ORIGINAL ARTICLE

ANZJSurg.com

Surgical treatment of early stage breast cancer in the Auckland and Waikato regions of New Zealand

Ian Campbell,*† Chunhuan Lao,‡ Tania Blackmore,‡ Melissa Edwards,* Louise Hayes,† Alex Ng§ and Ross Lawrenson†‡

*School of Medicine, The University of Auckland, Auckland, New Zealand
†Waikato District Health Board, Hamilton, New Zealand
‡Medical Research Centre, University of Waikato, Hamilton, New Zealand and
§Department of General Surgery, Auckland City Hospital, Auckland, New Zealand

Key words
breast cancer, New Zealand, surgery.

Correspondence
Associate Professor Ian Campbell, Waikato District Health Board, Private Bag 3200, Hamilton 3240, New Zealand. Email: ian.campbell@waikatodhb.health.nz

I. Campbell ONZM, MBChB, DObst, FRACS; **C. Lao** PhD; **T. Blackmore** PhD; **M. Edwards** BSc, MBChB, PGDip; **L. Hayes** MBChB, FRCS; **A. Ng** MBChB, FRCS; **R. Lawrenson** MBBS, MD, DRCOG, DipCommHealth, FPCert, DHMSA, FAFPHM, FFPH, FRCGP.

Accepted for publication 4 August 2018.

doi: 10.1111/ans.14840

Abstract

Background: The aim of this study was to understand the factors influencing the use of surgical options by New Zealand women with newly diagnosed breast cancer.
Methods: Using data from the Auckland and Waikato breast cancer registers, we included 11 798 women diagnosed with stage I–III breast cancer from June 2000 to May 2013. The characteristics of women receiving different surgical treatments and having immediate breast reconstruction following mastectomy were examined. A logistic regression was used to estimate the odds ratio of having breast-conserving surgery (BCS) versus mastectomy and immediate post-mastectomy reconstruction. Bilateral breast cancer cases and women with unilateral breast cancer, but who had bilateral surgery, were also identified.
Results: Fifty-two percent of women received BCS and 44% had mastectomy over the study period. Key influences associated with BCS were age, mode of diagnosis, socio-economic status and public or private treatment. Just under half of the women who underwent bilateral surgery did not have bilateral cancer. Nineteen percent of women undergoing mastectomy underwent immediate reconstruction. Implant use increased slightly over the study period but there was a decrease in the use of autologous flap procedures.
Conclusion: Surgical management of women with localized breast cancer was generally in line with guidelines, but with potential to further increase the use of breast conservation and immediate reconstruction in suitable cases.

Introduction

New Zealand (NZ) has a population of 4.5 million, of which 1.9 million live in and about the Auckland and Waikato regions. Three thousand NZ women are diagnosed with breast cancer each year. The primary treatment for 95% of women with localized breast cancer is surgery. Historically, surgical treatment has involved mastectomy,[1] but in 1990 the National Institutes of Health Consensus Conference recommended breast-conserving surgery (BCS) followed by radiotherapy (RT) as the treatment of choice for early stage breast cancer in suitable cases.[2] These recommendations led to a steady increase in the uptake of BCS.[3] More recently, however, rates of mastectomy have been seen to increase in the USA,[4] even in women with breast cancer that is suitable for BCS.[5]

Reasons why women choose BCS or mastectomy are multifactorial. Factors influencing decision-making include surgeon opinion,[6] tumour size (and size relative to breast size) and location,[7] access to RT,[8] socio-economic status and education level,[9] ethnicity,[10] co-morbidity,[11] use of preoperative magnetic resonance imaging,[4] BReast CAncer gene (BRCA) status[8] and family history.[6] Fear of recurrent cancer is an important factor driving the uptake of mastectomy, which offers a perception of reduced risk and avoidance of repeat treatments or RT associated with BCS.[6] In contrast, BCS is perceived as less radical, with a positive cosmetic outcome and body image.[2,6] From a surgical perspective, more women are becoming suitable for BCS with growing training and use of oncoplastic techniques, including reduction or volume replacement techniques.

