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ARTÍCULO ORIGINAL

Surgical site infection after breast cancer surgery at 30 days and associated factors

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Abstract

Background: The incidence of surgical site infection (SSI) in breast surgery has been higher than expected, considering this is a clean surgical procedure. Few studies have reported an incidence of less than 5.0% and most publications report an incidence of between 10.2% and 30.0%.
Objective: To estimate the incidence, associated factors and interval free from infection at 30 days postsurgery in women who underwent oncological and reconstructive breast surgery. *Methods:* Prospective cohort study of women with breast cancer who underwent conservative or radical breast surgery at a reference medical center in Medellín, Colombia. The outcomes were SSI and time to the event. The survival analysis of freedom from infection was performed using the Kaplan Meier method and the Cox proportional hazard model for multivariate analysis.
Results: Of the 308 consecutive surgical breast oncology procedures performed, 161 (52.3%) were quadrantectomies and 147 (47.7%) were mastectomies, with an SSI incidence of 16.2% (50 cases). The associated risk factors were seroma-hematoma, which occurred in 79 (25.6%) cases, hazard ratio (HR) 2.7 (95% CI 1.5-4.9); and the presence of drainage devices, HR 5.6 (95% CI 2.2-14.3). The median time to the development of SSI was 16 days.
Conclusion: Our study shows that the presence of postoperative seroma-hematoma and long-term drainage device use were independent risk factors for SSI in oncological breast surgery.

Keywords: Breast cancer; Cross infection; Surgical wound infection

Infección del sitio operatorio en cirugía oncológica de mama a 30 días y factores asociados

Resumen

Antecedentes: La incidencia de infección del sitio operatorio (ISO) en cirugía de mama ha sido mayor de lo esperado, considerando este como un procedimiento quirúrgico limpio. Pocos estudios han reportado una incidencia menor del 5,0% y la mayoría de publicaciones la ubican entre 10,2 y 30,0%.
Objetivo: Estimar la incidencia, los factores asociados y el intervalo libre de infección a 30 días, en las mujeres que se sometieron a cirugía oncológica y reconstructiva de mama.
Métodos: Estudio de cohorte prospectivo en mujeres con cáncer de mama, que se sometieron a cirugía de mama conservadora o radical en un centro médico de referencia de Medellín, Colombia. Los resultados fueron infección del sitio operatorio y tiempo al evento. El análisis de supervivencia libre de infección se realizó con el método de Kaplan Meier y el modelo multivariado de riesgos proporcionales de Cox.
Resultados: Seguimiento a 308 procedimientos quirúrgicos oncológicos de mama consecutivos; 161 (52,3%) fueron cuadrantectomías y 147 (47,7%) mastectomías, con una incidencia de ISO de 16,2% (50 casos). Los factores de riesgo asociados fueron: seroma-hematoma 79 (25,6%), HR 2,7 (IC 95%: 1,5; 4,9) y la presencia de dispositivos de drenaje, HR 5,6 (IC 95% 2,2; 14,3). El tiempo medio para el desarrollo de SSI fue de 16 días.
Conclusión: Nuestro estudio mostró que la presencia de seroma hematoma posoperatorios y el uso extendido de dispositivos de drenaje fueron factores independientes para la presentación de infección del sitio operatorio en cirugía oncológica de mama.

Palabras clave: Cáncer de mama; Infección asociada a la atención en salud; Infección del sitio operatorio

Introduction

Breast cancer represents 10% of new cancer events in the world every year[1]; It is the main cause of mortality in women between 35 and 64 years old.[2] In Colombia, it is the second malignant tumor in women and causes 1,700 deaths yearly.[3] Mastectomy, quadrantectomy and lymphadenectomy are the most frequent procedures in breast oncology surgery.[4,5]

Reported incidences of surgical site infection (SSI) vary between 10.2% and 30.0% and are higher than those of other clean surgeries (2.07%-3.9%).[4,6-13] The incidence of SSI in breast surgeries with prosthesis range between 2.5 and 30.0%.[14]

Our study estimates the incidence, associated factors and time freedom of infection at 30-days after breast oncology surgery with or without immediate reconstruction.

