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Original article

Variation in the management of early breast cancer in rural and metropolitan centres: Implications for the organisation of rural cancer services

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ABSTRACT

The study examines the management and outcomes of women with early invasive breast cancer treated in rural and metropolitan centres over a nine-year observation period. A prospective audit of the treatment and outcomes of 2081 women with early breast cancer who underwent potentially curative surgery between 1997 and 2006 in metropolitan Canberra or in the surrounding rural region was completed. Overall, there was good agreement between published guidelines and the treatment received by the women in the study. However, women treated in rural centres were less likely to receive post-operative radiotherapy after breast-conserving surgery, or to undergo axillary lymph node surgery or sentinel lymph node biopsy compared with women treated in metropolitan centres. Surgery in a rural centre was associated with increased breast cancer recurrence (HR = 1.54, $p < 0.001$) and increased breast cancer mortality (HR = 1.84, $p < 0.001$), after adjustment for age and tumour characteristics. Non-cancer related mortality was increased in women treated in rural centres compared with women travelling to a metropolitan centre for surgery (HR = 2.08; $p = 0.005$). There were differences in both the care provided and treatment outcomes between women treated in rural centres and women treated in metropolitan centres. However, the increased non-cancer related mortality in women treated in rural centres suggests an increased medical comorbidity in this group. Initiatives supporting rural-based surgeons to adopt new procedures such as sentinel node biopsy may help to optimise rural breast cancer treatment.

Introduction

The management of early breast cancer (EBC, breast cancer restricted to the breast with or without involvement of the ipsilateral axillary lymph nodes) has evolved to include breast-conserving surgery, axillary sentinel lymph node biopsy, adjuvant radiotherapy and adjuvant systemic therapies. These treatments are individualised for each patient, often with the treatment plan developed through the input of a multidisciplinary team.[1] Ideally, choices between treatment options should be informed by extensive evidence, based mainly on evidence from randomised trials and encapsulated in published treatment guidelines.[2]

Care provided to women has been shown to vary systematically in relation to the treatment setting and the characteristics of clinicians, particularly surgeons. Surgeons treating higher volumes of cases are reported to be more likely to provide care consistent with contemporary best practice guidelines.[3] There is some evidence that the observed variation in treatment can be associated with different outcomes, including survival.[4] In Australia, women living in rural areas and indigenous women are less likely to receive care in accordance with guidelines and may experience worse outcomes because of this.[5–7] In general, cancer survival in Australia diminishes with increasing remoteness of place of residence.[8]

Guidelines based explicitly on high level evidence have been developed to aid decision making in the management of EBC. However, the development and publication of appropriate guidelines may not be sufficient to improve care.[9] Reduction of variation

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in treatment by improving adherence to evidence based guidelines has been a goal of policy makers and clinicians.

As part of an initiative by a group of clinicians within the Australian Capital Territory (ACT) and South Eastern New South Wales (SE NSW) to improve breast cancer care, a prospective audit of EBC treatment was commenced in 1997. The resulting cohort has included women treated in metropolitan Canberra as well as rural settings in the region. Clinicians practicing in metropolitan Canberra have had greater case loads, and, since 2005, access to a regular multidisciplinary breast cancer meeting. In this report the determinants of treatment received by women with EBC over a nine-year period were examined and related to observed outcomes.

Methods

Data on women with EBC enrolled on the study were collected prospectively from July 1997 to June 2006. Information collected at enrolment consisted of patient and tumour characteristics, including resection margins, disease stage, and adjuvant treatment(s) administered. Details of the study design as well as patterns of surgical management have been described previously.[10] Outcome information was sought regularly from treating clinicians and general practitioners. All persons treated for breast cancer within the region were potentially eligible for enrolment into the study. However, for the purposes of this report, only women with unilateral invasive EBC undergoing potentially curative surgical resection were included. Males, those with synchronous bilateral breast cancer, *in situ* cancer only, and those presenting with metastatic disease were excluded. A goal of this study was the enrolment of all consecutive cases of EBC from each of the participating clinicians. Based on a comparison of the annual enrolment rate of ACT residents and the annual incidence of early invasive breast cancer determined from the ACT Cancer Registry, the estimated participation rate of ACT patients was 90%,[11] but obtaining an estimate of participation rates for rural SE NSW centres was not possible. The study was approved by the ACT Health Research Ethics Committee and all patients gave their written informed consent.

