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Breast conservation, mastectomy and axillary surgery in New South Wales women in 1992 and 1995

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Summary To measure the increase in uptake of BCT in NSW and its determinants, we examined Cancer Registry records of 2020 women with breast cancer in 1992 and 2883 in 1995 linked to records of their surgical treatment in the NSW Inpatient Statistics' Collection. In parallel, we examined trends and determinants in axillary surgery for breast cancer. Breast conservation increased from 39% of breast cancer in 1992 to 45% in 1995, mainly in women with the smallest cancers. In 1995, mastectomy was still most common in women with larger cancers (OR for breast cancers 3+ cm relative to <1 cm = 5.6, 95% CI 2.9–10.7) and cancers that had spread beyond the breast (OR = 2.0, 95% CI 1.4–2.7 relative to localized to the breast). Urban women had fewer mastectomies than rural women. Axillary surgery, common in 1992 (78%) and 1995 (82%), fell steeply with increasing age and more often accompanied mastectomy (93% in 1995) than BCT (67% in 1995). In 1995 the odds for axillary surgery were some two-fold or more higher for all cancers 1 cm or more in diameter compared with those <1.0 cm and highest for 2.0–2.9 cm cancers (OR = 3.3 95% CI 1.7–6.7 relative to <1.0 cm). Regional spread of the cancer at diagnosis was not a strong predictor. In the absence of collection of treatment data by cancer registries, linkage of cancer registry records with hospital inpatient data is an effective alternative for monitoring breast cancer treatment trends. © 2001 Cancer Research Campaign   http://www.bjcancer.com

Keywords: breast cancer; breast conservation therapy; mastectomy; axillary surgery

Breast-conserving therapy (BCT) is accepted as effective as mastectomy in treating early breast cancer. In June 1990, a Consensus Development Conference of the US National Institutes of Health concluded that breast conservation was appropriate for most women with Stage I and II breast cancer and was preferable to total mastectomy because it provided equivalent survival while preserving the breast (National Institute of Health, 1990). This position has been taken in other national and professional guidelines (National Health & Medical Research Council, 1995; Haward et al, 1999).

Changing established patterns of practice in areas such as clinical management of breast cancer usually takes time (Haward et al, 1999). Nonetheless, the release of information about treatment from clinical trials of the 1980s and the consensus statements that followed are widely credited with an increased uptake of BCT in the mid-to late 1980s and early 1990s in Europe and USA. Population-based reports on trends in breast cancer treatment, however, have been few in number (de Koning et al, 1994), mainly from the US SEER (Nattinger et al, 1996; Nattinger et al, 2000) and Yorkshire registries (Haward et al, 1999). Nationwide treatment data were available in the Netherlands, but not breast cancer registrations (de Koning et al, 1994).

Examination of population-based trends in breast cancer treatment depends on population-based cancer registration and recording of treatment. A minority of registries, however, such as the SEER (Lazovich et al, 1997; Nattinger et al, 2000) and some UK registries (Haward et al, 1999) collect treatment data, usually by sending trained abstractors to local hospitals. In its absence, and hoc or

continuing linkage of routinely collected hospital inpatient records with cancer registry records is a potentially workable alternative to meet needs for population-based monitoring (Hobbs and McCall, 1970; Baldwin, 1972; Kahn et al, 1996; McGeechan et al, 1998).

We used linked cancer registry records and inpatient records of surgical management in New South Wales (NSW), the most populous Australian state, to examine changes in treatment for breast cancer in Australia between 1992 and 1995. Specifically, we sought to use these records to examine whether management practice had changed to greater uptake of breast conservation surgery and, if so, to study demographic and clinical correlates of the changes.

SUBJECTS AND METHODS

All cases of invasive breast cancer in women registered with breast cancer in the population-based NSW Central Cancer Registry in 1992 and 1995 were eligible for this study. The NSW Department of Health had linked Cancer Registry records of women diagnosed with breast cancer in 1992 and 1995 with their NSW Inpatient Statistics Collection (ISC) records for separations from any public or private hospital up to 1 year before and 18 months after their diagnosis. Linkage was probabilistic, using Automatch software, and matched records by date of birth, hospital code, patient's medical record number, country of birth and address of residence; the women's names were not used.