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Recibido: 09/03/2016; Aceptado: 26/04/2016

Please cite this article in press as: Gil-Londoño J-C, et al. Surgical site infection after breast cancer surgery at 30 days

Methods

This was a prospective cohort study of 308 patients with breast oncology surgeries at Clínica Las Américas, Medellín Colombia, between August and December 2011. The procedures were radical (complete mastectomy with or without axillary lymphadenectomy, and with or without immediate reconstruction), or conservative (quadrantectomy, tumorectomy).

Inclusion Criteria: Women 18 years old or older who underwent elective breast oncology surgery, with or without immediate reconstruction.

Exclusion Criteria: Active breast infection at or near the intended surgical area at time of surgery.

The post-operative follow up was conducted by a trained team of physicians and nurses and begun with a medical examination in the first week after surgery; patients had additional medical and nursing controls if they needed; at 30 days after the procedure, patients had a telephone follow up with a pre-structured format and a new medical control was schedule when it was necessary.

Data collecting instruments had three moments: pre-operative evaluation, intra-operative follow up and post-operative follow up. The researchers did not modify the routine patient medical care. Socio-demographic variables were evaluated (age, socioeconomic status, educational level, type of health insurance); medical and surgical history, comorbidities and previous treatments; current procedure data including antibiotic prophylaxis (if was indicated), surgery executed, type of surgical wound, duration of surgery in minutes and use of drainage devices. The post-operative follow up included medical evaluation, wound healing, antibiotic use, drainage device used (in days), hospital readmission, surgical re-interventions related to the index procedure, presence of seroma-hematoma and SSI.

The adequate prophylactic antibiotic treatment was defined as the administration of cefazoline, clindamycin or vancomycin, 15-60 min before surgical incision, according to our institutional protocol.

The study was approved by the Bioethics Committee of University of Antioquia and the Research Ethics Committee of Clínica Las Américas.

The primary outcome was SSI cases, defined according to the criteria of the Centers for Disease Control, version 2008.[8] And secondary outcomes were seromas and hematomas diagnosed by attending physicians.

Statistical analysis

Qualitative variables were described by proportions and its independency relationships were established with Chi-square test. For quantitative variables, the mean, measures of central tendency and mean differences were determined. The Relative Risk (RR) was calculated for the incidence of SSI, according to type of surgery. Confusion and interaction were also evaluated. Cox proportional-hazards regression model was used to estimate the Hazard Ratios (HR) of SSI by the stepwise method, when the Log Rank Test *p* value was <0.25. The time to event was the number of days between surgical intervention until first infection symptoms in a range of 30 days postoperative. Deaths unrelated to SSI and losses of follow up were considered as censures. The statistical analysis was performed using the PASW Statistics (SPSS Inc., Version 18.0. Chicago: SPSS Inc).

Results

The SSI rate was 16.2% (50/308); the infection was classified as superficial in 36 cases (11.7%), deep in 14 (4.5%) and none organ/space SSI (Fig. 1). The median time to SSI diagnosis after surgical intervention was 16 days (IQR: 10-22). Nine of 40 patients with immediate breast reconstruction were diagnosed with SSI (22.5%).

