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The Impact of Ethnicity on the Incidence, Tumor Characteristics and Treatment of Ductal Carcinoma *in Situ*—An 11-Year Clinical Experience at a High Volume Teaching Hospital

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Abstract

Introduction: Screening mammography has led to a marked increase in detection of *in situ* breast tumors in the United States. The University of Southern California/Van Nuys Prognostic Index (USC/VNPI) predicts the recurrence rates of ductal carcinoma *in situ* (DCIS); however variations in tumor characteristics, USC/VNPI scores, receptor and human epithelial growth factor receptor (*HER*)-2/*neu* status across different ethnicities/races have not been well studied. This study aimed to evaluate the racial trends in incidence, patient demographics, tumor characteristics and treatment variations for patients with DCIS at a high volume teaching hospital. Methods: 395 women underwent surgical intervention for DCIS between 2000 and 2011. Their race/ethnicity was divided into five mutually exclusive categories and demographic and clinicopathological data was collected. Multivariate analysis was performed to evaluate variations in patient and tumor factors with respect to age, size and surgical management among different ethnicities and races. Results: 82.1% of Caucasian women underwent simple mastectomy with sentinel lymph node biopsy (SLNB) while lumpectomy with SLNB was highest in Hispanics (40%, $p = 0.005$). Overall, there was no significant difference in the incidence of receptor or *HER*-2/*neu* positivity, multicentricity, necrosis or grade of DCIS in the various racial groups, but there was a significant racial difference in the USC/VNPI scores ($p < 0.001$). Conclusion: On a community level, screening detected DCIS accounted for the vast majority of DCIS diagnosed, which reflected national trends. Although no racial variation

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in DCIS with respect to patient or tumor characteristics was observed, a racial difference in USC/VNPI score was identified among the Hispanic population. Additional studies are required to validate the significance of these findings.

Keywords

Ductal Carcinoma *in Situ*, *HER*-2/*Neu*, Ethnicity, Race, Breast Neoplasms

1. Introduction

Ductal carcinoma *in situ* (DCIS) is defined as the proliferation of malignant mammary epithelial cells that have not yet invaded the basement membrane [1]. DCIS accounts for more than 20% of newly diagnosed breast cancers in the United States, in part due to increased mammography screening which began in the 1980's [1]-[4]. In the United States, 57,650 cases of DCIS were diagnosed in 2011 [5]. Mammography is currently the gold standard to diagnose DCIS; however, 6% - 23% of DCIS lesions are not visible on mammography but may be detected by Magnetic Resonance Imaging (MRI) [6]. Prior to mammography, DCIS accounted for less than 1% of all breast cancers and was primarily an incidental pathologic finding at surgical resection [1] [7] [8].

Ethnic/racial variations among women with invasive breast cancer have been well studied [5] [9]. According to the American Cancer Society, a rapid increase in breast cancer incidence (4.1% per year) among white women occurred in the 1980's [10]. Liu *et al*. [9] examined the incidence trends of invasive breast cancer by race/ethnicity and age, noting that age-adjusted incidence rates (AAIRs) of invasive breast cancer rose equally among all races/ethnicities in Los Angeles County during 1980 through 2000. However, from 2004 to 2008, using data from the North American Association of Central Cancer Registries (NAACCR), Desantis *et al*. [5] analyzed incidence rates by race/ethnicity, finding that invasive breast cancer rates were stable among all racial/ethnic groups, but not equal. The highest incidence rate for breast cancer was reported among white women (125.4 cases per 100,000 females), followed by African American women (116.1 cases per 100,000 females) while the lowest incidence rate was observed in Asian American/Pacific Islander women (84.9 cases per 100,000 females) [5]. The 5-year disease-free survival rate among Asian American/Pacific Islander women is reported as 90.3% and 77.5% in African-American women [5]. While these differences in survival rates for invasive breast cancer suggest differences in tumor biology, stage of diagnosis, and access to treatment among different ethnicities, the same information for DCIS is lacking.

