Breast Cancer Research and Treatment (2005) 91: 243–248
DOI 10.1007/s10549-005-0324-9

Report

Racial disparities in treatment and survival of women with stage I–III breast cancer at a large academic medical center in metropolitan Detroit

Wei Du[1] and Michael S. Simon[2]
[1]*Clinical Pharmacology and Toxicology, Carman and Ann Adams Department of Pediatrics, Wayne State University, Children's Hospital of Michigan, Detroit, MI, USA;* [2]*Division of Hematology/Oncology, Karmanos Cancer Institute at Wayne State University, Detroit, MI, USA*

Key words: breast cancer, costs, patterns of care, racial disparities, survival

Summary

African-American (AA) women with breast cancer have higher mortality rates than Caucasian woman, and some studies have suggested that this disparity may be partly explained by unequal access to medical care. The purpose of this study was to analyze racial differences in patterns and costs of care and survival among women treated for invasive breast cancer at a large academic medical center. Subjects included 331 AA and 257 Caucasian women diagnosed with stage I–III breast cancer between 1994 and 1997. Clinical, socio-demographic, and cost data were obtained from the medical record, cancer registry, and hospital financial database. Data were collected on the use of cancer directed treatments (surgery, radiation, chemo and hormonal therapy) up to 1-year post-diagnosis. Survival analyses compared disease-free and overall survival by race adjusting for age, stage, nodal involvement, ER/PR status and a diagnosis of hypertension, diabetes, heart disease and cerebral vascular accident. There were no significant racial differences in treatment utilization and costs. The mean total 1-year treatment costs were $16,348 for AAs and $15,120 for Caucasians. While AAs had a significantly higher unadjusted relative risk (RR) of recurrence 2.09 (95% CI: 1.41–3.10) and death 1.56 (95% CI: 1.09–2.25), the multivariate adjusted analyses resulted in no significant differences in recurrence 1.38 (95% CI: 0.85–2.26) or death 1.06 (95% CI: 0.64–1.75). There was no obvious racial disparity in treatment and costs noted. Our findings support the theory that equal treatments produce equal outcomes. Improvement in screening may have an important impact on survival among minority women with breast cancer.

Background

Breast cancer incidence rates are higher among Caucasian than African-American (AA) women in the USA, although mortality rates from breast cancer are higher among AA women [1]. Numerous population-based studies using data from the Surveillance, Epidemiology and End Results (SEER) program [2–10] and other data bases [11–13], have been published showing worse prognostic features and lower survival rates for AA and other ethnic minority women with breast cancer compared with Caucasian women. A number of studies have also reported on racial differences in the patterns of care for women with breast cancer [8–12,14]. Unequal access to state-of- the-art cancer-directed treatment might, in part, explain racial differences in survival among women with breast cancer in this country. We analyzed clinical and financial data collected on AA and Caucasian women treated for stage I–III breast cancer at a single large urban academic medical center, in order to examine survival differences by race among women who were likely to have received equivalent treatment.

Methods

Study population

Data for this analysis came from clinical information collected on women diagnosed with stage I through III breast cancer from 1/1/94 through 12/31/97 with received all of their initial course of cancer therapy Karmanos Cancer Institute and who had at least 1-year of follow-up at the KCI. The KCI is one of the 55 National Cancer Institute (NCI) designated Comprehensive Cancer Centers (CCC's) in the U.S.A. It is affiliated with Wayne State University (WSU) and the Detroit Medical Center (DMC) and is located in Detroit, MI.

The study population was identified through a search of the Metropolitan Detroit Cancer Surveillance System (MDCSS), which is one of the 11 sites of the NCI's SEER program. Using the MDCSS database, we identified 750 women with stage I through III breast cancer whom had received at least some of their breast cancer directed therapy including surgery, radiation,

chemotherapy and/or hormonal therapy at the KCI. Medical records were reviewed in order to determine whether or not the patients had received all of their initial treatments at KCI and whether they were followed at the KCI for at least one year or until death, whichever came first. The 1-year time frame was selected in order to ensure that we captured to the extent possible all cancer-directed treatments received post-diagnosis. We excluded 162 women who had received treatment outside of the institution leaving us with a study population of 588 (78%) women. We did not include women with stage IV disease because of different patterns of care utilized for this patient population depending on the extent of disease and clinical condition at presentation. By including only women with stages I–III breast cancer, we were able to look specifically at patterns of care utilized for the primary treatment of non-metastatic disease. We also limited our study to women identified as either Caucasian or AA, since other racial groups made up less then 1% of women seen at the KCI for breast cancer treatment.