ICD9–CM procedure codes in the ISC records were used to classify each woman into one of five groups: mastectomy (ICD9–CM 85.41–85.48), breast conserving therapy (85.20–85.23), breast conserving therapy and mastectomy, diagnostic breast procedures only (85.0, 85.11, 85.12, 85.19), and no breast procedure. Analyses of therapeutic surgical procedures used two categories, women who had mastectomy (with or without BCT) and those who had
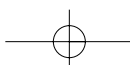
BCT only. Separate analyses examined use of axillary surgery. Women were considered to have had axillary surgery when there was a code for axillary surgery (ICD9–CM 40.22, 40.23, 40.29, 40.3, 40.51) or for surgery to the lymph nodes with mastectomy (85.43–85.48). Hospital admissions for surgery were counted up to 12 months after diagnosis.

Age was analysed in broad age groups, country of birth in three categories (Australia, UK and Europe, other countries) and residence at the admission closest to the date of diagnosis as urban or rural according to a standard coding scheme. Area of residence was used to categorize the women into one of five socio-economic (SES) groups based on an index of relative socio-economic disadvantage for local government areas (LGAs). The index, derived by the Australian Bureau of Statistics from the 1991 and 1996 Australian Censuses, was used to rank LGAs and divide them into five SES groups of approximately equal population size. Spread of cancer at diagnosis was classified as localized to the breast, invading adjacent tissue or regional lymph nodes or distant metastases. Breast cancer size was available for women 40–69 years for the whole of 1992 and for women of all ages in 6 months of 1995 (Kricker et al, 1999) and was grouped into four categories (0.1–0.9 cm, 1.0–1.9 cm, 2.0–2.9 cm and 3.0+ cm).

Hospitals were classified as urban or rural and private or public, and also grouped into categories of 'surgical volume' by use of their numbers of therapeutic surgical procedures for breast cancer in 1992 and 1995. The categories used were low (1–10 procedures), intermediate (11–20 procedures) and high (21 + procedures).

Predictors of mastectomy and axillary surgery in 1992 and 1995 were examined separately in logistic regression models, initially within subsets of variables relating to the woman (age, place of residence, SES of area of residence and country of birth), the cancer (histopathological type, extent of disease, and cancer size in women 40–69 years of age) and the hospital (volume of surgery for breast cancer, urban or rural location and public or private status). Variables that were independent predictors of the procedure of interest within each subset in either year were examined together in separate models for 1992 and 1995.

RESULTS

Most of the Cancer Registry records of women with invasive breast cancer were successfully linked to ISC records in 1992 (93%) and 1995 (96%). All analyses were based on the linked records.

Breast surgery

Hospital admissions for BCT or mastectomy were recorded for 2020 women in 1992 and 2883 in 1995. A mastectomy was done within 12 months of diagnosis in 61% of women in 1992 and 55% in 1995. Breast conservation as the only surgical procedure increased from 39% in 1992 to 45% in 1995.

Urban women were less likely to have mastectomy than rural women (Table 1) and this gap did not change between 1992 and 1995 (Tables 1 and 4).

In 1992, women 80 years of age and older (OR 0.6, 95% CI 0.4–0.8) and 40–49 years (OR 0.8, 95% CI 0.6–1.0) were less likely to have mastectomy than women 50–59 years (baseline age group; *P* for heterogeneity with age 0.02; Table 2). Women 25–39 and 60–79 years had similar odds of mastectomy to women 50–59 years. In 1995 the odds for mastectomy varied less and were not significantly heterogeneous by age (*P* = 0.3, Table 2).

Analyses of the relationship between breast cancer size and mastectomy were restricted to women 40–69 years of age for whom cancer size was known (Table 3). Mastectomy increased with increasing cancer size in urban women in both 1992 and 1995. The pattern in rural women was less clear, except that the greatest use of mastectomy was in women with the largest (3+ cm) cancers. The percentage of women with 3+ cm cancers who had mastectomy changed little between 1992 and 1995. On the other hand, the percentage who had mastectomy for <1 cm cancers fell from 50% to 36% in urban women and 64% to 47% in rural women. Most of the shift from mastectomy to BCT in this period occurred in these smallest cancers.

The odds of mastectomy were two-fold higher in the presence of regional spread of cancer at diagnosis than with localized cancer (Table 4). It was not increased in those with distant spread.