There were no significant differences in socio-demographic variables among the patients (Table 1). Previous history of breast surgery was present in 63 women (20.5%), diabetes mellitus in 34 (11%) and obesity/overweight in 161 (52.3%). The delimitation of surgical field was performed in 211 patients (69%) employing sentinel lymph node in 130 (61.6%), sentinel node plus

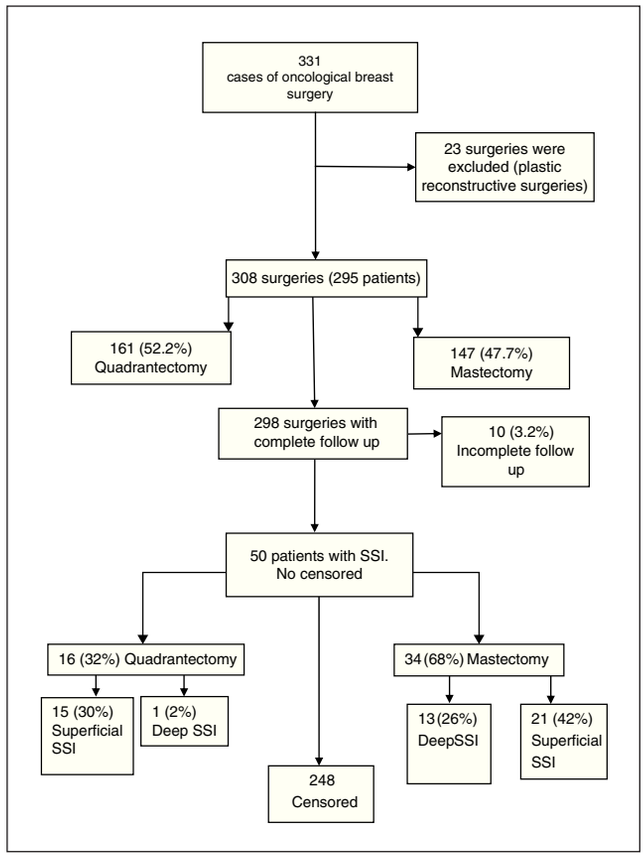

Figure 1. Cohort of breast cancer surgery. Clinica Las Americas, Medellin, Colombia 2011-2.

Table 1. Baseline characteristics.

	Variable	Mastectomy n (%)	Quadrantectomy n (%)	Overall (%)	*p*
Surgery	Patients	147 (47.7)	161 (52.3)	308 (100.0)	
Socioeconomic status	Low SES and high middle SES	111 (78.1)	112 (71.3)	223 (74.6)	0.17
	High SES	31 (21.8)	45 (28.6)	76 (25.4)	
BMI	Underweight	5 (3.4)	2 (1.25)	7 (2.3)	0.359
	Overweight	50 (34.9)	55 (34.3)	105 (34.6)	
	Obese	22 (15.3)	34 (21.2)	56 (18.4)	
	Normal	66 (46.1)	69 (43.1)	135 (4.5)	
Diabetes mellitus	Yes	16 (10.8)	18 (11.1)	34 (11.0)	0.934
	No	131 (89.1)	143 (88.8)	274 (88.9)	
Previous radiotherapy	Yes	8 (5.4)	5 (3.1)	13 (4.2)	0.308
	No	139 (94.5)	156 (96.8)	295 (95.8)	
Previous chemotherapy	Yes	26 (17.6)	14 (8.6)	40 (12.9)	0.019
	No	121 (82.3)	147 (91.3)	268 (87.0)	
Educational level	<=5 years of academic education	87 (61.2)	90 (58.0)	177 (59.5)	0.57
	>5 years of academic education	55 (38.7)	65 (41.9)	120 (40.4)	
Adequate antibiotic prophylaxis	No	34 (23.1)	34 (21.1)	68 (22.0)	0.671
	Yes	113 (76.8)	127 (78.8)	240 (77.9)	
Type of surgery	With reconstructive surgery	38 (25.8)	2 (1.2)	40 (12.9)	<0.01
	W/O reconstructive surgery	109 (74.1)	159 (98.7)	268 (87.0)	
Surgeon specialty	Oncologist	76 (51.7)	90 (55.9)	166 (53.8)	0.263
	Gynecologist	2 (1.3)	6 (3.7)	8 (2.5)	
	Mastologist	69 (46.9)	65 (40.3)	134 (43.5)	
Axillary limph node clearance	Yes	82 (55.7)	31 (19.2)	113 (36.7)	<0.01
	No	65 (44.2)	130 (80.7)	195 (63.3)	
Skin antiseptic cleanser	Iodine antiseptic	112 (76.1)	120 (74.5)	232 (75.3)	0.73
	Chlorhexidine	35 (23.8)	41 (25.4)	76 (24.7)	
Seroma or hematoma	Yes	41 (27.8)	38 (23.6)	79 (25.6)	0.38
	No	106 (72.1)	123 (76.3)	229 (74.4)	
Use of drainage systems	Yes	146 (81.1)	34 (18.8)	180(58.4)	<0.01
	No	1 (0.78)	127 (99.2)	128 (41.5)	
Type of drain	Hemovac	132 (90.4)	33 (97.0)	165 (91.6)	<0.01
	Jackson Prat	14 (9.5)	1 (2.9)	15 (8.3)	
SSI	Yes	34 (23.1)	16 (9.9)	50 (16.2)	0.002
	No	113 (76.8)	145 (90.0)	258 (83.8)	

