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Original article

Low Breast Conserving Surgery (BCS) rates in public hospitals in Malaysia: The effect of stage and ethnicity

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ABSTRACT

Introduction: Breast-conserving surgery (BCS) with radiation therapy is the procedure of choice for early-stage breast cancer. Survival and locoregional recurrence is non-inferior to mastectomy, with superior cosmetic and psycho-social outcomes. Differing health systems have demonstrated a wide variation in the rate of BCS. Little is known about the rate of BCS and factors influencing its practice in middle resource countries. This study aims to examine the BCS rates in Malaysia and to identify factors influencing its uptake.

Methodology: This is a multi-centre, cross-sectional study involving the University of Malaya Medical Centre (UMMC), Queen Elizabeth II Hospital (QEH), and Tengku Ampuan Rahimah Hospital (TARH). Patients diagnosed with invasive breast cancer from January 2014 to December 2015 were included, excluding stromal cancers and lymphomas. Univariate and multivariate analyses identified factors influencing BCS.

Results: A total of 1005 patients were diagnosed with breast cancer in the allocated time frame. Excluding incomplete records and those who did not have surgery, 730 patients were analysed. Overall BCS rate was 32.9%. The BCS rate was highest at QEH (54.1%), followed by UMMC (29.5%), and TARH (17.4%). 16.9% had BCS after neoadjuvant therapy. Factors influencing BCS uptake included age, ethnic group, breast-surgeon led services, AJCC Stage, tumour size, HER-2 expression, and tumour grade.

Conclusions: The rate of BCS in Malaysia is low. A wide variation of rate exists among the studied hospitals. Younger age, earlier AJCC stage, and the presence of a Breast sub-specialist surgeon, would make it more likely that the patient has her breast conserved.

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1. Introduction

Breast cancer is the most common cancer in females, making up 25% of cancers in women [1]. In Malaysia, breast cancer accounts for 32.1% of cancers in females [2], with an incidence of 38.9 per 100,000 [3]. Treatment for breast cancer has shifted from Halsted's radical mastectomy which, while curative, left women with significant morbidities [4], to breast-conserving surgery (BCS). This shift to less invasive procedures that emphasizes cosmesis, was driven by the need to ameliorate the psychological stress and changes in body image and sexuality that are associated with mastectomy [5]. BCS has been shown to provide superior cosmetic and equal survival outcomes compared to mastectomy [6,7]. Much work has been done to establish the non-inferiority of BCS [8–16], which has thus become the standard of care for early-stage breast cancer [17–19]. Following this, the rate of BCS vs mastectomy has been recognized as a global marker of advancing surgical practice in the treatment of breast cancer [20–24].

This is the first study to describe BCS rates and factors influencing its practice in a middle-income country in Southeast Asia.

2. Material and methods

This is an observational, cross-sectional, multicentre study that

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involves three large hospitals in Malaysia, namely;

1. University Malaya Medical Centre (UMMC), Kuala Lumpur, Peninsular Malaysia.
2. Tengku Ampuan Rahimah Hospital (TARH), Klang, Selangor, Peninsular Malaysia.
3. Queen Elizabeth Hospital (QEH), Kota Kinabalu, Sabah, East Malaysia (on Borneo Island)

Individual hospital characteristics are summarized in Table 1.

2.1. Data source and collected variables

Retrospective secondary data from hospital-based cancer registries were obtained. Variables collected included demographic data (treating hospital, age, and ethnicity), pathological data (tumour stage [T-stage] at presentation, tumour size in centimetres [cm], Estrogen Receptor [ER], Progesterone Receptor [PR], Human Epidermal Growth Factor Receptor-2 [HER-2] expression, tumour grade, American Joint Committee for Cancer [AJCC] stage at presentation) and clinical data (whether a patient had surgery done, type of surgery, and if a patient had neoadjuvant chemotherapy). Type of surgery was categorized into BCS, mastectomy, oncoplastic BCS, and mastectomy with reconstruction.

Relevant diagnostic test, including mammograms (MMG), ultrasounds (USG), and histopathological (HPE) reports were examined. All consecutive patients diagnosed with Ductal Carcinoma In-Situ (DCIS) and invasive carcinoma of the breast, treated with surgery, between January 2014–December 2015 were included. Inflammatory breast cancer, stromal cancers and breast lymphoma were excluded.