A small number of women are diagnosed with cancer in both breasts and undergo bilateral surgery – usually bilateral mastectomy. In some cases, women with unilateral disease choose bilateral mastectomy to prevent cancer in the other breast,[5] despite no clinical evidence to support any further survival benefit.[12] In addition, an increasing option for women choosing mastectomy is to

have immediate breast reconstruction,[13] using either autologous techniques (deep inferior epigastric perforator (DIEP) artery flaps, transverse rectus abdominis myocutaneous (TRAM) flaps and latissimus dorsi (LD) flaps) or implant-based reconstruction.[14]

This study examines the different surgical options used in a large cohort of NZ women with newly diagnosed breast cancer, and the sociodemographic and ethnic factors influencing treatment options.

Methods

This study is based on data from two cancer registers (Auckland and Waikato), which have prospectively collected data from almost 100% of newly diagnosed breast cancer cases. Data are entered on to the registers through clinic and operation records, multidisciplinary meeting records, oncology, palliative care and private and public hospital records.[15] We included 11 798 women diagnosed with stage I–III breast cancer between June 2000 and May 2013, and excluded 574 women with metastatic disease and men with a breast cancer diagnosis. Patient consent to access data from both registers was not required (ethics ref.: WAI/04/10/099/AM02).

Information in the combined registers includes (but is not limited to): (i) patient characteristics: age, diagnosis date, mode of diagnosis, socio-economic status, public/private, region (Auckland/Waikato) and ethnicity; (ii) tumour biology: cancer stage, grade and tumour size; (iii) treatment: chemotherapy, surgery and RT; and (iv) cancer progression: local recurrence, metastases and date of death. The presence of co-morbidities was ascertained by data linkage to the National Minimum Dataset (NMDS) that records clinical data for inpatients and day patients. We characterized patients as having no co-morbidities (C0), one co-morbidity (C1) or 2 or more (C2+) using the C3 co-morbidity count.[16]

Surgical choices were categorized as either BCS, mastectomy or no primary surgery. We recorded surgery to one or both breasts, and whether women choosing mastectomy opted for breast reconstruction. Reconstructive surgery was categorized as DIEP/TRAM flaps, LD flaps or implants/expanders. We identified bilateral breast cancer cases and women who had unilateral breast cancer but had bilateral surgeries.

Table 1 Characteristics of women receiving different surgical treatments

Factors	No primary surgery		BCS		Mastectomy		Total	*P*-value (chi-squared test)
	n	%	*n*	%	*n*	%	*n*	
Register								<0.001
Auckland	354	3.8	4689	50.9	4175	45.3	9218	
Waikato	116	4.5	1460	56.6	1004	38.9	2580	
Year of diagnosis								0.105
2000–2003	133	4.7	1461	51.1	1266	44.3	2860	
2004–2006	85	3.3	1323	51.9	1140	44.7	2548	
2007–2009	112	3.9	1477	51.6	1276	44.5	2865	
2010–2013	140	4.0	1888	53.6	1497	42.5	3525	
Ethnicity								<0.001
Māori	39	3.6	517	48.2	516	48.1	1072	
Pacific	58	8.0	273	37.9	390	54.1	721	
Non-Māori/non-Pacific	373	3.7	5359	53.6	4273	42.7	10 005	
Age								<0.001
<40	9	1.2	283	37.5	463	61.3	755	
40–49	31	1.2	1327	51.5	1219	47.3	2577	
50–59	39	1.2	1929	59.8	1258	39.0	3226	
60–69	37	1.3	1743	63.3	975	35.4	2755	
70–79	67	4.6	623	42.8	764	52.5	1454	
80+	287	27.8	244	23.7	500	48.5	1031	
Mode of detection								<0.001
Not screen detected	431	6.1	2827	39.8	3837	54.1	7095	
Screen detected	39	0.8	3322	70.6	1342	28.5	4703	
Stage								<0.001
Stage I	99	1.8	3854	71.9	1404	26.2	5357	
Stage II	264	5.8	1921	42.0	2385	52.2	4570	
Stage III	107	5.7	374	20.0	1390	74.3	1871	
Public/private								<0.001
Private	36	0.8	2751	60.2	1785	39.0	4572	
Public	434	6.0	3398	47.0	3394	47.0	7226	
Deprivation								<0.001
1–2 (low deprivation)	73	2.9	1402	55.7	1044	41.4	2519	
3–4	77	3.9	1070	54.7	809	41.4	1956	
5–6	89	3.5	1358	53.9	1074	42.6	2521	
7–8	105	4.5	1211	51.4	1042	44.2	2358	
9–10 (high deprivation)	115	4.9	1055	45.2	1164	49.9	2334	
Unknown	11	10.0	53	48.2	46	41.8	110	
Co-morbidity count								<0.001
0	176	1.9	5067	54.6	4036	43.5	9279	
1	44	4.7	453	48.6	436	46.7	933	
2+	250	15.8	629	39.7	707	44.6	1586	
Total	470	4.0	6149	52.1	5179	43.9	11 798	