The overall prognosis for DCIS is excellent with a 10-year survival rate of over 98% [11] [12]. However, whether that translates across all races is an important question that needs to be answered. Studies at the national level have compared the incidence of DCIS in Caucasian to African American women and revealed a higher incidence among Caucasians; however this has not been well studied in other races/ethnicities [13]-[16]. Based on the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) database trends in incidence of DCIS from 1972-1992, Ernster *et al*. [14] noted that the incidence of DCIS among all races rose 557% and after 1983, DCIS rates for African-American women increased at a rate of 3.8 to 14.4 per 100,000 while in Caucasian women it increased from 3.7 to 15.9 per 100,000. The alarming rise of DCIS in the United States warrants additional research with regards to patient and tumor characteristics in patients of different ethnic/racial groups to determine whether such factors as family history of invasive/*in situ* breast cancer, breast cancer (*BRCA*) gene mutations, tumor grade, tumor size, receptor and human epithelial growth factor receptor (*HER*)-2/*neu* patterns play a role. The University of Southern California/Van Nuys Prognostic Index (USC/VNPI) is a prognostic tool first described in 1996 that utilizes five factors (tumor size, margin width, nuclear grade, presence or absence of necrosis and age) to assess the risk of DCIS recurrence [17]. Racial variations in USC/VNPI scores may be important to predict recurrence patterns. This study sought to examine ethnic/racial trends in the incidence, tumor characteristics, patterns of care and USC/VNPI scores in DCIS patients admitted at a high volume tertiary care university affiliated medical center over an 11-year period.

2. Methods

Three hundred ninety-five women underwent surgical resection for DCIS at the Saint Barnabas Medical Center,

Livingston, NJ, between February 2000 and July 2011 and were included in the study after approval from the Institutional Review Board (IRB #11-48). Demographic and clinicopathological data including age, sex, ethnic/racial origin, family history of breast cancer, BRCA 1or 2 gene mutation, pre-operative radiological findings (including mammography, ultrasound and MRI), pre-operative clinical findings (including palpable versus non-palpable), type of surgery [lumpectomy versus simple mastectomy; sentinel lymph node biopsy (SLNB)], histopathological and receptor characteristics of the tumor were collected on all patients. One-hundred and four patients had insufficient information on mode of detection. Patients with a previous diagnosis of invasive breast cancer or other pathology such as Lobular carcinoma *in situ* (LCIS) not associated with DCIS were excluded from the study.

The Estrogen Receptor (ER) and Progesterone Receptor (PR) assays were performed on formalin-fixed paraffin embedded tissue sections using monoclonal antibodies and the Bond Polymer Detection System. A total of 200 tumor cell nuclei were scored. The tests were performed with positive and negative controls that showed the expected appropriate responses. The *HER*-2/*neu* gene status was evaluated by interphase fluorescence in-situ hybridization (FISH) on formalin fixed paraffin embedded tissue section using a chromosome 17 centromeric probe (CEP17) and a *HER*-2 probe (LSI *HER*-2) from the FDA-approved Vysis PathVysion *HER*-2 DNA Probe Kit. The procedure was performed and with amplified and non-amplified controls that showed the expected appropriate results. The ratio is calculated as the average of *HER*-2/*neu* gene copy number to that of chromosome enumerator probe 17. A ratio greater than 2.2 denotes amplification of the *HER*-2/*neu* gene. If the ratio is less than 1.8, the *HER*-2/*neu* gene is not amplified while a ratio of 1.8 to 2.2 is considered equivocal for *HER*-2 gene amplification.

BRCA 1 and 2 mutations are sent to Myriad Genetics (Salt Lake City, Utah, USA) for BRACAnalysis®. Indications for performing BRCA testing include breast cancer diagnosed at age 50 or younger, ovarian cancer at any age, two primary breast cancers in the same individual or on the same side of the family, male breast cancer, triple negative breast cancer, pancreatic cancer with a breast or ovarian cancer in the same individual or on the same side of the family, Ashkenazi Jewish ancestry with an Hereditary Breast and Ovarian Cancer syndrome-associated cancer in the same individual or on the same side of the family, two or more relatives with breast cancer with one relative under age 50, three or more relatives with breast cancer at any age and/or a previously identified BRCA mutation in the family.

Race/ethnicity was grouped into five mutually exclusive categories. The categories were non-Hispanic Caucasian (hereafter referred to as Caucasian); non-Hispanic African-American (African-American); Hispanic; Asian-Pacific Islander (Asian) and Other/Unknown. The Asian-Pacific Islander category included Chinese, Japanese, Filipino and Asian Indian women. Patients whose race/ethnicity was not documented were analyzed in the other/unknown category.