Table 1 Numbers of urban and rural women who had surgery and percentages of urban and rural women who had mastectomy or breast conservation and axillary surgery for breast cancer in 1992 and 1995 by age group

Age group	Urban women					Rural women			
	Mastec-tomy %	BCT only %	Axillary surgery %	No. of women n		Mastec-tomy %	BCT only %	Axillary surgery %	No. of women n
					1992				
<40	60	40	87	125		75	25	91	32
40–49	55	45	82	371		68	32	87	108
50–59	62	38	83	349		66	34	82	91
60–69	63	37	81	320		65	35	75	124
70–79	61	39	70	264		73	27	78	95
80+	46	54	46	111		57	43	57	30
All ages	59	41	78	1540		67	33	80	480
					1995				
<40	56	44	89	165		66	34	97	38
40–49	57	43	89	461		56	44	92	130
50–59	52	48	87	547		61	39	85	192
60–69	51	49	81	479		59	41	82	164
70–79	54	46	73	369		69	31	80	142
80+	49	51	52	128		56	44	44	68
All ages	53	47	82	2149		61	39	81	734

Table 2 ORs for mastectomy and axillary surgery by age in women with invasive breast cancer in 1992 and 1995

Age	1992			1995		
	OR[a]	95% CI		OR[a]	95% CI	
Mastectomy						
24–39	0.99	0.68	1.45	1.13	0.82	1.55
40–49	0.80	0.61	1.03	1.09	0.87	1.35
50–59	1.00			1.00		
60–69	0.98	0.75	1.30	0.92	0.75	1.14
70–79	1.02	0.76	1.37	1.16	0.92	1.46
80+	0.55	0.37	0.81	0.85	0.62	1.17
		P-value	0.02		*P*-value	0.3
Axillary surgery						
24–39	1.48	0.86	2.55	1.52	0.90	2.55
40–49	1.02	0.72	1.44	1.35	0.96	1.90
50–59	1.00			1.00		
60–69	0.79	0.56	1.11	0.67	0.50	0.89
70–79	0.52	0.37	0.73	0.46	0.35	0.62
80+	0.19	0.13	0.29	0.15	0.11	0.22
		P-value	<0.001		*P*-value	<0.001

[a]ORs were adjusted for urban or rural residence, SES and COB.

Table 3 Size of breast cancer and type of surgical breast procedure by urban and rural place of residence in women 40–69 years of age in 1992 and 1995

	1992					1995				
	Urban		Rural			Urban		Rural		
	Mastec-tomy	BCT only	Mastec-tomy	BCT only	All women	Mastec-tomy	BCT only	Mastec-tomy	BCT only	All women
	n = 898		*n* = 271			*n* = 659		*n* = 200		
	%	%	%	%		%	%	%	%	
Cancer size										
0–0.9 cm	50	50	70	30	128	36	64	53	47	160
1–1.9 cm	49	51	55	45	455	50	50	53	47	386
2.0–2.9 cm	62	38	63	37	329	64	36	50	50	206
3.0+ cm	81	19	87	13	257	79	21	87	13	107
All sizes	60	40	65	35	1169	54	46	58	43	859

Lobular cancer, although significantly associated with mastectomy after adjustment for size and spread of cancer at diagnosis in 1992 (OR 1.7. 95% CI 1.1–2.7), was less strongly associated with it in 1995 (OR 1.3, 95% CI 0.8–2.1; Table 4).

The odds of mastectomy did not vary significantly with socio-economic status after adjustment for age and size and spread of cancer at diagnosis (Table 4). Under similar conditions, mastectomy was, if anything, most prevalent in hospitals in which moderate numbers of breast procedures were done rather than in those with few or many.

Axillary surgery

There were 1 580 women who had axillary surgery recorded in the linked dataset in 1992 (78%) and 2,354 (82%) in 1995. Axillary surgery was more often done in association with mastectomy (91% in 1992, 93% in 1995) than with BCT (58% in 1992, 67% in 1995) and increased between 1992 and 1995, mainly with BCT.

Urban women were more likely to have axillary surgery with BCT than rural women in 1992 and 1995 (Table 1) while the odds of axillary surgery fell nearly 10-fold with increasing age (*P*-value for age <0.001 in each year; Table 2).

In comparison with cancers <1.0 cm in diameter, the odds of axillary surgery in 1992 was significantly higher only for breast cancers larger than 2 cm (OR for 2–2.9 cm = 1.8 95% CI 1.0–3.3; OR for 3+ cm = 1.6 95% CI 0.9–3.1) in women 40–69 years of age (Table 5). In 1995, it was some two-fold or more higher for all cancers 1 cm or more in diameter in comparison with those <1.0 cm; the highest odds ratio was in 2.0–2.9 cm cancers (OR = 3.3 95% CI 1.7–6.7).

Regional spread of cancer at diagnosis was a strong predictor of axillary surgery in 1992 (OR 2.4, 95% CI 1.6–3.7, with reference to localized cancer) but not in 1995 (OR 1.5, 95% CI 0.9–2.6).

