Impact of Radiologists' Training and Work Experience on Clinical Prognostic Stage of Breast Cancers Detected at Routine Mammography

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RESEARCH

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ABSTRACT

Purpose: The 8th edition of the American Joint Committee on Cancer staging system incorporates clinical prognostic staging in addition to the traditionally known anatomic staging of breast cancer. To our knowledge, no study has explored the impact that radiologist's number of years practicing, breast imaging fellowship training, or practicing dedicated breast imaging, may have on the clinical prognostic stage of breast cancers detected during routine mammography in asymptomatic women.

Material and methods: An IRB-approved, observational study was conducted over a six-year period at a single, safety-net, breast-imaging center. All asymptomatic patients with a diagnosis of breast cancer initially detected during routine mammography performed at the center were included. Data was collected for patients and for radiologists. A generalized linear model for a Poisson distributed dependent variable was used. P-values for between group comparisons were calculated. Chi-square test was used to analyze the grouping variables. Pearson chi square p-value or an exact chi square p-value was used. A 0.05 alpha level was used to determine statistical significance. Results: Data was available for 251 patients and 12 radiologists. There were no significant differences in type or characteristic of imaging findings at cancer diagnosis, availability of prior mammogram, digital breast tomosynthesis at detection and prognostic clinical stage.

Conclusion: At our institution, clinical prognostic stage at diagnosis of breast cancers detected during routine mammography in asymptomatic women does not differ by radiologists' characteristics.

Key Words: radiology, breast imaging fellowship, mammography, breast cancer, clinical prognostic stage.

INTRODUCTION

There is sound evidence that radiologists' interpretations of mammograms improve during their first few years of practice and continue to improve throughout much of their careers. Additional residency training and continued medical education may help reduce the number of workups of benign lesions while maintaining high cancer detection rates (1). Furthermore, having fellowship training in breast imaging may lead to improved cancer detection (2). Also, radiologist accuracy is dependent on the volume of cases they interpret (3, 4).

The 8th AJCC staging system of breast cancer incorporates clinical prognostic staging in addition to the traditionally known anatomic staging with which radiologists are familiarized (5).

To our knowledge, no study has explored the impact that a radiologist's characteristics, such as number of years practicing radiology, having undergone breast imaging fellowship training or practicing dedicated breast imaging, on the clinical prognostic stage at diagnosis of breast cancers detected on routine mammography in asymptomatic women. This study was conducted with the goal to determine whether these radiologist characteristics have an impact on such a prognostic stage.

MATERIAL AND METHODS

An IRB-approved, consent-waived, HIPPA-compliant observational study was conducted at a single safety-net hospital-based breast-imaging center in Miami, FL. The center is the only breast-imaging center in the area that provides services to the local uninsured and under-insured population as part of a countywide health system.

A retrospective review was conducted of all cases and their medical records were presented and discussed at a weekly breast tumor board during a consecutive 6-year period, from 05/01/2013 to 04/30/2019. All newly diagnosed breast cancer cases are presented and discussed at a weekly breast tumor board.

Patients with clinically evident breast cancer at diagnosis, including those with palpable and/or painful abnormalities, skin or nipple changes, or nipple discharge, were excluded. Patients with breast cancer detected at an outside facility and those undergoing short interval follow-ups were also excluded.

All asymptomatic patients with a diagnosis of breast cancer initially detected during routine mammography performed at the center were included.

Data collected for patients included age, race/ethnicity, imaging findings, characteristics of the biopsy-proven breast cancers at time of mammographic detection, and prognostic clinical stage at diagnosis.

Collected data also included interpreting radiologists' years of experience, whether they were solely dedicated to breast imaging in their practice, and whether they had breast imaging fellowship training.

Statistical analysis

Three different grouping variables of radiologists' characteristics were analyzed separately: years of practice in radiology, breast imaging fellowship vs. no breast imaging fellowship and dedicated breast imaging practice vs. breast imaging plus other areas of radiology. A generalized linear model for a Poisson distributed dependent variable was used to analyze continuous variables; the independent variable was one of the three grouping variables. Number, mean, and standard deviation of non-categorical variables were obtained for each group and the p-values for between group comparisons calculated. For categorical outcome data, a chi-square test was used to analyze each of the three grouping variables. Results were logged as cross tabulation tables with counts and row percentages in each cell. A Pearson chi square p-value was given if all cells had an expected value of 5 or more; otherwise, an exact chi square p-value was given. A 0.05 alpha level was used to determine statistical significance. SAS 9.4 (SAS Institute, Inc.; Cary NC) was used for all analyses.