BCS, breast-conserving surgery.

Descriptive statistics for categorical variables are displayed as actual numbers/percentages and compared between groups using chi-squared tests. All tests of significance were two tailed, with $P < 0.05$ considered significant. Sociodemographic and disease factors associated with the receipt of BCS (versus mastectomy), as well as the receipt of post-mastectomy breast reconstruction were determined using logistic regression to obtain odds ratios (ORs). All statistical analyses were performed in SPSS version 23 (IBM Corporation, New York, NY, USA).

Ethical approval for the study was granted through the Northern A Health and Disability Ethics Committee (reference: 12/NTA/42/AM01).

Results

Primary surgery

Of the 11 798 women diagnosed with stage I–III breast cancer between June 2000 and May 2013, 6149 (52%) women had BCS, 5179 (44%) had mastectomy and 470 (4%) had no primary surgery (Table 1). The probability of having BCS compared to mastectomy was greatest in the screening age range and decreased with age (Table 2). Women living in the Waikato (OR: 1.60, 95% confidence interval (CI): 1.44–1.78) and those with screened detected cancers (OR: 2.23, 95% CI: 2.04–2.43) were more likely to have BCS. Women treated in a public hospital (OR: 0.70, 95% CI: 0.64–0.77), living in the most deprived socio-economic quintile (9, 10) (OR: 0.76, 95% CI: 0.66–0.87) and with higher cancer stage (OR: 0.36 (95% CI: 0.33–0.39) for stage II versus stage I; OR: 0.13 (95% CI: 0.11–0.15) for stage III versus stage I) were less likely to receive BCS.

Breast reconstruction after mastectomy

After mastectomy, 972 (19%) women had immediate breast reconstruction: 434 (45%) DIEP or TRAM flaps, 131 (13%) LD flaps and 407 (42%) implant/expander reconstruction (Table 3). The rate of immediate reconstruction increased from 17% during 2000–2003 to 21% during 2010–2013. Implant/expander reconstruction increased from 12% during 2000–2003 to 56% during 2010–2013, and the use of DIEP and TRAM flaps decreased from 68% during 2000–2003 to 31% during 2010–2013.

Logistic regression showed that ethnicity, public/private hospital, having post-mastectomy RT, region, cancer stage, co-morbidity, screen detection, age and year of diagnosis had a significant impact on the likelihood of having breast reconstruction following mastectomy (Table 4). The adjusted ORs of having breast reconstruction were 0.53 (95% CI: 0.38–0.73) and 0.46 (95% CI: 0.31–0.67) for Māori and Pacific women compared to others; 0.43 (95% CI: 0.36–0.51) for women treated publicly compared to privately; 0.59 (95% CI: 0.45–0.78) for women living in the most deprived socio-economic quintile (9, 10); 0.76 (95% CI: 0.62–0.92) for those who had RT compared to those who did not; 1.41 (95% CI: 1.14–1.75) for Waikato patients compared to Auckland patients; 0.78 (95% CI: 0.64–0.95) and 0.52 (95% CI: 0.40–0.68) for women with stage II and III cancer compared to women with stage I cancer; 0.36 (95% CI: 0.23–0.57) for women with co-morbidity of 2+ compared to no co-morbidity; 1.87 (95% CI: 1.55–2.26) for women who were screen detected compared to those who were not; 0.91 (95% CI: 0.90–0.92) for age; and 1.03 (95% CI: 1.01–1.05) for the year of diagnosis. An additional 142 women had delayed reconstruction, although this may be an underestimate as plastic surgeon records are not always reported to the registers.