Univariate analysis was performed using the Statistical Predictive Software and Solutions (SPSS)™ (v19, IBM, NY, USA) to evaluate ethnic variations in patient factors including age, family history and BRCA mutations as well as mode of detection (palpability versus screen detection). Surgical therapy provided included simple mastectomy with SLNB, simple mastectomy with ALND and lumpectomy with SLNB were similarly evaluated. Tumor factors analyzed were size, pathological type of DCIS, presence or absence of necrosis, grade, presence of invasive component or other pathology (LCIS), multifocality, multicentricity, Van Nuys Prognostic Index score, Estrogen Receptor (ER), Progesterone Receptor (PR) and *HER*-2/*neu* status.

3. Results

3.1. Demographics (Table 1)

Between February 2000 and July 2011, 395 female patients with a median age of 56 years (range: 28 - 91 years) underwent surgical therapy for Stage 0 (DCIS) breast cancer (**Table 1**). Race/ethnicity was unknown/not documented for 3.7% (n = 15) of all DCIS cases. Among the 395 patients, 307 (77.7%) women were Caucasian with a median age of 56 years (range: 28 - 91 years). African American women comprised 9.87% (n = 39) of the total women in the study with a median age of 58 years (range of 36 - 79 years). Hispanic women numbered 10 patients (2.53%) with a median age of 51 years (range: 31 - 80 years). The Asian group was comprised of 24 women (6.07%) with a median age of 55 years (range: 42 - 75 years). Fifteen (3.79%) women were included in the Unknown/Other category and had a median age of 54 years (range: 37 - 76 years). There was no significant difference amongst the ethnic/racial groups with respect to age (p = 0.694). Overall, 56 (14.2%) women had a

Table 1. Patient characteristics, mode of detection and surgical treatment in 395 DCIS patients.

Patient Characteristics	Overall (n = 395)	Caucasian (n = 307)	African American (n = 39)	Hispanic (n = 10)	Asian-Pacific Islander (n = 24)	Unknown/ Others (n = 15)	*p* value*
Median age (yr)†	56	56	58	51	55	54	0.694
Family history							0.362
1st degree relative with breast cancer	56 (14.2%)	49 (15.9%)	0 (0.0%)	2 (20.0%)	3 (12.5%)	2 (13.3%)	
BRCA 1 positive	6 (1.5%)	5 (1.6%)	0 (0.0%)	0 (0.0%)	1 (4.2%)	0 (0.0%)	
BRCA 2 positive	6 (1.5%)	4 (1.3%)	1 (2.6%)	0 (0.0%)	0 (0.0%)	1 (6.7%)	
Mode of detection:							0.402
Microcalcification on MMG	255 (64.6%)	191 (62.2%)	30 (76.9%)	7 (70.0%)	18 (75.0%)	9 (60.0%)	
Palpable mass	36 (9.1%)	27 (8.8%)	5 (12.8%)	1 (10.0%)	1 (4.2%)	2 (13.3%)	
Information not available	104 (26.3%)	89 (29.0%)	4 (10.3%)	2 (20.0%)	5 (20.8%)	4 (26.7%)	
Surgical treatment							0.005
Lumpectomy with SLNB	84 (21.2%)	55 (17.9%)	11 (28.2%)	4 (40.0%)	6 (25.0%)	8 (53.3%)	
Simple mastectomy with SLNB	311 (78.7%)	252 (82.1%)	28 (71.8%)	6 (60.0%)	18 (75.0%)	7 (46.6%)	

BRCA 1 = breast cancer susceptibility gene 1; BRCA 2 = breast cancer susceptibility gene 2; DCIS = ductal carcinoma *in situ*; MMG = mammogram; DCIS = ductal carcinoma *in situ*, SLNB = sentinel lymph node biopsy. *p value statistically significant <0.05, for the trend; †median (range).

strong family history of breast cancer and 12 (3%) were either BRCA 1 or BRCA 2 gene positive. Among this group, a family history of a first degree relative with breast cancer was highest among Hispanic (20%, n = 2) women. No significant ethnic or racial difference was noted with respect to family history of a first degree relative with breast cancer or gene mutation status (p = 0.362).