2.2. Data analysis

Data analyses was performed using IBM SPSS v22.0.0. The rate of BCS was calculated as − [BCS + oncoplastic BCS/total number of surgeries done].

The data set was divided into three groups, according to hospital and then by type of procedure. Continuous data (age at diagnosis, tumour size) was assessed for normality via the Shapiro-Wilk test, as there were less than 2000 cases involved. Boxplots were then used to assess for outliers. The data was found to be not-normally distributed with significant outliers, therefore medians were reported and compared with a two-tailed Independent Samples Median Test. Pearson's chi-squared test was applied to assess correlations between the groups of categorical data. After identifying statistically significant variables that affect the rate of BCS on univariate analysis, a multivariate analysis was done with a Binary Logistic Regression Model to establish correlations between these identified variables and their influence on the rate of BCS. The dependant variable was type of surgery [mastectomy = 0, BCS = 1] and variable selection was forward. Patients who were Stage IV were excluded from the logistic regression as surgery was performed for palliative intentions. Those who had reconstructions were also excluded from the regression model as they did not fit the research question of "factors influencing BCS". P-values of <0.05 was taken as being statistically significant. The Confidence Interval (CI) was set at 95%.

3. Results

Between January 2014 to December 2015, 1005 patients were diagnosed with breast cancer across the three centres. 544 from UMMC, 222 from QEH, and 239 from TARH. After removing incomplete records of 133 patients, and excluding 6 patients who had stromal cancers and lymphoma of the breast, a sample of 866 patients was obtained (Fig. 1).

3.1. Patient characteristics

Patients at UMMC presented at a median age of 56 years. These patients were the oldest cohort. Patients at TARH were younger (median 55 years) and those at QEH were youngest (median 51 years). This age difference was statistically significant ($p = 0.003$) The ethnic group distribution differed across the three centres. The majority of patients at UMMC were of Chinese ethnicity ($n = 216$, 43.1%), whereas patients in QEH were mostly from the indigenous ethnic groups ($n = 109$, 59.6%). The Indigenous groups are largely comprised of the Kadazandusun, Bajau, and Murut people in combination with the 39 other smaller indigenous ethnic groups of Sabah. Most of patients from TARH were Malay ($n = 81$, 44.5%) ($p < 0.001$).

There was no significant difference in median tumour size ($p = 0.088$) across the centres, however, there was a difference when comparing T-stage ($p < 0.001$) with UMMC having the highest number of patients with T4 tumours ($n = 124$, 24.8%), and QEH having the highest number of T3 disease ($n = 40$, 21.9%). Overall, most patients presented with T2 ($n = 371$, 42.8%) tumours. Tumour-in-situ (Tis) totalled 4.8% ($n = 42$).

UMMC had the highest proportion of stage IV patients ($n = 99$, 19.8%), while QEH had the lowest ($n = 19$, 10.4%) ($p < 0.001$). Distribution of tumour biomarkers (ER, PR, HER-2, grade) also differed across hospitals ($p < 0.001$). Only 215 patients (24.8%) were given neoadjuvant chemotherapy. UMMC had the highest proportion of neoadjuvant chemotherapy ($n = 149$, 29.7%). Of the patients who had BCS, 23 (16.9%) had neoadjuvant chemotherapy. Neoadjuvant chemotherapy for BCS was not practiced at other centres. Table 2 summarizes these findings.

3.2. BCS vs mastectomy

A total of 730 (84.3%) patients had surgery done. The rate of BCS vs mastectomy varied significantly across centres. 240 patients had BCS (32.8%), and 490 (67.2%) had mastectomies. There were seven Oncoplastic BCS procedures (0.9%), and 54 mastectomies with reconstruction (7.4%). The rate of BCS at UMMC was 29.5%, QEH 54.1%, and TARH 17.4% (Fig. 2).

Table 1
Individual hospital characteristics.