Table 2 OR of having BCS compared to mastectomy

Factors	*P*-value	OR (95% CI)
Co-morbidity count		
1 versus 0	0.106	0.88 (0.75–1.03)
2+ versus 0	0.086	0.89 (0.78–1.02)
Year of diagnosis	0.360	1.00 (0.98–1.01)
Register: Waikato versus Auckland	<0.001	1.60 (1.44–1.78)
Age	<0.001	0.99 (0.99–1.00)
Ethnicity		
Māori versus non-Māori/non-Pacific	0.971	1.00 (0.86–1.17)
Pacific versus non-Māori/non-Pacific	0.521	0.94 (0.78–1.13)
Public versus private	<0.001	0.70 (0.64–0.77)
Deprivation		
3–4 versus 1–2	0.978	1.00 (0.87–1.14)
5–6 versus 1–2	0.635	0.97 (0.85–1.10)
7–8 versus 1–2	0.382	0.94 (0.82–1.08)
9–10 versus 1–2	<0.001	0.76 (0.66–0.87)
Stage		
Stage II versus Stage I	<0.001	0.36 (0.33–0.39)
Stage III versus Stage I	<0.001	0.13 (0.11–0.15)
Screen detected versus not screen detected	<0.001	2.23 (2.04–2.43)

BCS, breast-conserving surgery; CI, confidence interval; OR, odds ratio.

Bilateral cancer and bilateral surgeries

We found 295 (3%) women diagnosed with bilateral breast cancer, including 236 from Auckland and 59 from Waikato. Of these, 174 (59%) women had bilateral mastectomy, 82 (28%) had bilateral BCS, 17 (6%) had BCS and mastectomy on each side and 22 (8%) had no primary surgery. After bilateral mastectomy, 51 (29%) had immediate bilateral breast reconstruction.

There were 290 (2%) women diagnosed with unilateral breast cancer, but who underwent bilateral surgery, including 242 from Auckland and 48 from the Waikato. Of these, 285 (98%) women had a bilateral mastectomy. Following bilateral mastectomy, 79 (28%) had immediate bilateral breast reconstruction. The rates of bilateral mastectomy in women diagnosed with unilateral breast cancer increased over time (1.3% during 2000–2003 to 3.7% during 2010–2013).

Discussion

Mastectomy is still used in women with primary breast cancer that is potentially suitable for BCS. In this NZ cohort, we found slightly more use of BCS, with 52% of women receiving BCS while 44% of women received a mastectomy. More use of BCS is in contrast to reports of a steady rise in the use of mastectomy in the USA,[3,4] but is in accordance with the Australian BCS rates of 61% over similar time periods.[17] Women diagnosed through screening, even after adjustment for age and stage, were twice as likely to receive BCS, while only 29% underwent a mastectomy. In 2004, the eligible age range for screening in NZ was widened to include women aged 45–49 years in addition to the 50–69 year age group, which

could partly explain the slightly higher rate of BCS. We have shown fairly stable rates of mastectomy, slightly higher than the reported rate of 39% in Australia over a similar time period,[17] higher than the UK audit data for screen-detected cancers of 23% from 2013/2014 to 2014/2015,[18] and within variable provincial Canadian rates of 26–69%.[19]

It has been reported elsewhere that younger women, particularly <40 years of age, are more likely to choose mastectomy.[3–5] We report similar data, with 61% of women aged <40 years opting for mastectomy. Younger women have a higher likelihood of being BRCA gene mutation positive[4,5] and have a higher risk of local recurrence after BCS. Fear of recurrence has a major influence on decision-making for this age group. Women older than the NZ screening range (45–69 years) were also more likely to choose mastectomy.