self-retaining anchor wire in 55 (26.1%) and only self-retaining anchor wire in 26 (12.3%). Antibiotic prophylaxis was administered to 307 patients (99.7%), it was adequate in 77.9%; no differences were found between types of surgery. The overall median time of surgery length was 90 min, interquartile ranges (IQR) 65-120; for conservative surgery it was 70 min (IQR: 55-97.5), and for radical surgery, 115 min (IQR: 85-135).

Postoperative hospitalization was one day in 199 (64.6%). The median time until the first medical evaluation after hospital discharge was 9 days, (IQR): 8-16.

The postoperative follow up was performed by a physician in 217 patients (70.1%), by a physician and a nurse in 58 (18.8%) and by a nurse alone in 12 (3.9%). All patients were alive at the end of follow up.

Twelve patients had readmission (3.89%) due to SSI, with a median readmission time after surgery of 18 days.

Drains in situ were used during a median of 16 days (IQR: 12-22). Seromas-hematomas were detected in 79 cases (25.6%) and of these, 33 (41.8%) were drained. Inadequate manipulation of drain in situ was observed in 12.2% of cases.

The axillary node clearance was a risk factor in the bivariate analysis, RR 2.8 (95% CI: 1.67-4.74; *p* value <0.01), but it was not statistically significant in the multivariable model. The delimitation of surgical field was a protective factor in the bivariate analysis, RR: 0.49 (95% CI: 0.3-0.82; $p = 0.006$) (Table 2).

In patients with prolonged postoperative drain device SSI was higher than those without drainage, HR: 5.6 (95% CI

2.2-14.3, $p < 0.000$). The infection proportion with sili-cone suction drain (Jackson Pratt®) was 6.7% versus 27.0% with polyvinyl suction drain (Hemovac®) and it was higher in patients with seroma-hematoma, HR: 2.7 (95% CI: 1.55-4.96, $p < 0.001$) (Fig. 2).

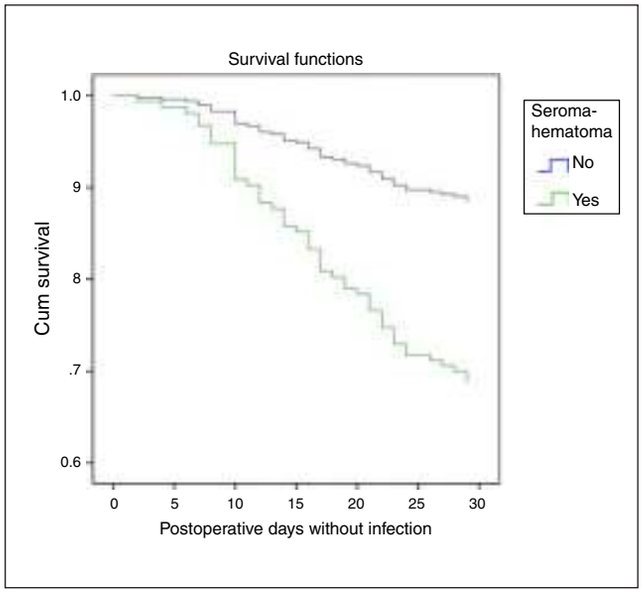

Figure 2. Seroma-hematoma versus time without infection.