A formal multidisciplinary meeting focusing on breast cancer commenced operation in 2005, towards the end of the study period. Quality indicators were based partly on quality thresholds used in the Australian National Breast Cancer Audit.[12] The quality indicators included the use of axillary lymph node dissection and sentinel lymph node biopsy, adequate surgical margins, adjuvant radiation therapy, and adjuvant chemotherapy and endocrine therapy. Treatment patterns for patients treated in rural centres were compared with patterns for those treated in metropolitan centres. The outcomes examined were: breast cancer recurrence rates, overall survival (OS) from the time of primary surgery, breast cancer specific survival and aggregate survival from other causes.

Statistical methods

Differences in patients' demographics, tumour characteristics and surgical management according to place of surgery were assessed using Pearson's chi-squared test for categorical variables and Mann–Whitney's *U* test for ordinal variables. Place of surgery was defined as 'metropolitan' (metro) when surgery was performed by surgeons operating in hospitals located within Canberra, or 'rural' when performed by surgeons operating in hospitals within SE NSW. Cases with specific missing data were excluded on a case by case basis during the analysis.

Concordance with treatment guidelines was examined in relation to the following indicators of care, coded as occurring or not occurring: 1) sentinel lymph node biopsy, axillary lymph node sampling or clearance, 2) radiotherapy following breast-conserving surgery, 3) attainment of clear margins at final surgery, 4) endocrine therapy for oestrogen receptor (ER) or progesterone receptor (PgR) positive cases, and 5) chemotherapy for node positive patients aged less than 65 years. In each case, the analysis included only those cases for which the specific treatment protocol was appropriate. Factors associated with each of the individual quality indicators were identified using Pearson's chi-squared test for differences in proportions and Mann–Whitney's *U* test for ordinal variables. A composite variable was also constructed to indicate overall concordance with guidelines, which was defined as 'met' if all the above criteria were met, where applicable, and 'not met' if any of these criteria were not met. This variable was used in multivariate logistic regression analyses of outcomes.

The impact of place of surgery on risk of death from breast cancer was examined using Cox proportional hazards regression modelling to adjust for demographic factors, tumour characteristics and treatment. Time to death was calculated from the date of diagnosis or the date of first surgery if the date of diagnosis was not known, to the date of death from breast cancer. The censoring date for all cases was December 31, 2007 or the date of death or non-cancer death, whichever came first. Variables modelled through forced entry included age (as a continuous variable), tumour size, tumour grade, nodal involvement (with unknown status expressed as a separate category), hormone receptor status (ER or PgR +ve), lymphovascular invasion, type of surgery, concordance with practice guidelines and place of surgery. Hazard ratios were adjusted for clustering by surgeon. Regression analyses also were undertaken for risk of death from other causes, with censoring of follow-up at December 31, 2007.

Similar Cox regression modelling was undertaken in relation to recurrence of breast cancer. Time to recurrence was calculated from the date of first surgery to the date when recurrence was first recorded, with censoring for non-recurrent cases at death or December 31, 2007, whichever came first.

Data were analysed using STATA v10 software.