	UMMC, Kuala Lumpur	QEH, Kota Kinabalu	TARH, Klang
University Centre	Yes	No	No
Breast Surgery Unit	Yes	No	No
Breast Surgery Training Centre	Yes	No	No
Breast Sub-Specialist	Yes	Yes	No
Oncology/Radiotherapy services	Yes	Yes	No
Number of Beds	1300	880	864

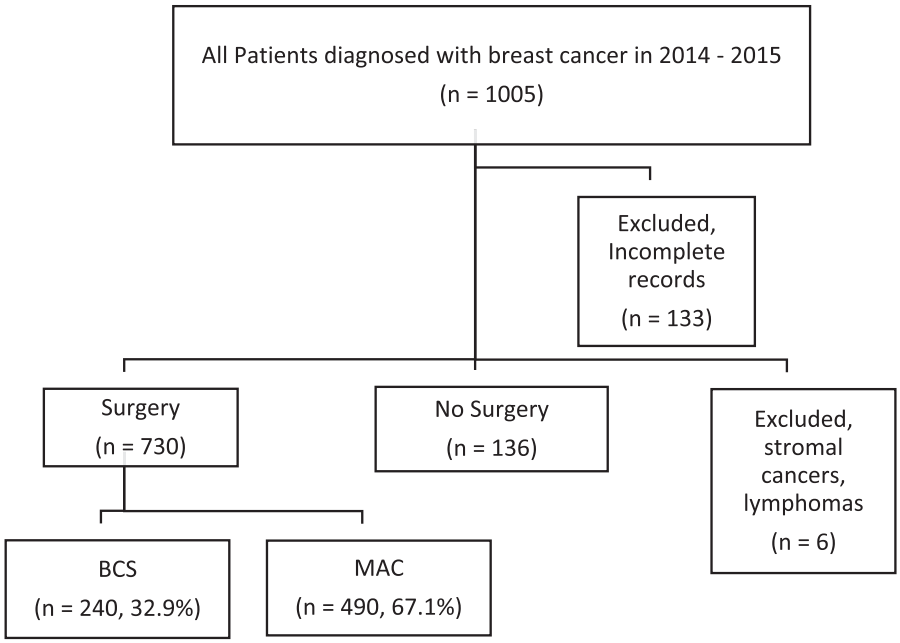

Fig. 1. Study population.

3.3. Factors influencing BCS

Table 3 demonstrates the univariate analysis on procedures done. All patient's demographic and surgical characteristics showed significant differences. ER/PR status did not show a significant difference, while there was a difference in HER-2 expression and tumour grade.

The median age of patients who had BCS was younger (53 years old), compared to patients who had mastectomy (58 years). Patients who had reconstructions were even younger (43 years). Age group analysis showed significant difference in choice of procedure. Patients under 45 years old had the highest proportion of mastectomy with reconstruction (n = 40, 26.1%), with similar rates of BCS (n = 54, 35.3%) and mastectomy (n = 59, 38.6%). In the 45–70 years old group, BCS rates was similar (n = 174, 34.6%) to the under 45 age group, but mastectomy rates (n = 317, 63.0%) increased and reconstruction rates dropped (n = 12, 2.4%). In the over 70 years old age group, BCS (n = 12, 16.2%) was lowest and mastectomy (n = 60, 81.1%), highest. Only 2 patients (2.7%) over 70 had reconstructions.

Median tumour size among patients who underwent BCS were smaller (2.1 cm) compared to those who had mastectomy (3.1 cm), while those who had mastectomies with reconstructions had the largest median size (3.8 cm). BCS rate was lower among the Malay (n = 61, 31.5%) Chinese (n = 76, 30.4%), and Indian (n = 32, 21.9%) ethnic groups, but higher among Indigenous patients (n = 62, 56.8%). There was a gradual decrease in BCS rates from stage 0 (n = 29, 70.7%) to stage IV (n = 6, 8.8%). ER/PR status had no significant effect on the type of surgery (p = 0.143 and 0.053). HER-2 over-expression was highest among patients who had mastectomies done (n = 101, 66.9%) but lowest among patients who had reconstructions (n = 18, 11.9%). HER-2 non-expression was highest among patients who had BCS done (n = 164, 35.9%) (p = 0.002). Most of the patients who had BCS had Grade 1 tumours (n = 55, 39.9%), whereas most of the patients who had mastectomies done had higher tumour grades (Grade 2, n = 208, 64.6%; Grade 3, n = 142, 64.0%) (p = <0.001).

From the univariate analysis, patients treated at QEH, of indigenous ethnicity, younger age, smaller tumours, earlier stage, and lower tumour grade were more likely to have BCS. Whereas patients who were of Chinese or Indian ethnicity, had HER-2 receptor overexpression, and had neoadjuvant chemotherapy were less likely to have BCS. Mastectomy with reconstruction rates were highest among young, Malay patients with large tumour sizes, operated on at UMMC.