Study measures

Patient clinical and treatment data were collected by medical record review and additional clinical information was obtained through the MDCSS registry. Study outcomes included patterns of treatment and treatment-related costs over the first-year post-diagnosis as well as disease-free survival (DFS) and overall survival (OS). DFS was defined as the duration between diagnosis and disease recurrence (or last follow-up date). OS was defined as the duration between diagnosis and death due to any cause (or last follow-up date). DFS and OS were obtained from medical record review as well as the MDCSS records. Demographic data included age at diagnosis, race (AA or Caucasian), and insurance coverage classified as commercial (conventional, HMO, or PPO), Medicaid, Medicare only, or Medicare plus any kind of supplemental insurance (e.g., Medigap or Medicaid). Clinical data included American Joint Committee on Cancer (AJCC) stage, the presence of axillary lymph node involvement (coded as either involved or not involved), estrogen and progesterone receptor status (coded as either positive or negative), and the presence of four common co-morbid conditions seen in this study population, which included hypertension, diabetes mellitus, heart disease and cerebral vascular accidents (CVA).

Information on treatment consisted of the use of surgery, radiation, chemotherapy, and tamoxifen and was documented through review of the patient medical record. Cost data consisted of costs associated with all inpatient and outpatient activity beginning with the date of diagnosis to 1 year after diagnosis or death (which ever came first). Cost data were obtained from the DMC cost accounting database, TSI (Transition Systems, Inc.). Costs associated with hospice care were not included in this analysis. We calculated 1-year total treatment related costs, pharmacy costs (which included the costs of all drugs as well as the costs of chemotherapy), laboratory test costs, and operating room (OR) costs. For the calculation of cost, we assumed the health care providers' (hospital systems) perspective. Thus, only facility-based costs were used, and the professional costs component was not included in this analysis.

Statistical methods

Chi-square tests and Student *t*-tests were used to compare AA and Caucasian women by demographic and clinical characteristics, treatment patterns and treatment-related costs. Survival rates were estimated by Kaplan–Meier survival curves. Cox proportional hazard regression was used to compare OS and DFS between AA and Caucasian women while adjusting for covariates. Covariates included in the multivariable analysis included factors that are generally considered important prognostic variables for breast cancer such as age at diagnosis, disease stage, axillary lymph node involvement (present vs. absent) and ER/PR status (positive vs. negative). We also adjusted for the presence or absence of four common co-morbid conditions (hypertension, diabetes mellitus, heart disease, and CVA). RR (or hazard ratios) for disease relapse and death along with their 95% CIs were calculated.

Results

Demographic and clinical characteristics

Table 1 shows the demographic and clinical characteristics of the 588 women for whom at least 1-year of treatment and follow-up (if survival was greater than one year) was completed at the KCI. The racial composition of the study population consisted of 56.2% AA and 43.7% Caucasian, with a mean and median age of 59 years. The majority of women treated at the KCI had some form of commercial medical insurance or Medicare. There was no significant difference in age at diagnosis by race, although AA women were on average slightly older than Caucasian women. However, AA women were less likely than Caucasian women to have commercial insurance ($p < 0.001$) and more likely to use Medicaid ($p < 0.001$).

There were also significant differences in clinical presentation by race. AA women were less likely than Caucasian women to have been diagnosed with stage I breast cancer and more likely to be diagnosed with stage III cancer ($p = 0.001$). AA women were also more likely to have hormone receptor negative breast cancer than Caucasian women ($p < 0.001$). Lastly, AA women had higher rates of the three evaluated co-morbid conditions than CAU women including higher rates of hypertension, diabetes mellitus and of heart disease or stroke.