Results

Patient characteristics

2115 Women with unilateral, invasive EBC treated with potentially curative surgery within the region were enrolled into the study. Of these, 13 did not undergo surgery and were excluded from the analysis. A further 21 women underwent surgery at centres outside the study region and were excluded from the analysis of outcomes related to the treatment setting (rural versus metropolitan). The median follow-up was five years (range one to nine years). Women residing in metropolitan Canberra made up 63.5% of the study cohort. A substantial majority of women with incident breast cancer resident within rural areas underwent their surgery within Canberra metropolitan hospitals (478 of 759, or 63%). Women undergoing surgery in rural centres tended to be older and more likely to be post-menopausal compared with women treated in Canberra (Table 1). The tumour characteristics of both groups were similar, although tumour HER2 status was less likely to be available in rural centres.

Treatment

The overall mastectomy rate was 51.6%, with similar rates in metropolitan and rural centres. During the study period, particularly after July 2000, sentinel lymph node biopsy became more common for women treated in urban centres, but not for women treated in rural centres (Table 2). There was a non-significant trend towards a greater number of second operations in rural centres.

Table 1
Patient and tumour characteristics by place of surgery ($n = 2081$).[a]

Patient and tumour characteristics	Place of surgery, *N* (%)		
	Metro (ACT), $n = 1815$	Rural (SE NSW), $n = 266$	*p*-Value
Age (mean yrs)	57.2 (±11.9)	60.3 (±12.3)	≤0.001
Residence			
Metro (ACT)	1337 (73.7)	1 (0.4)	≤0.001
Rural (SE NSW)	478 (26.3)	265 (99.6)	
Menopausal status			
Pre-menopausal	501 (27.6)	51 (19.2)	≤0.001
Peri-menopausal	188 (10.4)	16 (6.0)	
Post-menopausal	1123 (62.0)	198 (74.7)	
Unknown	3	1	
Cancer type			
Ductal	1460 (80.4)	218 (82)	0.284
Lobular	184 (10.1)	18 (6.8)	
Other	171 (9.4)	30 (10.2)	
Tumour grade			
Low (1)	538 (30.1)	76 (28.9)	0.788,
Intermediate (2)	702 (39.2)	109 (41.4)	MW = 0.988[b]
High (3)	550 (30.7)	78 (29.7)	
Unknown	25	3	
Tumour size			
0–10 mm	404 (22.3)	44 (16.5)	0.128,
11–20 mm	722 (39.8)	120 (45.1)	MW = 0.229[b]
20–50 mm	597 (32.9)	86 (32.3)	
>50 mm	90 (5.0)	16 (6.0)	
Unknown	2	0	
Nodal involvement			
No	1041 (57.4)	153 (57.5)	0.707
Yes	660 (36.4)	92 (34.6)	(unknown
Unknown	114 (6.3)	21 (7.9)	excluded)
Hormone receptor status			
ER and PgR positive	1228 (68.0)	177 (68.9)	0.118
ER positive only	235 (13.0)	37 (14.4)	
PgR positive only	22 (1.2)	7 (2.7)	
ER and PgR negative	322 (17.8)	36 (14.0)	
Unknown	8	9	
HER2 status			
Positive	142 (7.9)	13 (5.1)	0.789
Negative	834 (46.3)	83 (32.5)	
Unknown	826 (45.8)	159 (62.4)	

[a] 13 Women did not undergo definitive surgery and 21 women had surgery performed outside of the region.
[b] Mann–Whitney's *U* test for ordinal variables.

Table 2
Surgical management of breast cancer and place of surgery ($n = 2081$).[a]

Treatment	Place of surgery, *N* (%)		
	Metro (ACT)	Rural (SE NSW)	*p*-Value
Surgery type			
Mastectomy	947 (52.2)	126 (47.4)	0.143
Breast conservation	868 (47.8)	140 (52.6)	
Number of procedures			
1	1376 (75.8)	188 (70.7)	0.067
2	403 (22.2)	75 (28.2)	
3	36 (2.0)	3 (1.1)	
Axillary surgery			
None	115 (6.3)	22 (8.3)	≤0.001
Sampling	28 (1.5)	21 (7.9)	
Axillary clearance	942 (51.9)	202 (75.9)	
Sentinel node (SN)	410 (22.6)	18 (6.8)	
SN + axillary clearance	320 (17.6)	3 (1.1)	

[a] 13 Women did not undergo definitive surgery and 21 women had surgery performed outside of the region.