RESULTS

A total of 1,369 diagnosed breast cancer cases were presented and discussed at a weekly tumor board during the six-year period of the study. Of these, 267 cases met the study's inclusion criteria, and data were available for 251 of them (Figure 1).

A total of 12 radiologists interpreted mammograms at the center during the study time. Approximately two thirds of the interpreting radiologists did not undergo additional breast imaging fellowship training and a same proportion practiced dedicated breast imaging (Figure 2).

In total, 212 (84.4%) cases were interpreted by radiologists who practiced dedicated breast imaging work. Of the 167 (66.6%) cases interpreted by radiologists without breast imaging fellowship training, 102 (61%) cases were interpreted by radiologists with more than 20 years of experience and who practiced dedicated breast imaging work. On the other hand, of the 84 (33.4%) cases interpreted by radiologists with breast imaging fellowship training, 81 (96.4%) cases were interpreted by radiologists with less than 10 years of experience and who practiced dedicated breast imaging work.

There was no significant difference in patients' race/ ethnicity and age between the different radiologists' groups (Table 1).

Table 2 shows no significant difference in having prior mammograms for comparison and use of breast digital tomosynthesis at time of cancer detection by radiologists' group. Also, there was no significant difference between groups regarding the type and characteristics of the mammographic findings of the breast cancers at detection.

No significant difference was found between groups on the histologic type, grade, receptor status and clinical prognostic stage of the mammographically detected breast cancers (Table 3).

DISCUSSION

The role of radiology in anatomic staging of breast cancer is well understood by years of practice and evidence. However, the importance of biomarkers in breast cancer staging is a relatively new concept for radiologists. In this system, different prognostic stages are assigned to tumors with the same anatomic stage depending on the histologic grade, hormone receptor status, HER2 status and multigene panels. Since different prognostic stages call for different therapies for breast cancers with the same anatomic stage, radiologists' role in evaluating tumor response after appropriate therapies is also important (6).

A comparison of AJCC Anatomic and Clinical Prognostic Stage Groups in Breast Cancer at a single institution showed that compared with the anatomic stage, application of the clinical prognostic stage assigned 27.7% and 24.7% of cases to higher and lower stage groups, respectively. In 14% and 2.8% of cases, the assignment of clinical prognostic stage varied by 2 and 3 anatomic stages up or down, respectively. The authors concluded that the new clinical prognostic stage provides a more powerful, yet imperfect, tool for predicting breast cancer outcomes and that further refinement of this system might be necessary in the pursuit of precision medicine (7).

Our study, conducted at a single institution over a six-year time period, explored whether certain radiologist's characteristics have an impact on the clinical prognostic stage of breast cancer detected during routine mammography in asymptomatic women.

We found that years of radiology work experience, breast imaging fellowship training and dedicated breast imaging radiology work had no effect on the prognostic clinical stage of breast cancers detected at routine mammography in asymptomatic women. This may reflect the fact that all participating radiologists were Mammography Quality Standard Act (MQSA) qualified and had interpreted at least the minimum required number of mammograms during the study time. Furthermore, most participant radiologists had at least one of the following characteristics known to improve their interpretative skills: more than 10 years of practice, breast imaging fellowship, dedicated breast imaging practice.

The borderline significance noted for patients age at diagnosis and Nottingham histological grade of the mammographically detected malignancy between groups of years practicing radiology are both likely due to the relatively low number of radiologists in the 10-20 years group compared to theose with less or more years of practice.

We did not explore the performance parameters for screening and diagnostic mammography amongst the participating radiologists. Others have found that specialist radiologists detect more cancers including more early-stage cancers, recommend more biopsies and have lower recall rates than general radiologists (8).

In our study, the use of digital breast tomosynthesis at time of detection did not result in significant difference in the clinical prognosis of the detected breast cancer between the different radiologist groups. Svahn TM et al. reported improved interpretative efficiency and cancer detection with digital breast tomosynthesis versus standard mammography in population screening (9).