Table 1. Demographic and clinical characteristics of AA vs. CAU women

Characteristics (%)	AA ($n=331$)	CAU ($n=257$)	p-value (2-sided)
Age (mean/SD)	60/13.6	58/14.1	0.382
Insurance			<0.001
Commercial	37%	57%	
Medicare	37%	35%	
Medicaid	21%	8%	
Medicare + Supplemental	5%	0%	
Stage[a]			0.001
Stage I	42%	51%	
Stage II	47%	46%	
Stage IIIA	5%	1%	
Stage IIIB	6%	2%	
Node involvement (Yes/No)	39%	36%	0.563
Hormone receptors			
Estrogen receptor +	52%	73%	<0.001
Progesterone receptor +	49%	65%	<0.001
Either receptor +	56%	75%	<0.001
Co-morbidities			
Hypertension	55%	30%	<0.001
Diabetes	18%	5%	<0.001
Heart disease/CVA	15%	9%	0.027

[a]Stage was based on the American Joint Committee on Cancer staging criteria.

Treatment patterns and treatment-related costs

Table 2 shows the patterns of care and average 1-year costs of treatment stratified by race. There were no significant differences in overall treatment utilization or the 1-year total costs of treatment. Nearly 100% of the women underwent some form of surgical resection. AA women were more likely to undergo lumpectomy vs. mastectomy than Caucasian women, and were also more likely to undergo lumpectomy and radiation, although these differences were not statistically significant. About 2/5 of the women were prescribed chemotherapy and 3/4 who had ER- and/or PR-positive tumors received tamoxifen. The mean 1-year total breast cancer treatment costs were $16,348 for AA women and $15,120 for Caucasians, and this difference was not statistically significant. There were also no significant differences by race in the average 1-year costs associated with pharmacy, laboratory tests, or the use of the OR (see Table 2). In Table 3, we further looked at racial differences in treatment by stage at diagnosis (stage I vs. stage II and III). It was noted that among stage I patients, a significantly higher percentage of AA women had underwent lumpectomy than did Caucasian women ($p=0.022$), and that the cost of care for AA women with stage I disease was on average higher than for Caucasian women with stage I disease ($p=0.002$).

Disease-free and overall survival

The mean and median follow-up durations for women in this study were 3.68 and 3.72 years, respectively. The 3-year disease-free survival rate was 77% for AA women and 89% for Caucasians, while the 5-year overall survival rate was 71% for AA women and 78% for Caucasians. Unadjusted analyses showed that AA women had a higher risk of disease relapse (RR = 2.09; 95% CI: 1.41–3.10) and death (RR = 1.56; 95% CI: 1.09–2.25) compared to Caucasian women. Tables 4 and 5 show the multivariable results of DFS and OS for AA and Caucasian breast cancer patients. After adjusting for age, stage, axillary lymph node involvement, ER/PR status, and the presence of co-morbid conditions, AA women no longer had a significantly higher RR of disease recurrence (RR = 1.38; 95% CI: 0.85–2.26) or death (RR = 1.06; 95% CI: 0.64–1.75). Stage at diagnosis had a significant impact on disease-free and overall survival, and lymph node involvement had a significant impact on DFS. The RR of recurrence and death was 10.67 (95% CI: 4.47–25.48) and 9.52 (95% CI: 3.99–22.71) for stage IIIB vs. stage I disease, and 2.03 (95% CI: 1.1–3.73) and 1.30 (95% CI: 0.73–2.30) for lymph node involvement, present vs. absent. The presence of

Table 2. Mean 1-year treatment costs and treatment patterns by race

Items	AA ($n=331$)	Caucasians ($n=257$)	p-value (2-sided)
% with Surgical resection	97	96	0.584
% with Lumpectomy vs. Mastectomy	48/52	40/60	0.082
% Lumpectomy Pts with Radiation	82	76	0.240
% Mastectomy Pts with Radiation	25	16	0.075
% with Chemotherapy	41	42	0.952
% ER + or PR + Pts[a] with Tamoxifen	71	74	0.695
Total treatment cost (mean)	$16,348	$15,120	0.306
Pharmacy cost	$793	$814	0.891
Laboratory tests cost	$526	$529	0.971
OR cost	$1,471	$1,410	0.398

[a]Patients.