All surgeons working in a rural setting had total case loads of less than 100 patients with EBC over the nine-year study period, whereas three surgeons working in metropolitan centres had case loads of greater than 400.

Overall concordance of surgical and adjuvant therapy with the defined clinical indicators, is presented in Table 3. High overall rates of clear surgical margins, axillary lymph node surgery, radiotherapy following breast-conserving surgery, adjuvant chemotherapy and endocrine therapy were observed. Older women (aged ≥70 years) were less likely to have had an axillary lymph node dissection or biopsy or to have received radiation therapy after breast-conserving surgery. There was also a trend for less frequent attainment of clear surgical margins in older women. Adjuvant chemotherapy was received less frequently by women aged >50 years. A more recent year of diagnosis was associated with higher rates of axillary surgery, chemotherapy and endocrine therapy.

Women treated in rural centres had a greater likelihood of not receiving adjuvant radiotherapy following breast-conserving surgery (Table 3). Women with larger tumours, and high-grade tumours were more likely to have axillary surgery, adjuvant chemotherapy and adjuvant endocrine therapy. Large tumours were associated with a greater risk of incomplete surgical margins.

Hormone receptor positive tumours (ER+ and/or PgR+) were associated with not having axillary surgery, incomplete surgical margins and not receiving adjuvant chemotherapy. Axillary lymph node positive status was associated with increased involvement of surgical margins and also with increased use of adjuvant endocrine therapy (Table 3). For node positive women who were less than 65 years of age, a high rate of chemotherapy use (94%) was observed. When women up to the age of 50 years were considered, the use of adjuvant chemotherapy was even higher at 99%.

Recurrence

Overall, 221 recurrences of breast cancer were recorded. Of these, a total of 67 women had local or regional recurrences including 49 women (2.4% of the cohort) without metastatic disease and 18 women (0.9%) with simultaneous metastatic disease. Distant (metastatic) recurrence without local or regional recurrent disease occurred in 148 (7.1%) women. The mean time to recurrence was 35 months (SD: 31–38 months). Local or regional recurrence without simultaneous metastatic disease occurred in 38 of 1815 women (2.1%) undergoing surgery in a metropolitan centre compared with 11 of 266 women (4.1%) undergoing surgery in a rural centre ($p = 0.04$). Multivariate modelling of time to recurrence (any site) showed a significantly higher risk among women having surgery outside a metropolitan centre (HR = 1.54; $p < 0.001$) after adjusting for age and clinical factors (Table 4).

Survival

Of the 2081 women enrolled in the study at the time of analysis, 1674 women (80.4%) were known to be alive and free from recurrence, 70 women (3.4%) were alive with recurrence and 151 (7.3%) had died from breast cancer. In addition, 121 women (5.8%) were lost to follow-up and 65 (3.1%) had died from non-cancer related causes. The overall five-year survival from breast cancer among the cohort was 93.4%.

Factors associated with an increased risk of a breast cancer related death are listed in Table 5. The five known prognostic factors associated with an increased risk of breast cancer mortality were: large tumour size; high tumour grade; positive axillary lymph nodal status; the presence of vascular invasion; and hormone receptor negativity. Tumour HER2 status was not included in the survival analysis because of incomplete data. Lack of

Table 3
Factors associated with NOT receiving treatment according to the defined guideline based indicators.[a]

