER2 and PVI have been increasingly recognized as important predictors of outcomes and treatment response in infiltrating breast cancer.[35–37] We analyzed ER, PgR, Ki-67, and PVI on the

Table 3
Univariate analysis of biologic predictors of invasive disease and nodal involvement after initial diagnosis of DCIS on VABB.

	All	Disease type		[a]*p*	Nodal status			[a]*p* (pN+ vs. pNx + pN0)
		In-situ only	Invasive		pNx	pN0	pN+	
ER								
Absent	116	95 (81.9%)	21 (18.1%)		19 (16.4%)	92 (79.3%)	5 (4.3%)	
Present	551	425 (77.1%)	126 (22.9%)	0.32	136 (24.7%)	392 (71.1%)	23 (4.2%)	1.00
Missing	66	65 (98.5%)	1 (1.5%)		26 (39.4%)	40 (60.6%)	–	
PgR								
Absent	196	151 (77.0%)	45 (23.0%)		39 (19.9%)	144 (73.5%)	13 (6.6%)	
Present	471	369 (78.3%)	102 (21.7%)	0.76	116 (24.6%)	340 (72.2%)	15 (3.2%)	0.06
Missing	66	65 (98.5%)	1 (1.5%)		26 (39.4%)	40 (60.6%)	–	
Ki-67								
<20%	411	338 (82.2%)	73 (17.8%)		120 (29.2%)	281 (68.4%)	10 (2.4%)	
≥20%	256	182 (71.1%)	74 (28.9%)	0.001	35 (13.7%)	203 (79.3%)	18 (7.0%)	0.005
Missing	66	65 (98.5%)	1 (1.5%)		26 (39.4%)	40 (60.6%)	–	
PVI								
Absent	707	585 (82.7%)	122 (17.3%)		179 (25.3%)	514 (72.7%)	14 (2.0%)	
Present	25	–	25 (100%)	<0.0001	2 (8.0%)	10 (40.0%)	13 (52.0%)	<0.0001
Missing	1	–	1 (100%)		–	–	1 (100%)	

PVI: Peritumoral vascular invasion.
[a] Missing categories not included in analyses.

Table 4
Summary of findings of recent studies that evaluated predictive factors for presence of invasive component and for nodal involvement, in patients with a preoperative diagnosis of DCIS.

Author/year/lesion	Type of biopsy (needle size)	No with invasion (%)	Targets	Factors predicting invasive component	No of LN+ (%)	Factors predicting N+
Jackman 2001[22] DCIS	Auto (14G), S.VABB (11, 14 G)	Auto: 76/373 (20.4); VABB: 107/953, (11)	Calcifications; mass	Large core biopsy: presence of mass; ≤10 cores; tumor size	Not specified	Not specified
Yen 2005[23] DCIS	Auto/VABB (11,14 G), excisional biopsy	Auto/VABB 66/260 (25); excisional biopsy: 14/138 (10)	Not specified	Age ≤55 y; Auto or VABB; size ≥4 cm; tumor grade; comedonecrosis; type of surgery	14/141 (10)	Final IC; palpable lesion
Huo 2006[24] DCIS	161 S.VABB (9, 11G), 39 US-Auto (14,18G)	41/200 (21)	Calcifications; mass	Mass; lesion >1.5 cm; grade; lobular histology	6/103 (2.9)	Mass; lesion size >1.5 cm; mastectomy
Meijen 2007[25] DCIS	Auto (14G)	45/172 (26.2)	Calcifications; mass	Palpable lesion; mass on Mx; lesion >2.5 cm; grade	11/91 (12)	Age ≤55 y; ≥1 cm final invasion; vascular invasion
Yi 2008[26] DCIS or DCISM	Auto/VABB (11G); excisional biopsy	Auto/VABB: 29/624 (29.6); excisional biopsy: 20/624 (10.6)	Not specified	DCIS >5 cm, Auto/VABB, necrosis	40/624 (6,4)	Age <50 y; DCIS size 2–5 cm; >5 cm; Auto/VABB; IC
Sakr 2008[27] DCIS or DCISM	S.VABB	31/110 (16) DCIS 85/110 (42) DCIS + DCISM	Calcifications; solid lesions	>30 mm; preoperative DCISM; mastectomy	7/110(6)	Size >30 mm; mastectomy
Han 2010[28] DCIS	Not specified	52/199 (26.1)	Calcifications; mass	Mass on Mx ≥20 mm; solid-type DCIS; US-biopsy; mastectomy	18/131 (13.7)	Lesion size; IC; size of IC
Kurniawan 2010[29] DCIS or DCISM	S. US Auto (14G) VABB (11G)	81/375 (21.6) DCIS	Calcifications; mass; distortion	Grade; mass or distortion on Mx; Mx size ≥20 mm; screening interval ≥3y	Not specified	Not specified

VABB: Vacuum assisted breast biopsy; Auto: Automatic gun; S: Stereotactic; US: ultrasound guided; G: Gauge; DCISM: Ductal carcinoma in situ with microinvasion; Mx: mammogram; IC: invasive carcinoma.

definitive specimen in relation to presence of invasive component and nodal status. We found no relation with receptor status although high Ki-67 and presence of PVI were significantly associated with invasive component and nodal status. Ki-67 is not routinely investigated on biopsies but might be worth investigating a potential predictor of infiltrating component and axillary status in DCIS. In conclusion, this retrospective review of 733 single-institute DCIS cases diagnosed by VABB indicates that young age (<40 years), mammographic size >20 mm and residual disease after VABB are associated with increased risk of invasive component and nodal involvement at definitive examination. Nevertheless we would not recommend routinely foregoing SNB when DCIS is diagnosed by VABB in older women with small tumor and no residual disease, since non-negligible proportions of these women have invasive component and nodal involvement.

Conflict of interest statement

None declared.

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