Multivariate analysis showed that the treating hospital, age group, ethnicity, T-stage at presentation, and the stage of patients had a significant effect on the rate of BCS (Table 4). Tumour biology was significant for HER-2 receptor status, but ER/PR receptor status were not. Tumour grade was not significant. Whether or not a patient had neoadjuvant chemotherapy was not significant.

There was no difference in BCS rate between UMMC and QEH, but those treated at TARH were less likely to have BCS done (OR 0.34, CI 0.17–0.68, p < 0.01) when compared to UMMC.

Patients in the 45–70 (OR 0.49, CI 0.27–0.89, p = 0.02) and >70 age group (OR 0.09, CI 0.03–0.25, p < 0.01) were less likely to have BCS. There was no significant difference in the rate of BCS between Malay, Indian, Indigenous, and Foreigners, however, Chinese (OR 0.41, CI 0.22–0.77, p < 0.01) patients were less likely to have BCS.

Patients with T2 (OR 0.41, CI 0.20–0.87, p = 0.02) and T3 (OR 0.20, CI 0.07–0.57, p < 0.01) tumours were less likely to have BCS done. There was no difference between T1 and T4 patients. There was no difference in BCS rates between AJCC Stage I and Stage II patients. Patients who presented at Stage III (OR 0.33, CI 0.14–0.81, p = 0.02) were less likely to have BCS. There was no significant difference when comparing ER/PR receptor status. Patients who had equivocal HER-2 receptor expression (OR 0.41, CI 0.20–0.81, p = 0.01) and over-expression (OR 0.38, CI 0.19–0.76, p < 0.01) were less likely to have BCS. Tumour Grade and neoadjuvant chemotherapy did not significantly affect the rate of BCS.

In summary, independent factors that positively influenced BCS rates include younger age, earlier T-stage, earlier AJCC stage, and hospitals with breast sub-specialist surgeons (UMMC, QEH). Factors negatively affecting BCS rates include Chinese and Indian ethnicity, and HER-2 receptor overexpression. ER/PR status, tumour grade, and if a patient had neoadjuvant chemotherapy were not significant factors.

Table 2
Patient characteristics by hospital (n = 866).

	UMMC n = 501	QEH n = 183	TARH n = 182	
Variables				p-value
Age (years)				
Median (min - max)	56 (23–83)	51 (16–86)	55 (23–85)	0.003
<45	20.4%	25.7%	20.3%	0.140
45-70	66.3%	66.7%	70.3%	
70	13.4%	7.7%	9.3%	
Ethnicity				<0.001
Malay	33.7%	6.0%	44.5%	
Chinese	43.1%	27.9%	18.1%	
Indian	19.4%	2.2%	35.2%	
Indigenous	0.0%	59.6%	0.0%	
Foreigners	3.8%	4.4%	2.2%	
Tumour size (in cm)				0.088
Median (min - max)	3.0 (0.0–30.0)	3.4 (0.0–18.0)	3.3 (0.5–17.0)	
T-stage at presentation				<0.001
Tis	5.6%	6.6%	1.1%	
T1	27.5%	14.8%	11.0%	
T2	34.5%	51.9%	56.6%	
T3	7.6%	21.9%	12.1%	
T4	24.8%	4.9%	19.2%	
AJCC Stage at presentation				<0.001
0	5.6%	6.6%	1.1%	
I	19.8%	13.7%	10.4%	
II	32.9%	42.6%	44.5%	
III	22.0%	26.8%	27.5%	
IV	19.8%	10.4%	16.5%	
ER Status				<0.001
Positive	71.3%	74.9%	54.9%	
Negative	24.2%	23.5%	32.4%	
NA	4.6%	1.6%	12.6%	
PR Status				<0.001
Positive	47.3%	61.2%	50.5%	
Negative	47.9%	37.2%	36.8%	
NA	4.8%	1.6%	12.6%	
HER2 Status				<0.001
Positive	27.1%	10.9%	18.7%	
Negative	51.1%	79.2%	68.7%	
Equivocal	17.4%	8.2%	0.0%	
NA	4.4%	1.6%	12.6%	
Bloom & Richardson Grade				<0.001
1	18.0%	13.7%	18.1%	
2	38.7%	45.4%	49.5%	
3	34.5%	26.2%	30.2%	
NA	8.8%	14.8%	2.2%	
Neoadjuvant				<0.001
Yes	29.7%	15.3%	20.9%	
No	70.3%	82.5%	78.0%	
Unknown	0.0%	2.2%	1.1%	
Surgery				<0.001
Done	75.8%	100.0%	91.8%	
Not done	24.2%	0.0%	8.2%	
Surgery Type				<0.001
BCS	28.8%	51.9%	17.4%	
O-BCS	0.8%	2.2%	0.0%	
M	56.5%	45.4%	82.6%	
M + R	13.9%	0.5%	0.0%	