Factor	Guideline based treatment NOT actually received, *n*/*N* (%)				
	Axillary surgery or sentinel node biopsy	Attainment of clear surgical margins	Radiotherapy after breast-conserving surgery	Endocrine therapy for ER or PgR +ve tumours	Chemotherapy for node +ve, age <65 yrs
Total population	137/2102 (6.5)	51/2094 (2.4)	45/1022 (4.4)	152/1723 (8.8)	37/608 (6.1)
Age					
<40 years	2/130 (1.5)	2/129 (1.6)	0/48 (0.0)	9/96 (9.4)	0/68 (0.0)
40–49	1/442 (0.2)	13/439 (3.0)	5/191 (2.6)	43/357 (12)	2/205 (1.0)
50–59	21/713 (2.9)	12/710 (1.7)	3/363 (0.8)	43/581 (7.4)	20/248 (8.1)
60–69	22/484 (4.5)	12/483 (2.5)	7/261 (2.7)	29/405 (7.2)	15/72[b] (17.2)
70–79	58/250 (23.2)	6/250 (2.4)	12/119 (10.1)	23/214 (10.7)	n/a
80+	33/88 (39.8)	6/83 (7.2)	18/40 (45.0)	5/70 (7.1)	n/a
	$p \leq 0.001$[b]	$p = 0.059$ $p = 0.301$[b]	$p \leq 0.001$[b]	$p = 0.120$ $p = 0.390$[b]	$p \leq 0.001$[b]
Year of diagnosis					
1997–2000	54/573 (9.4)	16/567 (2.8)	12/269 (4.5)	60/474 (12.7)	15/152 (9.9)
2000–2003	58/744 (7.8)	16/744 (2.2)	18/368 (4.9)	31/609 (5.1)	10/226 (4.4)
2003–2006	25/785 (3.2)	19/783 (2.4)	15/385 (3.9)	61/640 (9.5)	12/230 (5.2)
	$p \leq 0.001$	$p = 0.737$	$p = 0.800$	$p \leq 0.001$	$p = 0.074$
Place of surgery					
Metro	115/1815 (6.3)	42/1809 (2.3)	26/868 (3.0)	135/1485 (9.1)	33/533 (6.2)
Rural	22/266 (8.3)	8/264 (3.0)	19/140 (13.6)	16/221 (7.2)	4/69 (5.8)
Other	0/21 (0.0)	1/21 (4.8)	0/14 (0.0)	1/17 (5.9)	n/a
	$p = 0.234$	$p = 0.616$	$p \leq 0.001$	$p = 0.605$	$p = 0.815$
Tumour size (mm)					
0–10	52/451 (11.5)	6/451 (1.3)	13/290 (4.5)	85/384 (22.1)	11/47 (23.4)
11–20	60/853 (7.0)	8/853 (0.9)	21/503 (4.2)	45/718 (6.3)	16/191 (8.4)
21–50	24/689 (3.5)	25/686 (3.6)	11/226 (4.9)	19/532 (3.6)	9/304 (3.0)
>50	1/107 (0.9)	11/103 (10.7)	0/2 (0.0)	3/88 (3.4)	1/65 (1.5)
	$p \leq 0.001$[b]	$p \leq 0.001$[b]	$p = 0.965$[b]	$p \leq 0.001$[b]	$p \leq 0.001$[b]
Tumour grade					
I	71/619 (11.5)	14/618 (2.3)	21/372 (5.6)	80/609 (13.1)	20/108 (18.5)
II	41/821 (5.0)	27/818 (3.3)	14/374 (3.7)	49/753 (6.5)	16/244 (6.6)
III	24/634 (3.8)	10/630 (1.6)	8/257 (3.1)	18/344 (5.2)	1/255 (0.4)
Unknown	1/28 (3.6)	0/28 (0.0)	2/19 (10.5)	5/17 (29.4)	n/a
	$p \leq 0.001$[b]	$p = 0.105$[b]	$p = 0.246$[b]	$p \leq 0.001$[b]	$p \leq 0.001$[b]
Hormone receptor status					
ER or PgR +ve	120/1723 (7.0)	48/1717 (2.8)	37/847 (4.4)	n/a	36/481 (7.5)
ER and PgR −ve	15/362 (4.1)	3/360 (0.8)	5/164 (3.0)		1/125 (0.8)
Unknown	2/17 (11.8)	0/17 (0.0)	3/11 (27.3)		n/a
	$p = 0.047$	$p = 0.028$	$p = 0.438$		$p = 0.005$
Axillary nodes					
Negative	n/a	17/1207 (1.4)	9/684 (1.3)	122/1005 (21.1)	n/a
Positive		29/752 (3.8)	6/232 (2.6)	17/601 (2.8)	
Unknown		5/135 (3.7)	30/106 (28.3)	13/117 (11.1)	
		$p = 0.001$	$p = 0.188$[b]	$p \leq 0.001$	

