

Comparative Effectiveness of MRI vs. Mammography Alone in Patients Undergoing Breast-Conserving Therapy for Breast Cancer

Objective

The goal was to compare the effectiveness of MRI vs. mammography alone in patients undergoing breast-conserving therapy for breast cancer.

Methods

Data Source and Study design

This retrospective longitudinal cohort study used data from the Texas cancer Registry (TCR)-Medicare and included breast cancer patients. We included patients if they met following inclusion criteria: (i) female beneficiaries with breast cancer as a primary cancer, (ii) age 66 and older, (iii) diagnosis of ductal carcinoma in situ (DCIS) or SEER Historic stage 0,1, and 2 breast adenocarcinoma, (iv) definitive treatment for breast cancer (breast conserving surgery + radiation therapy), (v) patients with no unilateral or bilateral mastectomy, (vi) patients with continuous Medicare Part A and B coverage without HMO in the 1 year before the diagnosis date and (vii) patients with no missing demographic and clinical characteristics.

Variables Definitions

- The primary independent variable was use of MRI/mammography vs. mammography.
- Outcome variables included (i) number of total biopsies, (ii) number of ipsilateral biopsies, (iii) number of false positive biopsies, (iv) time to local recurrence, and (v) disease-specific survival.
- Independent variables included patient demographics and clinical characteristics.

Statistical Analysis

Descriptive statistics was used to describe the study cohort and treatment surveillance pattern. Trend in the use of MRI and mammography over time was reported using descriptive statistics. Logistic regression analysis was conducted to determine factors associated with the used of MRI or mammography, as well as use of any imaging technique within 6 months and 1 year of the index date to determine factors associated with guideline adherence of the post treatment surveillance. Unadjusted and adjusted (for confounders) Cox proportional hazards regression models were constructed to compare the effectiveness of MRI with mammography for time to recurrence and disease-specific survival. Unadjusted and adjusted zero-inflated Poisson regressions were constructed to determine the effectiveness of MRI with mammography for total, ipsilateral and false positive biopsies.

Results

Descriptive Statistics

The study cohort included 7,693 patients. The mean age of the cohort was 74.0±5.8 years. The cohort was 81.3% whites, 12.1% Hispanics, 5.5% blacks and 1.2% others. For majority of patients (66.2%), tumor was well or moderately differentiated. Distribution of patients by SEER Historic Stage of cancer was as follows: 20.4% (stage 0), 68.5% (stage 1), and 11.1% (stage 2).

MRI and Mammography Utilization

From the index date, all patients were followed for a median of 4.9 years. Of 7,693 patients, 6,360 (82.7%) used mammography only, 483 (6.3%) used MRI and mammography and 850 (11.1%) used no imaging techniques during post treatment-surveillance time period. The use of MRI increased over time from 0.5% in 2004 to 17.7% in 2012 ($p < 0.001$). Table 1 summarizes the descriptive characteristics of patients. Table 2 reports predictors of MRI use and use of imaging technique within six months (guideline recommendations).

Table 1. Descriptive Characteristics

Characteristics	MRI/Mammography N (%)	Mammography N (%)	No imaging N (%)	P-value
Age				<0.0001
66-69	188(8.85)	1,751(82.44)	185(8.71)	
70-74	152(6.63)	1,929(84.09)	213(9.29)	
75-79	96(5.27)	1,500(82.37)	225(12.36)	
>= 80	47(3.23)	1,180(81.16)	227(15.61)	
Race/Ethnicity				<0.0001
Whites	379(6.06)	5,235(83.75)	637(10.19)	
Hispanics	80(8.59)	711(76.37)	140(15.04)	
Blacks	20(4.77)	366(80.19)	63(15.04)	
Others	4 (4.35)	78(84.78)	10(10.87)	
Comorbidity Score (mean, SD)	0.13(0.58)	0.18(0.80)	0.37(1.22)	<0.0001
Education*(high school only), quartile				0.1581
1	129(6.79)	1,595(83.95)	176(9.26)	
2	116(6.05)	1,583(82.62)	217(11.33)	
3	117(6.02)	1,604(82.47)	224(11.52)	
4	120(6.31)	1,554(81.70)	228(11.99)	
Income*, quartile				0.0010
1	120(6.36)	1,519(80.50)	248(13.14)	
2	92(4.91)	1,578(84.20)	204(10.89)	
3	117(6.18)	1,580(83.51)	195(10.31)	
4	143(7.55)	1,559(82.36)	191(10.09)	
Tumor size				<0.001
<1 cm	141(6.37)	1,852(83.61)	222(10.02)	
<2 cm	182(5.91)	2,578(83.76)	318(10.33)	
<3 cm	62(5.89)	846(80.42)	144(13.69)	
<4 cm	18(6.29)	216(75.52)	52(18.18)	
>=4 cm	12(5.11)	186(79.15)	37(15.74)	
Unknown	68(8.22)	682(82.47)	77(9.31)	
SEER Historic Stage				0.0379
0	115(7.32)	1,310(83.33)	147(9.35)	
1	319(6.05)	4,356(82.66)	595(11.29)	
2	49(5.76)	694(81.55)	108(12.69)	
Tumor differentiation				0.1896
Well/Moderate	309(6.07)	4,242(83.29)	542(10.64)	
Poor	115(6.80)	1,366(80.73)	211(12.47)	
Other	59(6.50)	752(82.82)	97(10.68)	
ER/PR status				<0.001
Positive	137(4.45)	2,503(81.29)	439(14.26)	
Negative	12(3.25)	311(84.28)	46(12.47)	
Unknown	334(7.87)	3,546(83.53)	365(8.60)	