Abbreviations: min = minimum; max = maximum; AJCC = American Joint Committee on Cancer; ER = estrogen receptor; PR = progesterone receptor; BCS = Breast Conserving Surgery; O-BCS = Oncoplastic Breast Conserving Surgery; M = Mastectomy; M + R = Mastectomy with Reconstruction; NA = not available.

4. Discussion

The overall rate of BCS was 32.9%, lower than high-resource countries (Canada 68%, Singapore 55.8%, Japan 59.3%, Hong Kong 40.5%) [21–24]. Although the sampled hospitals are large tertiary centres, there was a significant observable difference. Analysed in isolation, the rate of BCS was highest at QEH (54.1%), followed by UMMC (29.5%), and lowest at TARH (17.4%).

Multivariate analysis revealed that there was no significant difference between UMMC and QEH. There was a significant difference between centres that had breast sub-specialist surgeons (UMMC, QEH) and those that did not (TARH). This would suggest that the role of a sub-specialist is an important factor in increasing BCS rates. This concurs with other studies emphasizing sub-specialisation in advancing surgical practice and improving outcomes [24,25].

UMMC had the highest median age [56 years], most T4 [24.8%], Stage IV patients [19.8%], and highest rate of neoadjuvant chemo-radiotherapy [29.7%]); but the highest patient volume and reconstruction rate (13.9%). This suggests that the patients at UMMC are a more complicated subset, as evidenced by the older age and more advanced disease cohort seen here. Hence, the BCS rate is