Our study did not take into consideration whether the radiologist who read the initial routine mammogram in which breast cancer was detected was the same radiologist who read the subsequent diagnostic work-up. Buist DS et al have suggested that radiologists working up a minimum number of their own recalled cases could improve screening performance (10).

We did not find a difference in clinical prognostic stage of breast cancer detected on routine mammography between radiologists grouped by years of experience nor by additional breast fellowship training. Miglioretti DL et al reported that the interpretation of screening mammograms by radiologists improve early during their practice and continue to improve throughout their careers (11). It has been proposed that radiologists' additional training and targeted continuing medical education may help decrease unnecessary workups of benign lesions while still maintaining satisfactory cancer detection rates (11). Furthermore, the variability in interpretive performance at screening mammography and radiologists' characteristics associated with accuracy was studied by Elmore JG et al. (12). They showed that fellowship training in breast imaging may lead to improved cancer detection, but it is associated with higher false-positive rates.

Our study took place at a single institution where physicians, including radiologists, practice under the state's waiver of sovereign immunity. The influence of community radiologists' medical malpractice perceptions and experience on screening mammography was explored in a study by Elmore JG et al., concluding that radiologists are extremely concerned about medical malpractice and report that this concern affects their recall rates and biopsy recommendations (13).

Limitations of our study include that data collection from a single institution may limit applicability to other institutions with a different mix of radiologists and/or different patient populations. Also, this study was performed as a limited retrospective observational study. Also, no additional breast imaging features of diagnosed carcinomas, such as those on breast MRI, were considered.

In conclusion, at our institution, where only MQSA qualified radiologists, most of them with more than 10 years of practice, and/or breast imaging fellowship training, and/or dedicated breast imaging practice, differences in these characteristics do not have an impact on the clinical prognostic stage of breast cancer detected at routine mammography in asymptomatic women.

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PEER REVIEW

Not commissioned. Externally peer reviewed.