3.2. Mode of Detection (Table 1)

Screening mammography was the most common mode of DCIS detection across all groups (**Table 1**). Overall, 64.6% (n = 255) of patients with DCIS were screen detected. Information on mode of detection was not available for 26.3% (N = 104) of women. Screen detection was highest among African American women (76.9%, n = 30) and lowest among Caucasian (62.2%, n = 191) women. Among the different groups, African American women (12.8%, n = 5) were most often found with a palpable mass compared with 4.2% (n = 1) of Asian women. Although there were percentage differences amongst the different racial groups, mode of detection of DCIS among various races/ethnicities was not statistically significant (p = 0.402).

3.3. Surgical Procedure (Table 1)

All 395 patients were treated surgically by either lumpectomy with SLNB or simple mastectomy with SLNB as demonstrated in **Table 1**. Overall, 78.7% (n = 311) of the women underwent simple mastectomy with SLNB while 21.2% (n = 84) women underwent lumpectomy with SLNB. Lumpectomy with SLNB was most frequently observed in the Hispanic population (40.0%, n = 4) compared to 17.9% (n = 55) of Caucasian women. 82.1% (n = 252) of Caucasian women underwent simple mastectomy followed by 75% (n = 18) of Asian women. The type of surgery among races/ethnicities was statistically significant (p = 0.005). The results were further evaluated by subgroup analysis which demonstrated the significance within the Other group. More lumpectomies with SLNB were performed in the Other group compared with the Caucasian group. No significance within each group was found for surgical treatment.

3.4. Histopathological Characteristics of the Tumor (Table 2)

Table 2 illustrates the final histopathology for each DCIS patient treated. Median tumor size across all races/ethnicities was 1.0 cm. Among the different groups, median tumor size varied such that in the Caucasian group it was 1.0 cm while in the African American group it was 0.2 cm, but not statistically significant (p =

Table 2. Final histopathology and USC/Van Nuys prognostic index of 395 DCIS patients.

Tumor Factors	Overall (n = 395)	Caucasian (n = 307)	African American (n = 39)	Hispanic (n = 10)	Asian-Pacific Islander (n = 24)	Unknown/ Others (n = 15)	*p* value*
Histopathology							0.419
DCIS	307 (77.7%)	242 (78.8%)	29 (74.4%)	7 (70.0%)	19 (79.2%)	10 (66.7%)	
DCIS with IDC	70 (17.7%)	52 (16.9%)	6 (15.4%)	2 (20.0%)	5 (20.8%)	5 (33.3%)	
DCIS with LCIS	18 (4.6%)	13 (4.2%)	4 (10.3%)	1 (10.0%)	0 (0.0%)	0 (0.0%)	
Tumor characteristics							
Median tumor size (cm)	1.0	1.0	0.2	0.1	0.1	0.1	0.861
Multicentricity	47 (11.9%)	34 (11.1%)	5 (12.8%)	2 (20.0%)	3 (12.5%)	3 (20.0%)	0.772
Multifocality	92 (23.3%)	72 (23.5%)	9 (23.1%)	3 (30.0%)	3 (12.5%)	5 (33.3%)	0.615
High Grade	140 (35.4%)	107 (34.9%)	16 (41.0%)	3 (30.0%)	10 (41.7%)	4 (26.7%)	0.931
Comedonecrosis	264 (66.8%)	199 (64.8%)	29 (74.4%)	7 (70.0%)	19 (79.2%)	10 (66.7%)	0.364
Receptor status							
ER positive	235 (59.5%)	182 (81.3%)	21 (77.8%)	9 (90.0%)	12 (70.6%)	11 (84.6%)	0.737
PR positive	182 (46.1%)	139 (62.1%)	17 (63.0%)	7 (70.0%)	9 (52.9%)	10 (79.6%)	0.721
HER-2/*neu* positive	24 (6.1%)	21 (50.0%)	2 (50.0%)	0 (0.0%)	0 (0.0%)	1 (25.0%)	0.469
USC/Van Nuys prognostic index							<0.001
Low score	130 (32.9%)	103 (33.6%)	15 (38.5%)	0 (0.0%)	5 (20.8%)	7 (46.7%)	
Intermediate score	264 (66.8%)	204 (66.4%)	24 (61.5%)	10 (100%)	19 (79.2%)	7 (46.7%)	
High score	1 (0.3%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (6.7%)	

DCIS = ductal carcinoma *in situ*; IDC = intraductal carcinoma; LCIS = lobular carcinoma *in situ*; USC/VNPI = University of Southern California/Van Nuys prognostic index. *p value statistically significant <0.05, for the trend.