Table 3. Mean 1-year treatment costs and treatment patterns by race and stage

Items	AA	Caucasians	*p*-value (2-sided)
Stage I Pts[a] total treatment cost (mean)	$13,734	$10,915	0.002
Stage II–III Pts total treatment cost (mean)	$18,240	$19,491	0.555
% Stage I Pts with Lumpectomy vs. Mastectomy	66/35	51/49	0.022
% Stage II–III Pts with Lumpectomy vs. Mastectomy	36/64	30/70	0.307
% Stage I Lumpectomy Pts with Radiation	84	76	0.249
% Stage II–III Lumpectomy Pts with Radiation	81	76	0.630
% Stage I Mastectomy Pts with Radiation	10	4	0.224
% Stage II–III Mastectomy Pts with Radiation	30	25	0.416
% Stage I Pts with Chemotherapy	23	21	0.745
% Stage II–III Pts with Chemotherapy	55	63	0.157
% Stage I ER+ or PR+ Pts with Tamoxifen	63	63	0.968
% Stage II–III ER+ or PR+ Pts with Tamoxifen	77	85	0.227

[a]Patients.

estrogen and or progesterone receptors had a significant protective effect. For women with ER or PR positive tumors, the RR of recurrence was 0.56 (95% CI: 0.36–0.87) and the RR of death was 0.49 (95% CI: 0.31–0.79). The presence of three other co-morbid conditions had an adverse effect on DF and OS. These findings, though, were for the most part not statistically significant except for the relationship between diabetes and DFS (RR = 1.81; 95% CI: 1.03–3.18; $p = 0.041$) and heart disease and OS (RR = 1.37; 95% CI: 0.67–2.80; $p = 0.082$), which was marginally significant. The type of insurance coverage was not a predictor of either DFS or OS, and therefore was not entered into the final model.

Discussion

Survival trends for women with breast cancer have slowly improved over the past several decades [1], although disparities by race remain, with the majority of reports showing better survival for Caucasian compared with AA women [2–13]. An important question regarding racial differences in breast cancer survival pertains to the degree in which these differences are due to inherent biologic and/or genetic differences, social economic factors, and/or factors related to the quality of medical care received. We evaluated patterns of care and outcomes among women with breast cancer treated at a single large NCI funded CCC, in order to focus on racial differences in treatment and survival among a group of women who because of the center where they were treated, should have all had equal access to state-of-the-art medical care.

Similar to other reports, we show that AA women with breast cancer are more likely than Caucasian women to present with advanced stage and more aggressive disease and more likely to have Medicaid coverage [2–13]. AA women were also more likely to have had a diagnosis of one or more other co-morbid conditions along with their breast cancer. In our study population, we found no significant racial differences in treatment utilization as assessed by the use of surgery, radiation therapy, chemotherapy, hormonal therapy, or in the overall costs of treatment except that among stage I patients, AA women were more likely than Caucasian women to have had lumpectomy vs. mastectomy and the costs of treatment for AA women were greater than they were for Caucasian women. While there may be other unmeasured variables

Table 4. Multivariable analysis of disease-free survival for African-American and Caucasian women with breast Cancer treated at the Karmanos Cancer Institute

Patient characteristics	Hazard ratio	95% CI (Lower)	95% CI (Upper)	*p*-value (2-sided)
AA vs. CAU	1.38	0.85	2.26	0.195
Age (in decades)	1.07	0.91	1.27	0.421
Stage II vs. Stage I	1.51	0.74	3.09	0.254
Stage IIIA vs. Stage I	3.51	1.23	9.97	0.019
Stage IIIB vs. Stage I	10.67	4.47	25.48	<0.001
Nodal involvement (Yes/No)	2.03	1.10	3.73	0.023
ER/PR + (Yes/No)	0.56	0.36	0.87	0.010
Diabetes (Yes/No)	1.81	1.03	3.18	0.041
Hypertension (Yes/No)	1.16	0.71	1.88	0.555
Heart disease/CVA (Yes/No)	1.42	0.71	2.85	0.396

[a]Multivariable Cox proportional hazard regression adjusted for age, stage, nodal involvement, ER/PR status, and co-morbidities.