FIGURES

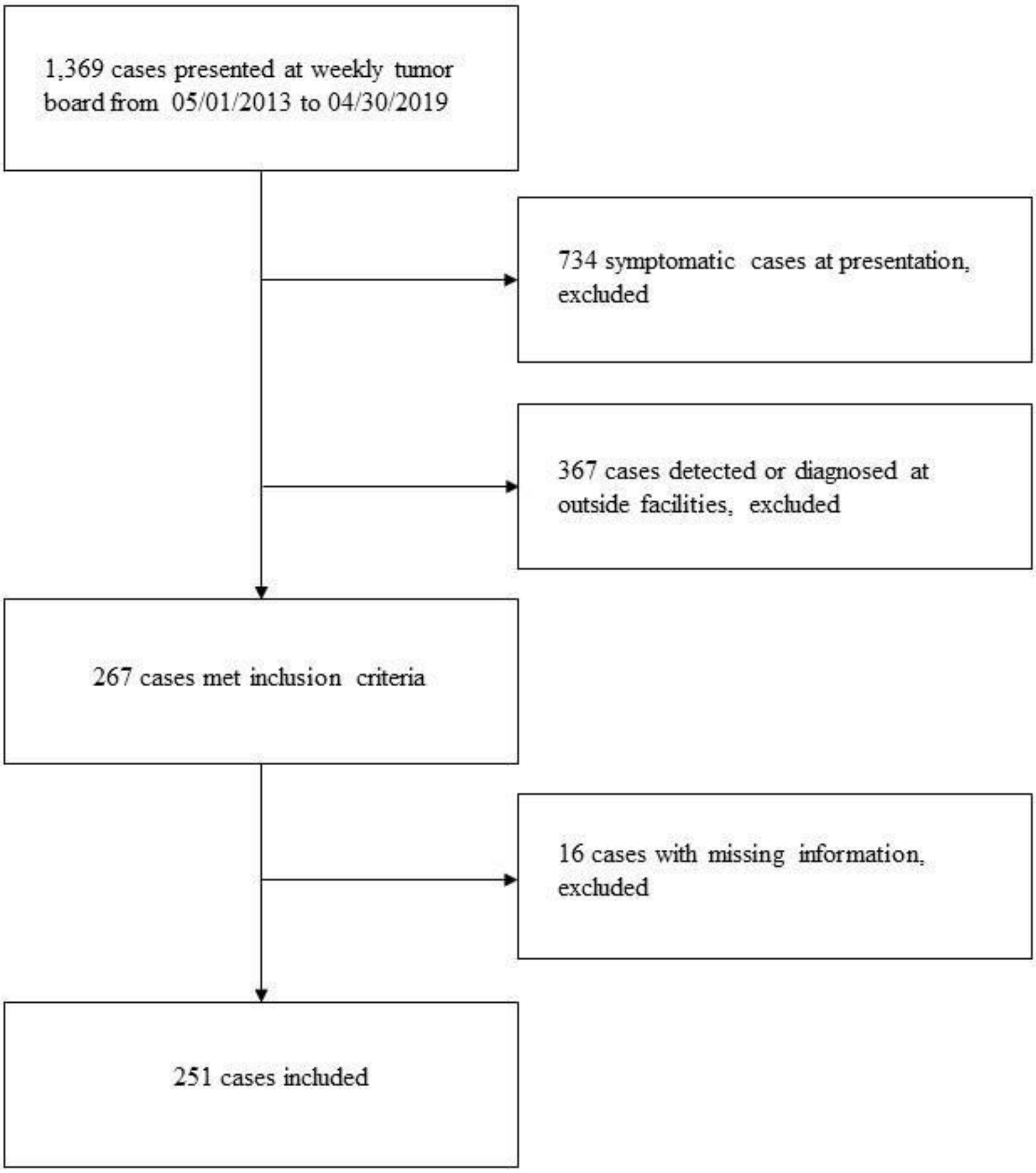

Figure 1. Flow chart of case selection and inclusion**.**

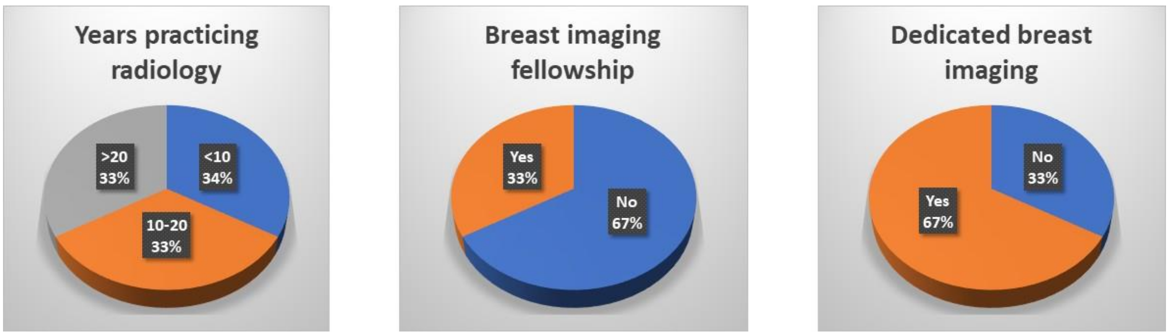

Figure 2. Distribution of radiologists by work profile.

TABLES

Table 1. Patients demographics by radiologists' work profile group.

	Years practicing radiology			*P* value	Breast imaging fellowship training		*P* value	Practices dedicated breast imaging		*P* value
	<10 (n=)	10-20 (n=)	>20 (n=)		Yes (n=)	No (n=)		Yes (n=)	No (n=)	
Race/Ethnicity										
HW	67	16	115	0.916	69	129	0.9890	167	31	0.573
NHB	10	1	18		10	19		26	3	
NHW	7	2	15		8	16		19	5	
Patient Age	56.19	55.26	58.81	0.016	56.39	58.34	0.054	57.58	58.10	0.696

Table 2. Type and characteristics of mammographic findings at breast cancer detection by radiologists' work profile group.