0.861). Pure DCIS was reported in 77.7% (n = 307) of all tumors and most frequently identified in the Asian population (79.2%, n = 19). DCIS with microinvasion was observed in 17.7% (n = 70) of all tumors and most often detected among Asian (20.8%, n = 5) women and Hispanic (20.0%, n = 2) women. Eighteen patients (4.6%) had a final pathology of mixed DCIS and LCIS. Overall, final histopathology of the primary tumor amongst the races was not statistically significant ($p = 0.419$).

Tumor characteristics analyzed included multifocality, multicentricity, high grade and comedonecrosis. Among the 395 patients, 35.4% (n = 140) of tumors were considered high grade which was identified most often in tumors of Asian women (41.7%, n = 10) and African American women (41%, n = 16). High grade DCIS was not statistically significant amongst the different ethnic/racial groups ($p = 0.931$). 66.8% (n = 264) of all tumors analyzed revealed comedonecrosis. Among the different ethnic/racial groups, comedonecrosis was observed most often in tumors of Asian (79.2%, n = 19) women when compared to Caucasian (64.8%, n = 199) women. Overall, comedonecrosis did not differ statistically between groups ($p = 0.364$). Multicentricity was detected in 11.9% (n = 47) of all tumors, with the highest rate among Hispanic (20%, n = 2) women and lowest rate among Caucasian (11.1%, n = 34) women. Multicentricity was not statistically significant among the various ethnic/racial groups ($p = 0.772$). Multifocality was revealed in 23.3% (n = 92) of all tumors with a similar rate detected in both Caucasian (23.5%, n = 72) women and African American (23.1%, n = 9) women. Overall, multifocality did not yield statistical significance ($p = 0.615$).

ER and PR receptors and *HER*-2/*neu* status among the 395 patients were evaluated as illustrated in **Table 2**. ER positive receptors were observed in 235 (59.5%) tumors while PR positive receptors were observed in 182 (46.1%) tumors. ER and PR positive receptors were identified most frequently in the Hispanic population (90.0% and 70.0%, respectively). *HER*-2/*neu* positive tumors were highest in Caucasian (50%, n = 21) and African

American (50%, n = 2) women. There was no statistical significance seen among the various races/ethnicities in ER receptor status ($p = 0.737$), PR receptor status ($p = 0.721$) or *HER-2/neu* status ($p = 0.469$).

3.5. University of Southern California/Van Nuys Prognostic Index (Table 2)

Table 2 depicts the USC/Van Nuys Prognostic Index (USC/VNPI) calculated for all 395 DCIS patients. The USC/VNPI is calculated using tumor grade, presence or absence of comedonecrosis, margin width, tumor size along with age. A significant difference in tumor characteristics between the different races/ethnicities was detected ($p < 0.001$). Overall, 66.8% (n = 264) women had an intermediate USC/VNPI score with 100% (n = 10) of Hispanic women included in this group. On further subgroup analysis with Caucasian women as the control group, Hispanic women had a higher percentage of intermediate VNPI scores ($p = 0.026$). Overall, 32.9% (n = 130) women had a low USC/VNPI score which was most frequently observed in African American women (38.5%, n = 15).

4. Discussion

DCIS of the breast constitutes a growing subset of breast cancer diagnoses among women in the United States and comprises 20% of new breast cancer cases [1]-[4]. With the rising incidence of DCIS diagnoses, it is important to understand variations in patterns of presentation and management of this disease in different racial/ethnic groups. With the increased use of screening mammography in the United States, an increased incidence of DCIS was observed in the 1980's across all ethnicities [18]-[21]. Innos and Horn-Ross analyzed data from the California Cancer Registry (1988-1999) looking at racial/ethnic differences and trends in the incidence of DCIS in 11,798 California women and found that the percentages of DCIS across races were similar between White (11.9%), Black (11.9%), Hispanic (10.8%) and Asian-Pacific Islander (14.9%) women [21]. Joslyn identified DCIS among 41,245 women of different races in nine different geographic areas across the United States using SEER (1973-2000) [3]. The study reported the incidence of DCIS in White women to be 9.2%, African American women 10.2%, American Indian/Alaska native women 7.3% and Asian-Pacific Islander women 15.0% [3]. These results are consistent with the current study. However, in a study of 950 women from the New Mexico SEER affiliated program (1973-1994), Adams-Cameron *et al.* found that the rate of DCIS was highest in Caucasian (77.6%) women followed by Hispanic (19.6%) women [19]. Conversely in the data collected from the Detroit SEER Program (1996-2000) that evaluated 358 African American and Caucasian women with DCIS, Nassar *et al.* observed that African American (61%; n = 217) women were diagnosed more often with DCIS than Caucasian (39%, n = 141) women [20].