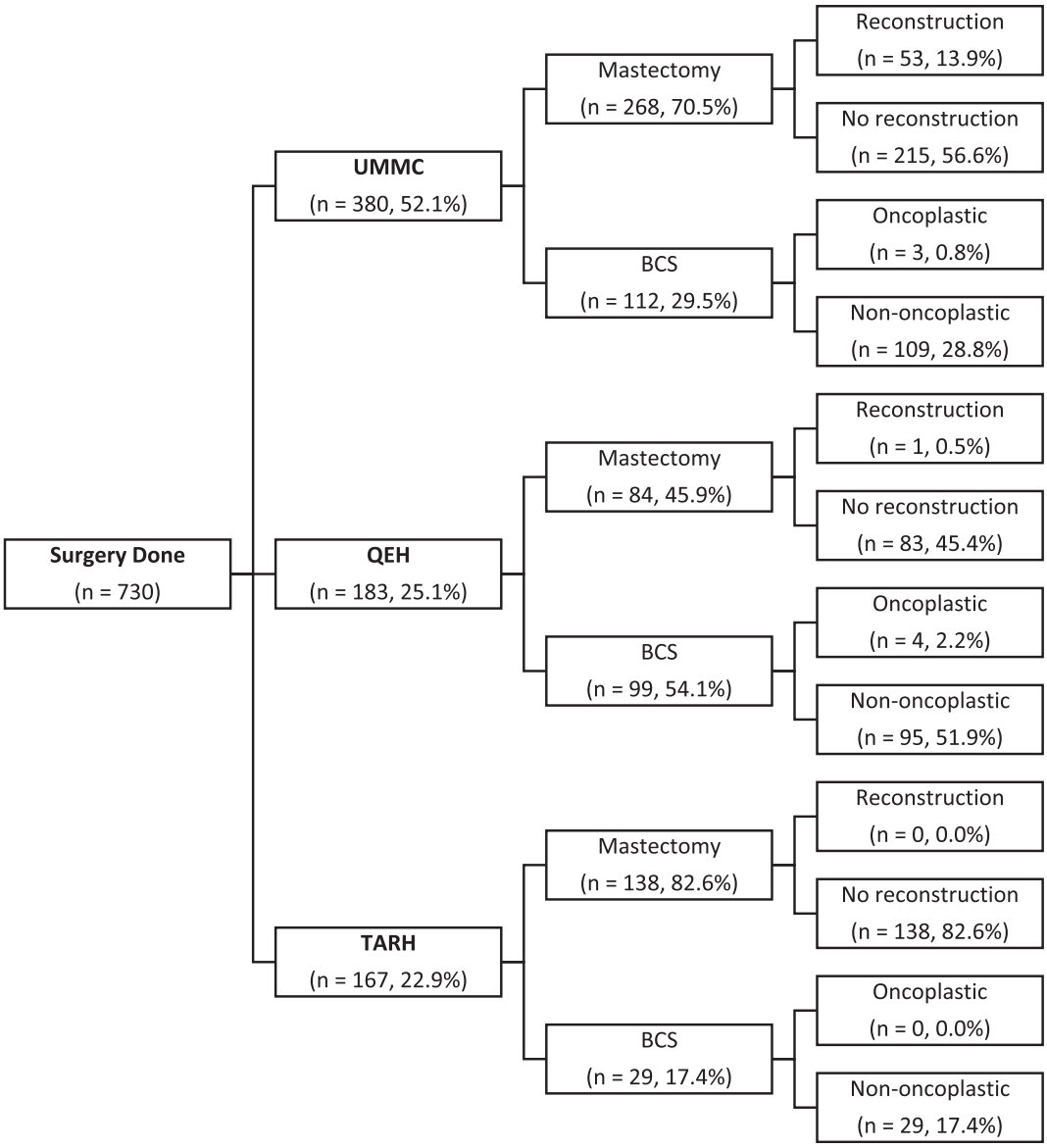

Fig. 2. Surgical procedures done (mastectomy with and without reconstruction, oncoplastic BCS, and non-oncoplastic BCS), by individual hospital.

unexpectedly lower than at QEH. The high reconstruction rate suggests that more surgical options are available when compared to the other centres.

Patients that presented to QEH were significantly younger (median 51 years). QEH also has on-site radiotherapy and oncologists. Coupled with the availability of breast sub-specialists, the rate of 54.1% is comparable to other high-resource countries in the Asia-Pacific region (Singapore 55.8%, Hong Kong 40.5%, Japan 59.3%) [22–24]. TARH had the lowest BCS rate, despite adjusting for stage and other factors. TARH is a general-surgeon led service, and lack on-site radiotherapy and oncologists. This could be the main contributing factor to the low BCS rate (17.4%).

The lack of difference in BCS rates among the younger age groups (<45 [35.3%], 45–70 [34.6%]), with the difference in mastectomy rate (<45 [38.6%], 45–70 years [63.0%]) can be explained by the fact that younger patients had more reconstructions. Both younger age groups (<45 and 45–70) had more BCS compared to the patients above 70 years old. It is reasonable to conclude that older patients would probably have more co-morbidities, and be less likely to take the risk of repeated surgery should there be margin involvement in BCS. An older patient would also be less concerned with the cosmetic effect of losing a breast as opposed to a younger patient [5,26,27].

There is a clear preference for mastectomy among Chinese patients. Although this subset of patients may have small tumours, they may not have been eligible for BCS from a technical point of view due to smaller breast volumes. Reports of cancer worry amongst Chinese patients have explored the preference for mastectomy over BCS, which include cultural opinions, lower screening participation, lack of acceptance of BCS, and a misconception that mastectomy is the only curative option [18,23,26].

An established indication for neoadjuvant chemotherapy is to downsize a tumour in preparation for BCS. Paradoxically, in our study, those who had neoadjuvant had less BCS done. In Malaysia, it is given primarily for locally advanced cancers, with the aim of rendering them operable through mastectomy.

Notably, there was a significant difference in ER/PR receptor status, HER-2 receptor expression, as well as tumour grade across

Table 3
Clinicopathological characteristics of patients by surgery type (n = 730).