	Years practicing radiology			*P* value	Breast imaging fellowship training		*P* value	Practices dedicated breast imaging		*P* value
	<10 (n=)	10-20 (n=)	>20 (n=)		Yes (n=)	No (n=)		Yes (n=)	No (n=)	
Maximum length of finding (cm)										
Calcifications	2.47	2.77	3.11	0.146	2.47	3.08	0.052	2.97	2.25	0.065
Mass	1.48	1.49	1.83	0.378	1.46	1.80	0.186	1.73	1.38	0.35
Asymmetry/focal asymmetry	2.59	2.30	2.23	0.866	2.59	2.23	0.598	2.52	1.50	0.157
Architectural distortion	1.9		2.61	0.451	1.90	2.61	0.451	2.42		
Mass										
Yes	35	11	69	0.419	37	78	0.4464	101	14	0.176
No	49	8	79		50	86		111	25	
Mass shape										
Irregular	34	11	57	0.236	36	66	0.4187	88	14	0.211
Other	4	0	12		4	12		16	0	
Mass margins										
Spiculated	18	7	43	0.298	19	49	0.0788	60	8	0.620
Indistinct	15	3	14		16	16		27	5	
Other	5	1	12		5	13		17	1	
Mass density										
High	29	8	41	0.307	30	48	0.2291	68	10	0.544
Equal	9	3	25		10	27		34	3	
Architectural distortion										
Yes	4	0	11	0.3446	4	11	0.4671	15	0	0.138
No	80	19	132		83	148		192	39	
Asymmetry/Focal asymmetry										

Yes	7	2	21	0.3395	7	23	0.1324	24	6	0.5935
No	77	17	120		80	134		181	33	
Prior mammogram available										
Yes	36	7	74	0.3892	36	81	0.2260	96	21	0.3245
No	48	12	74		51	83		116	18	
DBT performed										
Yes	34	12	52	0.0589	37	61	0.4098	82	16	0.7825
No	50	7	96		50	103		130	23	
Calcifications										
Yes	47	9	69	0.3839	48	77	0.2151	102	23	0.2125
No	37	10	79		39	87		110	16	
Type of Calcification										
Fine linear branching	21	6	43	0.2503	22	48	0.1368	57	13	0.8015
Corase heterogenous	24	4	26		24	30		43	11	
Distribution of Calcifications										
Grouped	19	4	33	0.3969	19	37	0.2122	45	11	0.8488
Linear	3	1	9		3	10		10	3	
Regional	4	0	8		4	8		9	3	
Segmental	22	5	19		23	23		39	7	

Table 3. TNM, histologic type and grade, hormone receptor status, HER2 status, and clinical prognostic stage by radiologists' work profile group.

	Years practicing radiology			*P* value	**Breast imaging fellowship training**		*P* value	**Practices dedicated breast imaging**		*P* value
	<10 (n=)	10-20 (n=)	>20 (n=)		Yes (n=)	No (n=)		Yes (n=)	No (n=)	
DCIS										
Yes	56	13	81	0.1484	58	92	0.1042	122	28	0.0954
No	28	6	67		29	72		90	11	
IDC										
Yes	48	11	85	0.9979	50	94	0.9812	123	21	0.6282
No	36	8	63		37	70		89	18	
ILC										
Yes	2	1	11	0.2664	2	12	0.1476	12	2	1
No	82	18	137		85	152		200	37	
DCIS grade										
1	13	2	10	0.3474	14	11	0.0811	22	3	0.4649
2	21	5	42		21	47		56	12	
3	22	6	28		23	33		43	13	
T										
Is	33	7	54	0.7925	34	60	0.7402	77	17	0.1865
1	35	10	61		37	69		87	19	
2	13	2	29		13	31		41	3	
N										
0	82	18	134	0.1987	85	149	0.0702	196	38	0.478

1	2	1	12		2	13		14	1	
Nottingham grade										
1	19	1	30	0.0732	19	31	0.6454	46	4	0.056
2	19	10	41		21	49		55	15	
3	13	1	23		13	24		34	3	
ER										
+	71	15	125	0.8180	74	137	0.7541	178	33	0.9184
-	13	4	23		13	27		34	6	
PR										
+	62	13	120	0.2654	65	130	0.4094	164	31	0.7692
-	22	6	28		22	34		48	8	
Her2neu										
+	15	2	18	0.4959	15	20	0.3180	32	3	0.1287
-	45	11	83		47	92		112	27	
Clinical prognostic stage										
0	33	7	54	0.9910	34	60	0.9554	77	17	0.2477
I	40	10	70		42	78		100	20	
II	11	2	20		11	22		31	2	
Mass										
Yes	35	11	69	0.4194	37	78	0.4464	101	14	0.1761
No	49	8	79		50	86		111	25	