Clinical Oncology xxx (2017) 1–8

Contents lists available at ScienceDirect

Clinical Oncology

journal homepage: www.clinicaloncologyonline.net

Original Article

Breast Cancer Incidence and Predictors of Surgical Outcome: a Nationwide Longitudinal Study in Taiwan

Hong-Tai Chang *†, Hon-Yi Shi †‡§, Being-Whey Wang *, Shu-Chuan Jennifer Yeh †§

* *Division of General & Gastroenterological Surgery, Department of Surgery, Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan, Republic of China*
† *Department of Business Management, National Sun Yat-sen University, Kaohsiung 80607, Taiwan, Republic of China*
‡ *Department of Healthcare Administration and Medical Informatics, Kaohsiung Medical University, Kaohsiung 80708, Taiwan, Republic of China*

Received 24 May 2016; received in revised form 30 November 2016; accepted 6 December 2016

Abstract

Aims: Despite the huge and growing global burden of patients who require breast cancer surgery, high-quality population-based studies of breast cancer trends and outcomes are scarce. The purpose of this study was to explore the incidence of breast cancer and predictors of hospital resource utilisation, mortality and recurrence in a nationwide population of patients who have received surgery.
Materials and methods: This retrospective study analysed trends and outcomes in a Taiwan population of 77 971 patients after breast cancer surgery during 1996–2010. The Cox proportional hazards model was used for multivariate assessment of both mortality and recurrence predictors.
Results: The data analysis indicated that, during this period, the estimated mean hospital treatment cost and mean length of stay increased by 16.3% and 53.4%, respectively. The estimated mean overall survival time was 138.9 months (standard deviation 0.3 months) and the overall 1, 3, 5 and 10 year survival rates were 97.3, 89.2, 82.2 and 70.1%, respectively. The estimated mean overall recurrence time was 10.8 months (standard deviation 0.2 months) and the overall 1, 3, 5 and 10 year recurrence rates were 0.1, 18.8, 26.6 and 36.0%, respectively. Outcomes were significantly associated with age, Deyo-Charlson comorbidity index score, surgeon seniority, hospital volume, surgeon volume, surgery type, hospital level and baseline comorbidities ($P < 0.001$).
Conclusions: Analyses of these population-based data revealed simultaneous increases in the standard incidence of breast cancer surgery and its associated medical resource utilisation. Notably, healthcare providers and patients should recognise that both patient attributes and hospital attributes may affect breast cancer surgery outcomes.

Key words: Breast cancer; hospital resource utilisation; mortality rate; recurrence rate surgery; trends

Introduction

Breast cancer is the most common cancer type in women. Globally, breast cancer comprises 23% of cancer cases and causes 14% of all cancer-related deaths in women [1]. Incidence rates are higher in Western countries than in Asia, but an estimated 50% of all cases and 60% of related deaths occur in economically developing countries [1]. In the USA, about 27% of either non-invasive or invasive breast cancers occur in women younger than 50 years [2]. In Taiwan, the age-standardised incidence rate of female breast cancer per 100 000 persons has steadily increased from 12.8 during 1890–1984 to 44.5 during 2000–2006 [3]. However, predicting the healthcare service utilisation and mortality rates associated with breast cancer is difficult because of its widely varying rate and extent of recovery. Additionally, although breast cancer patients consume substantial medical resources, their outcomes tend to be poor, especially in the rapidly growing elderly population.

However, most studies of breast cancer patients who have received have only analysed a single medical institution, which may not enable objective estimates of trends

Author for correspondence: Shu-Chuan Jennifer Yeh, Department of Business Management, 70 Lienhai Rd, National Sun Yat-sen University, Kaohsiung 80607, Taiwan, Republic of China. Tel: +886-7-3211101x2758; Fax: +886-7-3137487.
E-mail address: hshi@kmu.edu.tw (S.-C.J. Yeh).
§ Equal contributors.

http://dx.doi.org/10.1016/j.clon.2017.01.005
0936-6555/

and outcomes [4,5]. Furthermore, although many studies have evaluated outcomes of breast cancer surgery, few longitudinal studies have exceeded 10 years, and most published data have been limited to populations in the USA or in Organization for Economic Co-operation and Development (OECD) countries [4–6]. Additionally, one study has carried out hierarchical linear regression and propensity score matching to evaluate the use of hospital and surgeon volume for predicting breast cancer surgery costs [7]. Very few studies of breast cancer surgery patients have carried out longitudinal analyses of survival and temporal trends in hospital resource utilisation, mortality rate and recurrence rate, and none has systematically evaluated associations with these outcomes in this patient group [7–9].