*Sample size does not add up to 7,693, missing excluded

Table 2. Logistic Regression Analysis Results: Predictors

Characteristics	Predictors of MRI, OR, (95% CI)	Predictors of imaging within six months, OR, (95% CI)
Age		
66-69	Ref.	Ref.
70-74	0.85(0.72, 0.99)	0.87(0.73, 1.05)
75-79	0.64(0.54, 0.76)	0.83(0.68, 1.01)
>= 80	0.47(0.40, 0.56)	0.70(0.56, 0.87)
Race/Ethnicity		
Whites	Ref.	Ref.
Blacks	0.69(0.53, 0.90)	0.93(0.67, 1.30)
Hispanics	0.84(0.70, 1.02)	0.97(0.77, 1.21)

Other	0.76(0.44, 1.31)	1.20(0.66, 2.17)
Comorbidity score	0.85(0.80, 0.91)	1.01(0.93, 1.10)
Education(high school only) , quartile		
1	Ref.	Ref.
2	0.83(0.70, 0.98)	0.82(0.66, 1.01)
3	0.84(0.70, 1.01)	0.96(0.79, 1.18)
4	0.82(0.68, 0.98)	0.95(0.77, 1.16)
Income, quartile		
1	Ref.	Ref.
2	0.98(0.83, 1.16)	0.98(0.80, 1.21)
3	1.06(0.89, 1.26)	1.08(0.88, 1.33)
4	1.14(0.95, 1.37)	0.94(0.75, 1.17)
Tumor size		
<1 cm	Ref.	Ref.
<2 cm	0.98(0.84, 1.13)	1.03(0.86, 1.23)
<3 cm	0.83(0.68, 1.01)	1.17(0.93, 1.48)
<4 cm	0.67(0.49, 0.93)	1.19(0.82, 0.73)
>=4 cm	0.66(0.47, 0.94)	0.83(0.51, 1.31)
Unknown	1.04(0.83, 1.32)	1.22(0.93, 1.60)
SEER Historic Stage		
0	Ref.	Ref.
1	0.87(0.73, 1.03)	1.20(0.82, 1.73)
2	0.85(0.70, 1.08)	1.61(1.22, 2.11)
Tumor differentiation		
Poor	Ref.	Ref.
Well/Moderate	1.09(0.94, 1.28)	0.78(0.65, 0.94)
Other	0.94(0.76, 1.17)	0.90(0.70, 1.16)
ER/PR status		
Positive	Ref.	Ref.
Negative	1.14(0.86, 1.53)	1.25(0.91, 1.73)
Unknown	1.85(1.63, 2.09)	1.01(0.82, 1.11)

Comparative Effectiveness of MRI versus Mammography

Table 3 reports unadjusted and adjusted results for MRI versus mammography for different outcomes. In adjusted analysis, MRI and mammography were associated with higher detection of recurrence, but also associated with higher number of total and false positive biopsies. The lower survival in MRI/mammography groups is likely due to higher likelihood of recurrence and severity of the condition.

Table 3: Comparative Effectiveness of MRI vs. Mammography: Cox and Poisson Regression Results

	Time to Recurrence, HR (95% CI)	Time to Death, HR (95% CI)	Total Biopsies, β (SE)	False Positive Biopsies, β (SE)
Unadjusted (MRI vs. Mammo)	1.65(1.22, 2.22)	0.41(0.28, 0.59)	1.04(0.07)	1.12(0.08)
Adjusted (MRI vs. Mammo) ^a	1.56(1.15, 2.13)	0.51(0.35, 0.74)	0.95(0.08)	1.01(0.09)

^a Adjusted for all variables mentioned in Table 1.

Conclusions

- MRI use for post-treatment surveillance increased in Texas in the last decade.
- Only 11.7% of patients adhere to the guideline and done any imaging within six months of cancer treatment.
- Several demographic and clinical characteristics are associated with the higher use of MRI.
- The use of MRI/mammography resulted in detection of higher recurrence yield but this was also associated with the higher numbers of biopsies done including false positive biopsies.