Variables	Total n = 730	BCS n = 240	Mastectomy n = 436	Mastectomy + Reconstruction n = 54	
	100%	32.9%	59.7%	7.4%	p-value
Hospital					<0.001
UMMC	380	29.5%	56.6%	13.9%	
QEH	183	54.1%	45.4%	0.5%	
TARH	167	17.4%	82.6%	0.0%	
Age					
Median (min - max)	55 (16–86)	53 (25–77)	58 (16–86)	43 (24–79)	<0.001
<45	153	35.3%	38.6%	26.1%	<0.001
45-70	503	34.6%	63.0%	2.4%	
>70	74	16.2%	81.1%	2.7%	
Ethnicity					<0.001
Malay	203	31.5%	56.7%	13.3%	
Chinese	250	30.4%	62.8%	6.8%	
Indian	146	21.9%	74.0%	4.1%	
Indigenous	109	56.8%	42.2%	0.9%	
Foreigners	22	40.9%	45.5%	13.6%	
Tumour Size (in cm)					<0.001
Median (min - max)	3.0 (0.1–18.0)	2.1 (0.1–9.5)	3.1 (0.1–18.0)	3.8 (0.5–16.5)	
T-stage at Presentation					<0.001
Tis	41	70.7%	26.8%	2.4%	
T1	174	48.9%	42.5%	8.6%	
T2	349	30.9%	63.9%	5.2%	
T3	89	20.2%	71.9%	7.9%	
T4	77	0.0%	83.1%	16.9%	
AJCC Stage at Presentation					<0.001
0	41	70.7%	26.8%	2.4%	
I	141	51.8%	41.8%	6.4%	
II	311	33.4%	60.5%	6.1%	
III	169	16.6%	71.6%	11.8%	
IV	68	8.8%	83.8%	7.4%	
ER Status					0.143
Positive	507	32.5%	59.4%	8.1%	
Negative	186	30.6%	62.4%	7.0%	
NA	37	48.6%	51.4%	0.0%	
PR Status					0.053
Positive	379	34.3%	58.3%	7.4%	
Negative	313	29.1%	62.6%	8.3%	
NA	38	50.0%	50.0%	0.0%	
HER2 Status					0.002
Positive	151	21.2%	66.9%	11.9%	
Negative	457	35.9%	57.5%	6.6%	
Equivocal	86	30.2%	59.7%	7.0%	
NA	36	50.0%	50.0%	0.0%	
Bloom & Richardson Grade					<0.001
1	138	39.9%	52.9%	7.2%	
2	322	27.3%	64.6%	8.1%	
3	222	28.8%	64.0%	7.2%	
NA	48	68.8%	27.1%	4.2%	
Neoadjuvant Chemotherapy					<0.001
Yes	136	16.9%	70.6%	12.5%	
No	590	36.3%	57.5%	6.3%	
Unknown	4	75.0%	25.0%	0.0%	

Abbreviations: BCS = Breast Conserving Surgery; min = minimum; max = maximum; AJCC = American Joint Committee on Cancer; ER = estrogen receptor; PR = progesterone receptor; NA = not available.

the three hospitals. TARH had the lowest ratio of ER-positive patients (54.9%), whereas QEH had the highest number of PR-positive patients (61.2%). UMMC, on the other hand, had the highest number of patients with HER-2 receptor over expression (27.1%). While most of the tumours presented with at Grade 2, there were significant differences in their ratios across hospitals.

Within the public service in Malaysia, there are about 19 breast surgeon subspecialists, and a further 25 in private practice. Most breast cancer patients in Malaysia are managed by general surgeons, in both the public and private sector. An urgent need to produce subspecialists should be balanced with producing general surgeons to manage the bulk of cancers in the country. BCS may be seen as a luxury, but with current literature showing equal or better outcomes in breast cancer [7,11,13,28,29], coupled with behavioural factors that contribute to late presentation of breast cancer in Malaysia [30], there should be a more concerted effort to improve access to BCS. Interestingly, in this study, all 3 centres have access to radiotherapy within 20 km from the treating hospital. This is in contrast to some regions in Malaysia (E.G. East coast of the peninsula of Malaysia) that have no convenient access to radiotherapy services.

As with all studies, this study has its own limitations. Firstly, other important variables were not examined, such as (1) socio-economic status, (2) education level, (3) mode of diagnosis, (4) co-morbidities (5) marital status. These factors were described as influencing the rate of BCS [18,22,26]. In a retrospective study such as this, obtaining this data was not possible. A patient who was diagnosed via a screening MMG may be more likely to be eligible

Table 4
Multivariate Logistic Regression Results for Patients who had BCS.