[a] All patients to undergo axillary surgery or sentinel lymph node biopsy, all patients to achieve clear surgical margins, breast-conserving surgery to be followed by adjuvant radiotherapy, hormone receptor positive tumours to be treated with adjuvant endocrine therapy and adjuvant chemotherapy to be provided for women aged less than 65 years with node positive tumours.
[b] Mann–Whitney's *U* test for ordinal variables.

concordance of treatment with any one of the above five quality indicators, was associated with a trend to increased breast cancer mortality (HR = 1.55), but this was of borderline significance ($p = 0.056$). In addition to these five factors, surgery in a rural setting was associated with an increased risk of breast cancer mortality compared with surgery in a metropolitan centre (HR = 1.84; $p < 0.001$).

Non-breast cancer related mortality was significantly higher in rural women treated in rural centres compared with rural women who travelled to a metropolitan centre for their surgery (HR = 2.08; $p = 0.005$).

Discussion

A high level of concordance of treatment received with treatment recommended by published guidelines was found across this cohort of women with EBC. In addition, there was a trend to a greater use of adjuvant systemic therapy and axillary surgery, especially sentinel lymph node biopsy, over time. The high survival rate was in accordance with recently published Australian five-year breast cancer survival rates over the same period.[8]

Potentially important differences were found when comparing treatment provided in metropolitan centres with treatment provided in rural centres. Women treated in a rural setting tended to be older and also had increased non-breast cancer mortality during the study period. In addition, breast cancer related mortality appeared to be increased.

Rural treatment was associated with lower rates of adjuvant radiotherapy. This effect has been observed by others and probably is related to the increased inconvenience and burden that radiotherapy imposes on rural women, leading them to prefer to avoid it. Across the whole cohort, women avoiding postoperative

Table 4
Factors associated with breast cancer recurrence.

Factor	Hazard ratio	95% CI	*p*-Value[a]
Age (years)	1.01	1.00–1.01	<0.001
Surgery			
Breast conservation	1.00		
Mastectomy	1.32	0.82–2.13	0.258
Tumour size (mm)			
0–10	1.00		
11–20	0.95	0.60–1.51	0.827
21–50	1.47	0.75–2.89	0.264
>50	2.55	0.95–6.86	0.063
Tumour grade			
I	1.00		
II	2.46	1.56–3.88	<0.001
III	3.59	2.71–4.77	<0.001
Axillary nodes			
Negative	1.00		
Positive	2.18	1.80–2.66	<0.001
Unknown	1.02	0.66–1.58	0.928
Hormone receptor status			
ER or PgR +ve	1.00		
ER and PgR −ve	2.03	1.47–2.79	<0.001
Vascular invasion			
Not present	1.00		
Present	1.51	1.02–2.25	0.040
Cancer management			
As per guidelines	1.00		
Differed from guidelines	1.53	0.94–2.51	0.088
Place of surgery			
Metropolitan	1.00		
Rural	1.54	1.21–1.96	<0.001

[a] Multivariate Cox model with any recurrence as time dependent outcome variable, adjusted for clustering by surgeon.

Table 5
Factors associated with breast cancer death.