Women living in the Waikato region were more likely to be treated with BCS, even after adjustment for stage, grade and size of tumour. Surgeon or system differences could account for some of the variation in the type of surgery chosen. The level of surgeon influence on women's surgery decisions is a significant factor in published studies.[3,6,10,20] Patients treated publicly and those living in the most deprived socio-economic quintile (9, 10) were less likely to receive BCS. Social deprivation likely plays a role in decision-making[8,9] and lower rates of breast reconstruction[21] and may also indirectly relate to differences in surgical treatment between the public and private sectors.[10]

Only 586 women underwent bilateral surgery, and 290 (50%) of these did not have bilateral cancer. Bilateral mastectomy reduces the risk of contralateral breast cancer following unilateral disease, but does not increase survival in BRCA1/2 mutation negative women.[12] Reasons why women choose bilateral surgery are related to clinical, psychological and cosmetic outcomes,[12] anxiety surrounding future treatments, family history[9] and being BRCA or other gene mutation positive.[22] Fear of recurrence and a misperception of enhanced survival are major influences,[12] with younger women more anxious than older women[23] and therefore more likely

Table 3 Characteristics of women having immediate breast reconstruction following mastectomy

Factors	Total reconstruction		DIEP and TRAM flaps		Latissimus dorsi flap		Expander reconstruction and implant		*P*-value (chi-squared test)
	n	%	*n*	%	*n*	%	*n*	%	
Register									<0.001
Auckland	789	18.9	363	46.0	47	6.0	379	48.0	
Waikato	183	18.2	71	38.8	84	45.9	28	15.3	
Year of diagnosis									<0.001
2000–2003	217	17.1	147	67.7	43	19.8	27	12.4	
2004–2006	195	17.1	92	47.2	29	14.9	74	37.9	
2007–2009	250	19.6	98	39.2	19	7.6	133	53.2	
2010–2013	310	20.7	97	31.3	40	12.9	173	55.8	
Ethnicity									<0.001
Māori	54	10.5	27	50.0	9	16.7	18	33.3	
Pacific	37	9.5	16	43.2	1	2.7	20	54.1	
Others	881	20.6	391	44.4	121	13.7	369	41.9	
Age									<0.001
<40	180	38.9	71	39.4	25	13.9	84	46.7	
40–49	389	31.9	174	44.7	46	11.8	169	43.4	
50–59	313	24.9	157	50.2	48	15.3	108	34.5	
60–69	84	8.6	31	36.9	11	13.1	42	50.0	
70–79	5	0.7	1	20.0	1	20.0	3	60.0	
80+	1	0.2					1		
Mode of detection									
Not screen detected	639	16.7	294	46.0	88	13.8	257	40.2	<0.001
Screen detected	333	24.8	140	42.0	43	12.9	150	45.0	
Stage									<0.001
Stage I	344	24.5	134	39.0	50	14.5	160	46.5	
Stage II	435	18.2	200	46.0	56	12.9	179	41.1	
Stage III	193	13.9	100	51.8	25	13.0	68	35.2	
Public/private									<0.001
Private	558	31.3	301	53.9	61	10.9	196	35.1	
Public	414	12.2	133	32.1	70	16.9	211	51.0	
Deprivation									<0.001
1–2	265	25.4	135	50.9	22	8.3	108	40.8	
3–4	188	23.2	76	40.4	14	7.4	98	52.1	
5–6	199	18.5	81	40.7	34	17.1	84	42.2	
7–8	173	16.6	81	46.8	30	17.3	62	35.8	
9–10	133	11.4	52	39.1	30	22.6	51	38.3	
Unknown	14	30.4	9	64.3	1	7.1	4	28.6	
Co-morbidity count									<0.001
0	901	22.3	410	45.5	120	13.3	371	41.2	
1	48	11.0	18	37.5	7	14.6	23	47.9	
2+	23	3.3	6	26.1	4	17.4	13	56.5	
Total	972	18.8	434	44.6	131	13.5	407	41.8	

DIEP, deep inferior epigastric perforator; TRAM, transverse rectus abdominis myocutaneous.

to opt for bilateral mastectomy.[9,22,23] In the current cohort, 80% of women who had unilateral breast cancer but opted for bilateral surgery were <60 years of age, and as age increased, the likelihood of having a bilateral mastectomy decreased.