Variables	Subgroups	Odds Ratio	(95% C.I.)	p-value
Hospital	UMMC	1.00	–	**ref**
	QEH	1.82	(0.83–3.98)	0.14
	TARH	0.34	(0.17–0.68)	<0.01
Age	<45	1.00	–	**ref**
	45–70	0.49	(0.27–0.89)	0.02
	>70	0.09	(0.03–0.25)	<0.01
Ethnicity	Malay	1.00	–	**ref**
	Chinese	0.41	(0.22–0.77)	<0.01
	Indian	0.52	(0.26–1.02)	0.06
	Indigenous	1.15	(0.42–3.13)	0.79
	Foreigners	1.37	(0.41–4.58)	0.61
T-stage at presentation	T1	1.00	–	**ref**
	T2	0.41	(0.20–0.87)	0.02
	T3	0.20	(0.07–0.57)	<0.01
	T4	0.00	(0.00 –)	0.99
AJCC Stage at presentation	I	1.00	–	**ref**
	II	0.72	(0.34–1.53)	0.39
	III	0.33	(0.14–0.81)	0.02
ER	Negative	1.00	–	**ref**
	Positive	0.69	(0.34–1.40)	0.30
PR	Negative	1.00	–	**ref**
	Positive	1.17	(0.64–2.14)	0.62
HER2	Negative	1.00	–	**ref**
	Positive	0.38	(0.19–0.76)	<0.01
	Equivocal	0.41	(0.20–0.82)	0.01
Grade	1	1.00	–	**ref**
	2	1.03	(0.58–1.84)	0.93
	3	0.98	(0.51–1.89)	0.96
Neoadjuvant	No	1.00	–	**ref**
	Yes	0.74	(0.36–1.5)	0.40

Abbreviations: BCS = Breast Conserving Surgery; min = minimum; max = maximum; AJCC = American Joint Committee on Cancer; ER = estrogen receptor; PR = progesterone receptor; NA = not available.

for BCS as the tumour size would be smaller. However, population-based screening is not practiced in Malaysia, whereas opportunistic screening exists in pockets [31], and may be affected by socioeconomic status [32], education level [33], and availability of subsidies [34]. Patients who had significant co-morbidities would be expected to undergo a mastectomy as opposed to a BCS, to reduce the risk of repeated surgery in the event of positive tumour margins [35].

Breast-to-tumour volume, an important consideration for BCS and oncoplastic surgery, was not assessed in this study. Although clinical judgement is sufficient to decide on BCS, tumour-to-breast volume would be best objectively assessed via a breast MRI, as opposed to MMG [36,37]. Breast MRIs are not routinely performed on all patients undergoing BCS [38], as the costs involved would be very high. A prospective trial to evaluate breast-to-tumour volume via MRI and correlations with the surgeon's clinical judgement on feasibility of BCS can be performed. The BRCA gene testing results are not available in this study. As the BRCA gene mutation is a relative contraindication for BCS, knowing this variable would likely influence the rate of BCS [39–41]. However, BRCA testing was not routinely offered at the sampled centres, hence, treatment-focused genetic testing was not a factor in treatment decisions in this study.

Although the initial sample group of 1005 patients was reduced to 730 in the final analysis, this still provided a sizable sample. The sampled centres showed a variety of services provided in Malaysia, providing a broad overview of breast cancer care in Malaysia, and gives information on current practices.

5. Conclusion

Breast-Conserving Surgery is a well-established treatment modality for early breast cancer, and should be offered to all eligible women diagnosed with early-stage tumours. The rate to which it is practiced varies between centres, even within the same country and state. In this study, hospitals with breast surgeon-led services, on-site oncological services, age, ethnicity, tumour size, and stage of presentation are independent predictors of BCS rate. Chinese women were more likely to have mastectomy.

Patients who do not have contra-indications for BCS should be offered BCS given the equal outcomes. Given the large volume of work for breast cancer, general surgeons still play a major role in treating breast cancer, however, a referral pathway should be in place to refer those suitable for BCS to a breast sub-specialist surgeon.

Conflicts of interest

There are no conflicts of interest by the authors.

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Ethical approval

This study was registered and approved with the Malaysian National Medical Research Registry (NMRR ID Number: 17-1056-35007 IR). Ethical approval was obtained from the UMMC Medical Ethics Committee (UMMC MECID Number: 2016719-4028) and the Medical Research and Ethics Committee of Malaysia (Ref: (5)KKM/NIHSEC/P17-1215).

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.breast.2019.05.016.

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