Providing effective medical care for breast cancer surgery patients is challenging and requires good planning and effective clinical decision making policies. Thus, the aim of this cohort study was to explore the incidence of breast cancer and predictors of hospital resource utilisation, mortality and recurrence in a nationwide population of patients who have received surgery for breast cancer.

Materials and Methods

Patients were recruited by reviewing monthly patient discharge data released by the Bureau of National Health Insurance (BNHI). The NHI programme is a mandatory single-payer health insurance programme that covers almost 100% of the residents of Taiwan [10]. This unified reimbursement system includes outpatient clinic and inpatient hospitalisation services provided by both the private and public sectors. All medical claims are submitted and recorded electronically [11]. The recruitment criterion was an International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) diagnosis code for breast cancer (174.XX). Each discharge record contained up to 15 of the procedure codes listed in the ICD-9-CM. These codes were used to identify the surgery type as well as the indications for surgery (see Table 1 for the categories of procedure codes used in the study). After excluding duplicate patients during the study period, 435 829 breast cancer patients were initially eligible for recruitment. After further excluding patients who had not received surgery for breast cancer ($n = 354\,255$), patients with incomplete data ($n = 3594$) and patients younger than 18 years ($n = 9$), the final study sample included 77 971 patients who had received breast cancer surgery between 1 January 1996 and 31 December 2010.

The unit of analysis in this study was the individual breast cancer surgery patient. The characteristics of the study patients were expressed in terms of sample size (percentage) or median (interquartile range). The study period was divided into three equal time intervals (time period 1: 1996–2000; time period 2: 2001–2005; and time period 3: 2006–2010). Originally proposed by Charlson *et al.* in 1987, and then modified in 1992, the Deyo-Charlson comorbidity index (CCI) assigns a score to various chronic medical conditions and uses the sum to predict long-term outcomes [12]. Odds ratios and 95% confidence intervals were determined to assess the changing trend in each covariate when using time period 1 as the reference group in comparison with time period 3. The adjusted incidence rates were further standardised by age and gender (all breast cancer patients were women) using the direct method based on the 2000 World Health Organization world standard population [13]. An analysis of the crude and adjusted incidence rates was carried out to obtain the Poisson rate.

Table 1
Patient characteristics ($n = 77\,971$)

Variables	Number	%
Year		
T1 (1996–2000)	18 114	23.2
T2 (2001–2005)	25 335	32.5
T3 (2006–2010)	34 522	44.3
Age group (years) (mean [interquartile range])	50.5 [43.9–59.6]	
<65	64 647	83.0
65–74	9315	11.9
≥75	4009	5.1
Deyo-Charlson comorbidity index (score) (mean [interquartile range])	0 [0–6]	
0	50 183	64.4
1–5	4735	6.0
≥6	23 053	29.6
Surgery type		
MRM	59 719	76.6
BCS	15 779	20.2
Reconstruction	2473	3.2
Chemotherapy		
Yes	50 993	65.4
Radiotherapy		
Yes	37 270	47.8
Hospital level		
Medical centre	45 927	58.9
Regional hospital	28 077	36.0
District hospital	3967	5.1
Endocrine, nutritional, and metabolic diseases; immunity disorders		
Yes	5576	7.2
Circulatory system diseases		
Yes	9279	11.9
90 day mortality rate		
Death	374	0.5
5 year mortality rate		
Death	10 582	13.6

	Mean	Standard deviation
Mean age (years)	52.2	11.9
Deyo-Charlson comorbidity index (score)	1.9	2.8
Surgeon seniority (years)	12.7	5.1
Hospital volume (cases/year)	54.7	44.3
Surgeon volume (cases/year)	15.2	16.8
Length of stay (days)	5.8	5.0
Hospital treatment cost (US dollars)	1768.20	890.90

MRM, modified radical mastectomy; BCS, breast-conserving surgery.

Please cite this article in press as: Chang H-T, et al., Breast Cancer Incidence and Predictors of Surgical Outcome: a Nationwide Longitudinal Study in Taiwan, Clinical Oncology (2017), http://dx.doi.org/10.1016/j.clon.2017.01.005