Table 5. Multivariable analysis of overall survival for African-American and Caucasian women with breast cancer treated at the Karmanos Cancer Institute

Patient characteristics	Hazard ratio	95% CI (Lower)	95% CI (Upper)	*p*-value (2-sided)
AA vs. CAU	1.06	0.64	1.75	0.817
Age (in decades)	1.28	1.08	1.52	0.005
Stage II vs. Stage I	2.12	1.08	4.15	0.030
Stage IIIA vs. Stage I	2.39	0.69	8.26	0.168
Stage IIIB vs. Stage I	9.52	3.99	22.71	<0.001
Nodal involvement (Yes/No)	1.30	0.73	2.30	0.374
ER/PR + (Yes/No)	0.49	0.31	0.79	0.003
Diabetes (Yes/No)	1.58	0.86	2.92	0.145
Hypertension (Yes/No)	1.40	0.84	2.32	0.187
Heart disease/CVA (Yes/No)	1.37	0.67	2.80	0.082

[a]Multivariable Cox proportional hazard regression adjusted for age, stage, nodal involvement, ER/PR status, and co-morbidities.

that explain these differences in treatment utilization, for the most part AA women received treatment that was at least equivalent to that received by Caucasian patients at our center. In addition, adjustment for factors that typically affect breast cancer survival (age, stage and hormone receptor status) as well as the presence of comorbid conditions, accounted for the racial differences in survival seen in our patient population. These results suggest that equal access to oncologic care among women with stage I–III breast cancer results in comparable survival outcomes for AA and Caucasian patients.

Several studies that were population based have reported on racial differences in treatment utilization [7,8,10,15]. Using SEER data for the years 1992 through 1998, Li et al. [10] showed that AA and other ethnic minority women were less likely than Caucasian women to elect a first course of surgical and radiation treatment that met 2000 National Comprehensive Cancer Network standards and in a similar analysis, Joslyn [7] showed that AA women were less likely to receive breast radiotherapy. In an analysis of treatment utilization in the Detroit Metropolitan Area, we previously reported that AA women were less likely to undergo lumpectomy and radiation therapy [14], although our current results based on a single institution suggest the opposite trend. A number of other reports have found that differences in receipt of cancer-directed therapy account for at least some of the noted survival differences between AA and Caucasian women with breast cancer [7,15]. Chu et al. [8] found racial differences in survival for younger, but not older women, and they concluded from this that access to Medicare which pays for medical treatment allowed for better survival among older women. In three other analyses, adjustment for prior mammography [11], and socioeconomic status [3,4], accounted for some but not all of the ethnic differences in breast cancer survival. To sum up, a number of studies reported in the literature suggest that on a population scale, access to treatment and factors that predict access such as income, insurance coverage and education may explain at least some of the racial disparities in survival. In contrast to the above population-based studies, our study evaluated patterns of care and costs of medical care for breast cancer among women treated at a single comprehensive cancer center where state-of-the-art therapy should be uniformly available to all patients. Our results indicate that racial differences in survival can be accounted for mainly by clinical/pathological characteristics of the cancer present at the time of diagnosis at an institution where we showed that access to medical care appears to be equal across racial groups. In addition, the presence of four co-morbid conditions which were more commonly seen in AA women in our study affect survival to some extent, possibly by affecting the extent to which women tolerate or complete their therapy. These findings suggest the need to focus on screening and early detection as a way to improve survival among minority women with breast cancer. Future studies are needed to look at how the presence of co-morbid medical conditions might affect treatment choices and outcomes among women with breast cancer.

The strengths of our study include the availability through medical record review and the SEER review of comprehensive information on cancer-directed treatment and survival for a large number of women with breast cancer treated at a large urban medical center. Through medical chart reviews and access to cost accounting data, we were able to provide more specific data on treatment utilization than that which is available through the SEER registry, and this allowed us to more confidently evaluate patterns of care than we could by utilization of SEER data alone.

Our findings, though, should be interpreted with some caution given the unique characteristics of our study sample. The women in this study received all of their oncologic care at a CCC, which provided state-of-the-art cancer-directed therapy. Our inclusion criteria were necessary though in order to accurately compare treatments and costs since treatment information and financial data outside of our institution were not readily available. In addition, in our study the AA patients were slightly older than the Caucasian patients, and this is

contrary to what is generally observed in population-based studies. This age discrepancy is likely due to sampling variation since our sample size is relatively small compared to other population studies. Finally, since this was a retrospective chart review, we were not able to collect information on other factors that may or may not explain patterns of care and patient outcomes. It is important to stress that the unique characteristics of our study sample only impact on the findings related to treatment patterns and costs. Our finding that states equal treatment produces equal outcomes should be independent of patients' baseline characteristics since the multivariate results were adjusted for these characteristics.