Although the present study did not observe major differences in age adjusted incidence of DCIS between the various ethnic/racial groups (median age at presentation: 56 years), Innos and Horn-Ross have reported that although a steady increase was noted in all racial/ethnic groups, the increase in the age-adjusted incidence rate of DCIS (both in terms of absolute increase and percent change) was steepest among Asian-Pacific Islander women (from 15.0 in 1988 to 46.2 in 1999) compared to Hispanic women (from 12.4 in 1988 to 30.4 in 1999), Black women (from 24.5 in 1988 to 46.1 in 1999), and White women (from 35.0 in 1988 to 59.3 in 1999) [21]. When examined by age group, the estimated annual percentage change (EAPC) was significantly higher in Asian-Pacific Islander women age 50 - 64 years (EAPC = 12.0; 95% CI, 9.3 - 14.6) compared with White women of a similar age (EAPC = 5.6; 95% CI 4.6 - 6.6) [21]. The only significant differences between racial/ethnic groups observed were for White women age 40 - 49 years (EAPC = 3.1; 95% CI, 1.3 - 5.0) and those >65 years (EAPC = 6.1; 95% CI, 5.3 - 6.8) [21]. Adams-Cameron *et al.* [19] found that Hispanics, non-Hispanic whites, and American Indians had stable rates of DCIS between 1973 and 1984. Beginning in 1985, rates for all groups combined steadily increased (averaging a 21% increase per year) and by 1994, the DCIS incidence rate was 13.8 per 100,000 in non-Hispanic whites and 9.7 per 100,000 for Hispanics [19].

Several authors have reported that the prevalence of BRCA 1 and BRCA 2 mutations are similar in DCIS and invasive breast cancer [22]-[24]. However, there is limited data regarding family history, gene mutations and DCIS with respect to race/ethnicity. Nassar *et al.* evaluated the incidence of DCIS with respect to family history of breast cancer and race (Caucasian and African American) and found no significant association between the two (p = statistically not significant) [20]. They observed that 29.2% African American women (21/72) and 23.4% Caucasian (11/47) had a strong family history of breast cancer, compared to our study in which Hispanic women

had the highest rate of a first degree relative with breast cancer (20%), but the result was not statistically significant [20].

Screening mammography has been principally the most important method of detection for DCIS. The Detroit Medical Center/SEER program identified 136 women in whom both clinical and mammographic information was available and found that 88% overall presented with mammographic calcifications and 12% overall with a breast mass/density [20]. 16% of African American (n = 13) and 9% of Caucasian (n = 5) women presented symptomatically (either as a breast mass, nipple discharge or pain) [20]. These results are consistent with the current study where 12.8% of African American and 8.8% Caucasian women presented with symptoms.

The primary treatment of DCIS is surgical excision via a breast conservation approach (BCS) or by mastectomy. Utilization of BCS for treatment of DCIS has increased significantly over time in all SEER sites, ranging from 56.8% in Utah to 75.6% in Connecticut [3]. Adams-Cameron *et al.* found an increase in the use of BCS for the treatment of DCIS between 1985-1994 at the rate of 6% per year, resulting in a BCS rate of 52% in 1994 and they observed that use of BCS for DCIS did not vary significantly by age and ethnicity where Hispanics had a rate similar to that of Caucasian women [19]. BCS acceptance rates vary significantly by geographic region in that women receiving Medicare who live in southern and west central states have lower rates of BCS than women living in New England and far western states. Lower rates of BCS are also reported in rural areas within states, with fewer physicians, and in areas without a cancer center or radiation treatment facility [25]. More recently a trend towards the treatment of DCIS by mastectomy began in 2001 [26], raising concerns about over treatment or lack of patient involvement in decision making. In a study of the ethnic variations in treatment decisions for DCIS among 2647 women (70.2% white, 18% African Americans and 11.8% others), Katz *et al.* reported that African American women reported seeing more surgeons (40% of African American women reported seeing two or more surgeons versus 27.6% of white women; $p < 0.001$) and were more likely to undergo a mastectomy than their white counterparts (only 31.4% of African American women were informed about BCS versus 50.7% of white women; $p = 0.029$) [26]. These results are in contrast to the current study in which mastectomy rates were highest in Caucasian (82.1%) women, followed by Asians (75.0%), then African Americans (71.8%) and Hispanics (40%) who underwent the most lumpectomies. The mastectomy procedure was based on extent of microcalcification as well as patient choice. Tseng *et al.* reported that African American women were less likely to be offered referrals for reconstruction and African American women along with Asian women had low rates of reconstruction compared with Caucasian women [27].