Discussion

SSI is one of the most important complications of breast oncology surgery that frequently occurs after patient discharge. In this study the most important risk factors were prolonged postoperative drain device and seroma-hematoma.[4,9,10]

The persistence of a drain in situ was a risk fac-tor for SSI. The extended persistence of drains, washing tubes to remove fibrin clots, connection and disconnection of proximal tubes without standardized aseptic practices increase the risk of infection.[4,11-14] Some authors recommend removal of the drain when drainage volume becomes less than 30-50 ml/day during 48 h; others recommend their removal at fixed time intervals (5-7 days); in our study, the median time of drainage was 16 days[4,7,14-18]. Future studies should be directed to remove the drain in less time.

In the postoperative period, the most frequent complications in breast oncology surgery were seroma-hematoma formation, with higher risk of SSI for seroma and for hematoma, increased the mortality and length of hospital stay.[12,19] In our study, postoperative seroma-hematoma incidence was 25.6% while in others it ranged from 18% to 59%.[6,14,15,20-22] A case-control study showed that seroma-hematoma puncture and drainage were risk factors for SSI.[20]

The risk of developing SSI was significantly higher for mastectomies vs conservative surgeries in our study; other reports showed SSI incidences of 38.3% and 18% respectively.[11] Studies with one year follow up in breast surgeries with immediate reconstruction reported similar incidences of SSI (2.5-30%).[6-8]

Wire localization delimitation of the surgical field and radiocoloid injection before surgery showed a protective association; the limitation of intervention area decreases the risks of postoperative adverse events. The axillary node lymphadenectomy showed statistical differences in the development of infection. These findings are similar to other published reports.[14-23]

Follow-up was completed in a high proportion of patients, this is strength and it was possible compared preoperative, intraoperative and postoperative risk factor.

The most important risk factors mentioned in the literature were evaluated. Next studies should appraise shaving of patients at home and their relationship with SSI. The strengthening of postoperative epidemiological surveillance systems, the use of silicone drains and sterile techniques to manipulation of tube[11,13,14] are practical tools to evaluate the reduction in seroma-hematoma formation and drain time in other studies.

In conclusion, our study shows that presence of postoperative seroma-hematoma and long time drain device were independent risk factors for SSI on oncology breast surgery. These results should encourage further studies on tools to help remove the drains in less time and avoid the formation of seromas and hematomas.

Ethical disclosures

Protection of people and animals. The authors state that for this investigation have not been performed experiments on humans or animals.

Confidentiality of data. The authors declare that they have followed the protocols of the workplace on the publication of patient data.

Right to privacy and informed consent. The authors declare that this article does not appear patient data.

Funding

This work was funded by The Sustainability Strategy 2013-2014, University of Antioquia.

Conflict of interest

The authors have no conflict of interest to declare.

Acknowledgments

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Table 2. SSI in breast cancer surgery - bivariate analyses.