The uptake of breast reconstruction has been increasing slowly over time.[13] In this cohort, immediate reconstruction increased from 17% to 21% at the end of the study period. This compares to a rate of 12–16% in Australia,[24] an average regional rate of 21% in the UK[25] and 26% in the USA.[26] In our study, the crude percentages of reconstruction between the two NZ regions were similar, but the OR for breast reconstruction in the Waikato was 40% higher than in Auckland after adjusting for greater deprivation and use of post-mastectomy RT in the Waikato. Regional differences can be due to a mixture of patient factors (age and social deprivation), system factors (size and location of treatment facilities) and surgeon preferences (e.g. timing and suitability for reconstruction, and preferred method such as implants alone versus use of LD flaps). Regional differences have also been reported in the USA, where up to 84% of Caucasian women in areas with a high density of plastic surgeons and private insurance undergo immediate reconstruction.[27]

Women identified through breast screening but who chose mastectomy were also more likely to have reconstruction. There are many possible reasons for this, including, higher health literacy, fewer Māori and Pacific women in this population and a higher proportion of screened women having tumours that do not require RT, for example, extensive ductal carcinoma *in situ*. Compared with NZ European, Māori and Pasifika women were significantly less likely to undergo breast reconstruction. Ethnic disparities have been reported previously[10] and may in part be influenced by factors such as smoking and obesity. Other factors influencing whether women receive reconstruction (but not addressed in this study) include living remotely,[28] surgeon caseloads or large tumour size.[24]

Table 4 OR of having immediate reconstruction or not after mastectomy

Factors	*P*-value	OR (95% CI)
Ethnicity		
Māori versus non-Māori/non-Pacific	<0.001	0.53 (0.38–0.73)
Pacific versus non-Māori/non-Pacific	<0.001	0.46 (0.31–0.67)
Public versus private	<0.001	0.43 (0.36–0.51)
Deprivation		
3–4 versus 1–2	0.355	0.89 (0.70–1.14)
5–6 versus 1–2	0.116	0.82 (0.65–1.05)
7–8 versus 1–2	0.226	0.85 (0.66–1.10)
9–10 versus 1–2	<0.001	0.59 (0.45–0.78)
RT versus no RT	0.006	0.76 (0.62–0.92)
Register: Waikato versus Auckland	0.002	1.41 (1.14–1.75)
Stage		
Stage II versus Stage I	0.012	0.78 (0.64–0.95)
Stage III versus Stage I	<0.001	0.52 (0.40–0.68)
Co-morbidity count		
1 versus 0	0.069	0.73 (0.51–1.03)
2+ versus 0	<0.001	0.36 (0.23–0.57)
Screen detected versus not screen detected	<0.001	1.87 (1.55–2.26)
Age	<0.001	0.91 (0.90–0.92)
Year of diagnosis	0.012	1.03 (1.01–1.05)

CI, confidence interval; OR, odds ratio; RT, radiotherapy.

There was a decrease in the use of autologous procedures (DIEP, TRAM and LD flaps) and an increase in the use of implants from 12% during 2000–2003 to 56% during 2010–2013 (Table 3). This trend has also been reported elsewhere[29] and is likely due to improvements in implant techniques, with growing use of acellular dermal matrices and subsequent use of fat grafting, whilst avoiding the morbidity associated with autologous methods. Autologous procedures also often involve specialist plastic surgical input, which additionally makes the scheduling and timely provision of surgery more difficult.

The relatively large sample is a strength of this study. The sample was derived from generally complete population-based data sets. A limitation is that we restricted our analysis on breast reconstruction to immediate surgeries, as we were concerned that there may be an under-recording of delayed surgical intervention. However, we believe the proportion of delayed breast reconstruction is <10% of the total.

This study examines the different surgical options used in a large cohort of NZ women with newly diagnosed breast cancer. We have shown slightly more use of BCS over the study period, perhaps explained by the increase in diagnoses through screening. Mastectomy was more likely in older women, but more women in the <40 year age group were also opting for mastectomy, which is in accordance with trends reported elsewhere. Almost 3% of women underwent bilateral mastectomy despite having unilateral breast cancer. We report growing rates of immediate breast reconstruction, with an increase in implant-based reconstruction techniques. By international standards, there is room for improvement in both breast conservation rates and use of immediate breast reconstruction.

Acknowledgements

We acknowledge the Auckland and Waikato Breast Cancer Registers for providing the data. This work was supported by the Health Research Council of NZ (Grant number 14/484).

Conflicts of interest

None declared.

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