Factor	Hazard ratio	95% CI	*p*-Value[a]
Age (years)	1.02	1.01–1.03	≤0.001
Surgery			
Breast conservation	1.00		
Mastectomy	1.48	0.82–2.67	0.140
Tumour size (mm)			
0–10	1.00		
11–20	1.64	1.15–2.56	0.019
21–50	2.02	1.67–3.33	≤0.001
>50	4.18	2.53–10.35	≤0.001
Tumour grade			
I	1.00		
II	1.29	0.83–2.96	0.598
III	2.84	2.30–5.11	≤0.001
Axillary nodes			
Negative	1.00		
Positive	2.32	2.14–3.67	≤0.001
Unknown	0.76	0.17–1.75	0.598
Hormone receptor status			
ER or PgR +ve	1.00		
ER and PgR −ve	2.43	1.95–3.08	≤0.001
Vascular invasion			
Not present	1.00		
Present	1.69	1.11–2.59	0.14
Cancer management			
As per guidelines	1.00		
Differed from guidelines	1.55	1.16–2.77	0.056
Place of surgery			
Metropolitan	1.00		
Rural	1.84	1.41–2.30	≤0.001

[a] Multivariate Cox regression model with breast cancer death as time dependent variable, adjusted for clustering by surgeon.

radiotherapy after breast conservation tended to be older and to have small, node-negative, hormone receptor positive tumours. Such an approach is supported by evidence suggesting the absolute benefit of postoperative radiotherapy is lower in this subgroup.[13] The extent to which avoidance of postoperative radiotherapy by rural women was due to practitioner or patient preference, as opposed to a consideration of reduced absolute benefit due to age and comorbidities, could not be determined in this study.

During the study period, sentinel lymph node biopsy was introduced as a preferred way of managing the axilla in women with clinically node-negative disease. Use of this technique increased markedly in metropolitan centres during the study. The procedure is more difficult to perform in small rural centres due to the need for radiopharmaceuticals. Women treated in rural centres underwent axillary lymph node dissection more frequently due to the reduced use of sentinel lymph node biopsy.

The differences in local treatments (surgery and radiotherapy) provided in rural and metropolitan centres might have influenced the rates of local or regional recurrence. Although women treated in rural centres had increased breast cancer mortality, we were able to demonstrate only a small increase in the rate of local or regional recurrence. Local or regional recurrences were generally rare and the difference observed would not be expected to produce a measurable impact on breast cancer specific survival. In addition, we observed no clinically important differences in systemic adjuvant therapy which could have contributed to the difference in breast cancer survival between women treated in rural and metropolitan areas. Tumour stage and other prognostic variables were similar between the two groups, but, importantly, this study did not collect information documenting staging tests used to exclude metastatic disease. The inclusion of occult stage 4 rural patients in the study is a potential source of bias.

Non-breast cancer mortality was higher in rural women having treatment in a rural centre compared with those rural women who travelled to a metropolitan centre for treatment, presumably due to other medical comorbidities. These data suggest that women who are generally less well prefer to stay near to home to undergo breast cancer surgery. Unfortunately information directly documenting medical comorbidities was not included in this study. Serious comorbid conditions could influence breast cancer mortality indirectly by appropriately influencing treatment choices or by hastening death when there is advanced recurrent disease.[14,15]

Entry of women into the cohort was arranged by the treating clinicians on a voluntary basis, after obtaining written informed consent from the patient. Thus the cohort is a subset of the eligible population of women with operable breast cancer and bias could result from selective enrolment. However, the estimated participation rate was high, which would counter selection bias.

Overall, the observed outcomes of women treated for EBC in this study were good. Local and regional recurrences were rare. Treatment in a rural centre was associated with reduced compliance with some treatment guidelines, compared with treatment in a metropolitan centre and with reduced breast cancer survival. Much of this difference may have been due to comorbidities and future studies of rural-based services will need to assess this effect directly. Valid reasons for deviating from guidelines do exist for individual patients. However, optimising access of rural women with EBC to services such as sentinel lymph node biopsy, multidisciplinary care and postoperative adjuvant radiotherapy should be a priority for regional health services.

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Conflict of interest statement

There is no conflict of interest reported by any of the authors.

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