	Variable	SSI n = 50 (% incidence)	Overall *n* = 308	Value *p*	RR (IC 95%)
Socioeconomic status	Middle SES and low SES	40 (81.6)	223	0.2151	1.51 (0.77-2.97)
	High SES	9 (18.3)	76		
Mellitus diabetes	Yes	8 (16.0)	34	0.22	1.50 (0.78-2.99)
	No	42 (84)	274		
BMI	Obesity	12 (21.4)	56	0.2	1.52 (0.79-2.92)
	Overweight	17 (16.2)	105	0.64	1.15 (0.62-2.10)
	Thinness	1 (14.3)	7	0.41	0.46 (0.06-3.27)
	Normal	19 (14.4)	132		
Educational level	<=5 years of academic education	28 (59.5)	177	0.99	0.99 (0.58-1.70)
	>5 years of academic education	19 (40.4)	120		
Surgery	Mastectomy	34 (68.0)	147	0.001	2.32 (1.34-4.03)
	Cuadrantectomy	16 (32.0)	161		
Delimitation of surgical field	Yes	26 (52.0)	211	0.006	0.49 (0.30-0.82)
	No	24 (48.0)	97		
Axillary node clearance	Yes	31 (62.0)	113	<0.01	2.81 (1.67-4.74)
	No	19 (38.0)	195		
Hair removal	Yes	4 (8.0)	16	0.32	1.50 (0.65-3.86)
	No	46 (92.0)	292		
Skin antiseptic cleanser	Iodine antiseptic	38 (76.0)	232	0.9	1.03 (0.57-1.88)
	Chlorhexidine	12 (24.0)	76		
Timing of antibiotic prophylaxis	Intraoperative	1 (0.5)	4	0.0017	1.77 (0.29-10.65)
	>61 min after starting surgery	12 (24.0)	53	0.21	1.60 (0.75-3.43)
	30 min before surgery	10 (20.0)	71		
	Between 31 and 60 min before surgery	27 (54.0)	179	0.84	1.07 (0.54-2.09)
Adequate antibiotic prophylaxis	No	15 (30.0)	68	0.14	1.51 (0.88-2.59)
	Yes	35 (70.0)	240		
Use of drainage systems	Yes	45 (90.0)	178	<0.01	6.57 (2.68-16.09)
	No	5 (10.0)	130		
Manipulation of drainage systems	Yes	11(24.4)	22	<0.01	2.26 (1.35-3.78)
	No	34(75.5)	154		
Seroma or hematoma	Yes	25 (50.0)	79	<0.01	2.80 (1.77-4.74)
	No	25 (50.0)	229		
Seroma drainage	Yes	15(60.0)	35	0.05	1.88 (0.96-3.66)
	No	10(40.0)	44		
Surgeon specialty	Oncologist	31 (62.0)	166	0.29	1.31 (0.78-2.22)
	Gynecologist	0 (0.0)	8	0.79	0.78 (0.11-5.20)
	Mastologist	19 (38.0)	134		

References

1. Cunningham M, Bunn F, Handscomb K. Prophylactic antibiotics to prevent surgical site infection after breast cancer surgery. Cochrane Database Syst Rev. 2006;(2):CD005360. Review. Update in: Cochrane Database Syst Rev. 2012;1:CD005360.
2. Elias S, Contreras A, Llanque C. Cáncer o carcinoma de mama. Rev Pacena˜ Med Fam. 2008;5:14-23.
3. Molano M. Factores pronósticos del cáncer de mama. Una mirada hacia el futuro. Rev Colomb Cancerol [Inter-net]. 2007;11. Available from: http://www.cancer.gov.co/ contenido/contenido.aspx?catID=437&conID=788&pagID=921
4. Fellipe W, Werneck G, Santoro G. Surgical site infection among women discharged with a drain in situ after breast cancer surgery. World J Surg. 2007;12:2293-9.
5. Olsen MA. Hospital-associated costs due to surgical site infec-tion after breast surgery. Arch Surg. 2008;143:53.
6. Mortenson MM, Schneider PD, Khatri VP, Stevenson TR, Whetzel TP, Sommerhaug EJ, et al. Immediate breast recon-struction after mastectomy increases wound complications: however initiation of adjuvant chemotherapy is not delayed. Arch Surg. 2004;139:988-91.
7. Francis SH, Ruberg RL, Stevenson KB, Beck CE, Ruppert AS, Harper JT, et al. Independent risk factors for infection in tissue expander breast reconstruction. Plast Reconstr Surg. 2009;124:1790-6.
8. Horan T, Andrus M, Dudeck M. CDC/NHSN surveillance def-inition of health care-associated infection and criteria for specific types of infections in the acute care setting. CDC. 2008;36:309-32.
9. Sorensen LT, Horby J, Friis E, Pilsgaard B, Jorgensen T. Smoking as a risk factor for wound healing and infection in breast cancer surgery. Eur J Surg Oncol. 2002;28:815-20.