Axillary surgery was much more likely in hospitals with moderate or high numbers of breast procedures in 1992 than in those with low numbers (Table 5). This difference was not present in 1995.

DISCUSSION

Breast conserving surgery increased in NSW between 1992 and 1995, mainly in women with small, localized breast cancers. For larger breast cancers or cancers that had spread beyond the breast, mastectomy remained the most common surgical treatment. By 1995, most women had axillary surgery regardless of cancer size or reported regional spread of the cancer. Women

Table 4 Association of mastectomy with age, SES, urban or rural residence cancer spread, histopathological type, cancer size, and the hospital volume of surgical procedures in women 40–69 years of age diagnosed with invasive breast cancer in 1992 and 1995

	1992 (n = 1085)			1995 (n = 799)		
	OR (adjusted)	95%CI		OR (adjusted)	95% CI	
Age (years)						
40–49	0.7	0.5	0.9	1.1	0.8	1.6
50–59	1.0			1.00		
60–69	1.0	0.7	1.4	1.1	0.8	1.6
		P-value	0.01		*P*-value	0.7
SES						
859–952	1.0			1.0		
953–979	0.6	0.4	1.0	0.8	0.5	1.3
9810–1000	0.7	0.4	1.1	1.2	0.7	1.9
1001–1057	0.8	0.5	1.2	1.1	0.7	1.8
1058–1170	0.7	0.5	1.2	0.8	0.5	1.3
		P-value	0.4		*P*-value	0.5
Residence						
Urban	1.0			1.0		
Rural	1.3	1.0	1.9	1.3	0.9	1.9
		P-value	0.09		*P*-value	0.3
Extent of cancer						
Localized	1.0			1.0		
Regional	2.0	1.5	2.7	2.0	1.4	2.7
Metastatic	0.8	0.3	2.3	1.1	0.2	6.8
		P-value	<0.001		*P*-value	<0.001
Histopathological type						
Ductal	1.0			1.0		
Lobular	1.7	1.1	2.7	1.3	0.8	2.1
Special types	0.7	0.4	1.1	0.5	0.3	1.0
		P-value	0.01		*P*-value	0.07
Size (cm)						
0–0.9	1.0			1.0		
1.0–1.9	0.7	0.5	1.1	1.4	1.0	2.1
2.0–2.9	1.1	0.7	1.7	1.8	1.1	2.9
3+	3.1	1.8	5.3	5.6	2.9	10.7
		P-value	<0.001		*P*-value	<0.001
Hospital volume						
1–10 procedures	1.0			1.0		
11–20 procedures	1.5	0.9	2.6	1.3	0.6	2.5
21+ procedures	0.9	0.6	1.4	1.3	0.7	2.1
		P-value	0.04		*P*-value	0.7

with the smallest (<1 cm) cancers, however, were less likely to have nodes removed. Axillary surgery fell steeply with increasing age from 25–39 years to the oldest women 80+ years. Our study depended on the linkage of two sets of routinely collected, computerised health records, a well-regarded method of enriching individually collected datasets for epidemiological and health services research.

BCT rates also increased in the USA and UK in the late 1980s and early 1990s (Chouillet et al, 1994; Richards et al, 1996; Nattinger et al, 1996; Lazovich et al, 1997) mainly, as in NSW, in women with smaller cancers (Lazovich et al, 1997). In the USA, rates of stage I cancers, which doubled from 1983 to 1996, were already at a high level by 1990 (National Cancer Institute, 1999) while BCT rates rose steadily from 1990 to 1995 (Lazovich et al, 1997; Nattinger et al, 2000). Thus, increasing BCT rates in the 1990s appear not to be due solely to increasing rates of smaller cancers, though BCT rates in the USA were higher in women with smaller cancers (Lazovich et al, 1997), as in NSW.

BCT use appears to have peaked in the UK and Netherlands in the late 1980s to 1990 at around 40% of women with breast cancer (de Koning et al, 1994; Haward et al, 1999). The high rate in 1995 in NSW (45%) may prove to have been a peak and, if so, would be consistent with De Koning et al's (1994) predicted limit for BCT at around 42% of all newly diagnosed breast cancers (de Koning et al, 1994).