In conclusion, there were no major discrepancies in the patterns of care for AA and Caucasian women with stage I–III breast cancer treated at a CCC located at a large urban academic medical center. Adjustment for patient clinical characteristics at the time of diagnosis, including the presence of other co-morbid conditions accounted for the majority of survival differences by race. Our finding supports the theory that equal treatment produces equal outcomes. Improvement in breast cancer screening and better management of co-morbid conditions among all women may have a significant impact on survival from breast cancer.

Acknowledgement

This work was supported by a Susan G. Komen Grant POP 00-00-142.

References

1. Weir HK, Thun MJ, Hankey BF, Ries LA, Howe HL, Wingo PA, et al.: Annual report to the nation on the status of cancer, 1975–2000, featuring the uses of surveillance data for cancer prevention and control. J Natl Cancer Inst 95(17): 1276–1299, 2003
2. Edwards MJ, Gamel JW, Vaughan WP, Wrightson WR: Infiltrating ductal carcinoma of the breast: the survival impact of race. J Clin Oncol 16(8): 2693–2699, 1998
3. Simon MS, Severson RK: Racial differences in survival of female breast cancer in the Detroit metropolitan area. Cancer 77(2): 308–314, 1996
4. O'Malley CD, Le GM, Glaser SL, Shema SJ, West DW: Socioeconomic status and breast carcinoma survival in four racial/ethnic groups: a population-based study. Cancer 97(5): 1303–1311, 2003
5. Clegg LX, Li FP, Hankey BF, Chu K, Edwards BK: Cancer survival among US whites and minorities: a SEER (Surveillance, Epidemiology, and End Results) Program population-based study. Arch Intern Med 162(17): 1985–1993, 2002
6. Shavers VL, Harlan LC, Stevens JL: Racial/ethnic variation in clinical presentation, treatment, and survival among breast cancer patients under age 35. Cancer 97(1): 134–147, 2003
7. Joslyn SA: Racial differences in treatment and survival from early-stage breast carcinoma. Cancer 95(8): 1759–1766, 2002
8. Chu KC, Lamar CA, Freeman HP: Racial disparities in breast carcinoma survival rates: separating factors that affect diagnosis from factors that affect treatment. Cancer 97(11): 2853–2860, 2003
9. Joslyn SA: Hormone receptors in breast cancer: racial differences in distribution and survival. Breast Cancer Res Treat 73(1): 45–59, 2002
10. Li CI, Malone KE, Daling JR: Differences in breast cancer stage, treatment, and survival by race and ethnicity. Arch Intern Med 163(1): 49–56, 2003
11. Wojcik BE, Spinks MK, Stein CR: Effects of screening mammography on the comparative survival rates of African American, white, and Hispanic beneficiaries of a comprehensive health care system. Breast J 9(3): 175–183, 2003
12. Jatoi I, Becher H, Leake CR: Widening disparity in survival between white and African-American patients with breast carcinoma treated in the U. S. Department of Defense Healthcare system. Cancer 98(5): 894–899, 2003
13. Mancino AT, Rubio IT, Henry-Tillman R, Smith LF, Landes R, Spencer HJ, et al.: Racial differences in breast cancer survival: the effect of residual disease. J Surg Res 100(2): 161–165, 2001
14. Simon MS, Severson RK: Racial differences in breast cancer survival: the interaction of socioeconomic status and tumor biology. Am J Obstet Gynecol 176(6): S233–S239, 1997
15. Shavers VL, Brown ML: Racial and ethnic disparities in the receipt of cancer treatment. J Natl Cancer Inst 94(5): 334–357, 2002

Address for offprints and correspondence: Dr W. Du, Wayne State University, Department of Pediatrics. Children's Hospital of Michigan, 3901 Beaubien, Room 3N47, Detroit, MI 48201, USA; *Tel.:* 313-966-8727; *Fax:* 313-745-5441; *E-mail:* duw@med.wayne. edu