10. Medina-Cuadros M, Sillero-Arenas M, Martínez-Gallego G, Delgado-Rodríguez M. Surgical wound infections diagnosed after discharge from hospital: epidemiologic differences with in-hospital infections. Am J Infect Control. 1996;24:421-8.
11. Vilar-Compte D, Jacquemin B, Robles-Vidal C, Volkow P. Surgical site infections in breast surgery: case-control study. World J Surg. 2004;28:242-6.
12. Vilar-Compte D, Rosales S, Hernandez-Mello N, Maafs E, Volkow P. Surveillance, control, and prevention of surgical site infections in breast cancer surgery: a 5-year experience. Am J Infect Control. 2009;37:674-9.
13. Vilar-Compte D, Roldán-Marín R, Robles-Vidal C, Volkow P. Sur-gical site infection (SSI) rates among patients who underwent mastectomy after the introduction of SSI prevention policies. Infect Control Hosp Epidemiol. 2006;27:829-34.
14. Gupta R, Pate K, Varshney S, Goddard J, Royle GT. A comparison of 5-day and 8-day drainage following mastectomy and axillary clearance. Eur J Surg Oncol. 2001;27:26-30.
15. Athey N, Gilliam AD, Sinha P, Kurup VJ, Hennessey C, Leaper DJ. Day-case breast cancer axillary surgery. Ann R Coll Surg Engl. 2005;87:96-8.
16. Purushotham AD, McLatchie E, Young D, George WD, Stallard S, Doughty J, et al. Randomized clinical trial of no wound drains and early discharge in the treatment of women with breast cancer. BJS. 2002;89:286-92.
17. Talbot ML, Magarey CJ. Reduced use of drains following axillary lymphadenectomy for breast cancer. ANZ J Surg. 2002;72:488-90.
18. Throckmorton AD, Boughey JC, Boostrom SY, Holifield AC, Stobbs MM, Hoskin T, et al. Postoperative prophylactic antibi-otics and surgical site infection rates in breast surgery patients. Ann Surg Oncol. 2009;16:2464-9.
19. Chow L, Loo W. Factors predicting seroma formation after mastectomy for Chinese breast cancer patients. Indian J Cancer. 2007;44:99.
20. Brewer VH, Hahn KA, Rohrbach BW, Bell JL, Baddour LM. Risk factor analysis for breast cellulitis complicating breast conservation therapy. Clin Infect Dis. 2000;31:654-9.
21. Ulusoy AN, Polat C, Alvur M, Kandemir B, Bulut F. Effect of fibrin glue on lymphatic drainage and on drain removal time after modified radical mastectomy: a prospective randomized study. Breast J. 2003;9:393-6.
22. Purushotham AD, McLatchie E, Young D, George WD, Stallard S, Doughty J, et al. Randomized clinical trial of no wound drains and early discharge in the treatment of women with breast cancer. Br J Surg. 2002;89:286-92.
23. Lucci A, McCall LM, Beitsch PD, Whitworth PW, Reintgen DS, Blumencranz PW, et al. Surgical complications associated with sentinel lymph node dissection (SLND) plus axillary lymph node dissection compared with SLND alone in the American College of Surgeons Oncology Group Trial Z0011. J Clin Oncol. 2007;25:3657-63.