Mastectomy rates were higher in non-metropolitan than urban or metropolitan women, as in the USA (Howe et al, 1992; Nattinger et al, 1996; Lazovich et al, 1997), independently of any regional differences in breast cancer size and stage at diagnosis (Table 4). These higher rates were unlikely to be due to poorer health and a consequent possible lower tolerance of adjuvant therapy since rural Australian women, if anything, are healthier than urban women (Mathers, 1994; Australian Institute of Health and Welfare, 1998). Australian rural residents generally have a low use of medical services and less access to specialist medical care (Australian Institute of Health and Welfare, 1998) and their higher mastectomy

Table 5 Association of axillary surgery with age, SES, cancer spread, cancer size, and the hospital volume of surgical procedures in women 40–69 years of age diagnosed with invasive breast cancer in 1992 and 1995

	1992 (n = 1088)			1995 (n = 794)		
	OR (adjusted)	95% CI		OR (adjusted)	95% CI	
Age (years)						
40–49	1.0	0.7	1.6	0.9	0.5	1.7
50–59	1.0			1.0		
60–69	0.9	0.6	1.4	0.5	0.3	0.9
		P-value	0.8		*P*-value	0.04
SES						
859–952	1.0			1.0		
953–979	0.9	0.4	1.7	0.6	0.3	1.2
980–1000	0.6	0.3	1.1	1.2	0.5	2.8
1001–1057	1.3	0.6	2.6	0.6	0.3	1.3
1058–1170	0.5	0.3	1.0	0.9	0.4	1.8
		P-value	0.008		*P*-value	0.2
Extent of cancer						
Localized	1.0			1.00		
Regional	2.4	1.6	3.7	1.5	0.9	2.6
Metastatic	0.7	0.2	2.3	–	–	–
		P-value	<0.001		*P*-value	0.1
Size						
0–0.9 cm	1.0			1.0		
1.0–1.9 cm	1.0	0.6	1.8	2.2	1.3	3.8
2.0–2.9 cm	1.8	1.0	3.3	3.3	1.7	6.7
3+ cm	1.6	0.9	3.1	1.8	0.8	3.9
		P-value	0.04		*P*-value	0.003
Hospital volume						
1–10 procedures	1.0			1.0		
11–20 procedures	2.0	1.1	3.6	1.1	0.4	3.1
21+ procedures	2.6	1.6	4.1	1.1	0.5	2.5
		P-value	<0.001		*P*-value	1.0

rates may have been due to less specialized care (Howe et al, 1992) and less access to radiotherapy, a recommended accompaniment to BCT (National Institute of Health 1990).

Although we did not find that hospital caseload was a strong predictor of BCT, higher surgeon caseload had been in a 1995 national survey (Hill et al, 1999) and low surgeon caseload a predictor of mastectomy in urban NSW in 1992 (Taylor et al, 1999). Perhaps, as in the USA, use had become more uniform across hospital settings by the 1990s (Lazovich et al, 1997). We found little evidence that SES influenced BCT rates.

Axillary surgery increased slightly from 1992 to a high percentage of NSW women in 1995. The patterns of axillary surgery mirrored US experience, accompanying mastectomy more often than BCT and being inversely related to women's ages and only weakly related to cancer size (Du et al, 1999; Nattinger et al, 2000). Since larger cancer size predicts positive nodes and young women have a higher probability of positive nodes than women of other ages (Olivotto et al, 1998; Yiangou et al, 1999), axillary surgery appeared to be appropriately targeted to younger women but less evidently to larger breast cancers.

If 'appropriate' (arguably optimal) surgery is defined as 'according to recommendation', then just over 80% of women in this study had optimal surgical treatment of the axilla. Axillary dissection in early breast cancer aims to control disease by reducing recurrence and to provide stage information for decisions about systemic therapy. In addition, women place a high value on knowing the status of the lymph nodes even when unfavourable,

despite poor outcomes in about 40% of women including arm dysfunction such as pain and loss of grip strength (Galper et al, 2000). Attention, appropriately, to women's preferences may account for some of the 20% of women who appear not to have optimal treatment of the axilla.

Women also have personal reasons for choosing non-conservative surgery. Surgeons reported that 25% of Australian women with early breast cancer in 1995 chose non-conservative surgery for reasons such as concerns about recurrence or treatment by radiotherapy, which were sometimes age- or residence-related (Hill et al, 1999). This preference, together with those in relation to axillary surgery, suggests that benchmarks should be set not only for the proportions of women having particular procedures but also for the proportions who were informed about the options and their pros and cons, and whether their preferences were honoured.

Our results show that detailed and informative analyses of patterns of breast cancer care in a whole population can be gained through linkage of routinely collected cancer registry and inpatient statistics records when the cancer registry does not routinely collect treatment data. This may be a cost-effective alternative to separate collection of treatment data by cancer registries.

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