The goal of treating DCIS is to reduce local recurrence and progression to invasive cancer. Thus the receptor status of the tumor is an important predictive factor. Use of tamoxifen therapy has been shown to decrease local and contralateral occurrence of invasive and non-invasive breast disease [28]. Invasive breast cancer subtypes have distinct sociodemographic, anthropometric and reproductive characteristics. Trivers *et al.* found that ER/PR negative tumors were associated with African American race, obesity, having a first child at a young age and a recent birth [29]. Using the information of 1893 DCIS patients of the North Carolina Cancer Registry (1998-1999), Jackson *et al.* found that of the 278 women with data on hormone receptor status, 77% were hormone positive and 23% were hormone negative, with no significant differences found among racial groups [28]. These results are similar to the current study in which 59.5% of women were found to be hormone positive, but no statistical significance was observed between the different ethnic/racial groups.

Since DCIS represents a broad spectrum of breast disease with various treatment options, the USC/VNPI was created to assist in treatment formulation since a standardized method is not appropriate [17]. The USC/VNPI includes nuclear grade of the tumor, comedonecrosis, margin width, size of tumor and age of patient in the calculation of local recurrence risk. The USC/VNPI quantifies prognostic factors in DCIS and identifies specific groups of patients that may be offered excision alone, excision plus radiation or mastectomy [17]. The current study looked at the USC/VNPI scores among the different ethnic/racial groups. High grade and comedonecrosis, which is an indicator of a more aggressive DCIS, was highest among Asian (41.7% and 79.2% respectively) and African American women (41.0% and 74.4%) while it was found at a relatively low rate among Caucasian women (34.9% and 64.8%). Although these findings were not independently significant, the factors were calculated into the USC/VNPI and subgroup analysis was performed. It was observed that there was a significant racial difference in the USC/VNPI score among Hispanic women ($p < 0.001$), notably 100% of Hispanic women were categorized as intermediate USC/VNPI score. This raises a point of concern with regards to their adjuvant treatment. Based on previous reports by Silverstein *et al.*, treatment recommendations for the intermediate group are the most complicated and vary from no further treatment needed to recommending mastectomy [17]. How-

ever, owing to the small sample size in this study, these results need to be validated on a larger scale. To date, there have been no studies of DCIS patients using the USC/VNPI and local recurrence patterns among the different ethnicities/races in addition to this small sample report. The results of such studies will aid in counseling DCIS patients of different ethnicities/races and allow the development of evidence based treatment options using parameters obtained after initial excision.

The current study has several limitations, notably the overall small sample size as well as the disparity between the Caucasian group and the rest of the groups. The patient population is predominantly Caucasian, which explains the differences. Further validation of these single institutional results are needed from a population based database analysis.

5. Conclusion

As mammographic detection of DCIS continues to rise, racial/ethnic variations in patient and tumor characteristics need to be appropriately studied. Presentation, extent and patterns of treatment (including awareness of reconstruction) selected by women of different ethnicities/races are highly variable. This study demonstrated that racial/ethnic variations in tumor characteristics were identified among patients treated for DCIS based on the USC/VNPI, specifically in the Hispanic population. Thus, the USC/VNPI may be uniquely suited to detect ethnic variation among DCIS patients. Additional research is underway to examine the interplay among USC/VNPI scores, hormone receptor status, *HER-2/neu* status and recurrence patterns between the different ethnicities/races in a large population based database.

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