Samuli Paajanti

APPROPRIATENESS OF SURGICAL ANTIBIOTIC PROPHYLAXIS IN MASTECTOMY FOR BREAST CANCER SURGERY

Syventävien opintojen kirjallinen työ

Kevätlukukausi 2019

Samuli Paajanti

APPROPRIATENESS OF SURGICAL ANTIBIOTIC PROPHYLAXIS IN MASTECTOMY FOR BREAST CANCER SURGERY

Kliininen laitos

Kevätlukukausi 2019

Vastuuhenkilö: Salvatore Giordano

TURUN YLIOPISTO
Lääketieteellinen tiedekunta

Paajanti Samuli:
APPROPRIATENESS OF SURGICAL ANTIBIOTIC PROPHYLAXIS IN MASTECTOMY FOR BREAST CANCER SURGERY

Syventävien opintojen kirjallinen työ, 18 s.
Kirurgia
Huhtikuu 2019

Surgical site infections (SSI) affect 5 – 28 % of the patients who undergo breast surgery. In worst cases SSI can cause sepsis, delay of oncological treatments or death. Antibiotic prophylaxis (AP) is often used in these operations to reduce the risk of SSI's, even though the research data is somewhat conflicting. It is also shown that microbial resistance to antibiotics is growing, and one of the reasons is the abuse of antibiotics. The primary purpose of this study was to evaluate the impact of AP in mastectomies, and secondarily to identify other risk factors for SSI's.

A retrospective medical record review of 300 consecutive patients who underwent mastectomy for oncological reasons between 1.5.2014 – 11.7.2016 was conducted. Patients were divided into two groups, where the prophylaxis group had received 1.5 g cefuroxime intravenously and the control group received no intervention. SSI incidences were compared between the two groups, and additionally other complications. Analysis about how certain potential risk factors managed to predict SSI's and other complications was also performed.

There were no statistically significant differences in the occurrence of SSI's between the two groups. AP did not reduce the SSI rate in prophylaxis group when compared to the control (RR 1.3; 95% CI: 0.75–2.30, p=0.343). The most common microorganism isolated was *Staphylococcus Aureus* in both groups. Findings of this study does not support the routine use of antibiotic prophylaxis in mastectomy, and more studies about the subject are needed.

Avainsanat: Leikkaus, Infektio, Antibiootti, Profylaksia

Appropriateness of surgical antibiotic prophylaxis in mastectomy for breast cancer surgery: a comparative study

Samuli Paajanti[1], Ilkka Koskivuo[1], Riitta Aaltonen[1], Salvatore Giordano[1].

[1] *Department of Plastic and General Surgery, Turku University Hospital, Turku, Finland.*

Background and objectives

The rates of surgical site infections (SSI) following breast surgical procedures range from 5 to 28 % and prophylactic antibiotics have an important role in breast surgery as they have been proved to reduce the incidence of SSI's. However, although the value of using preoperative prophylactic antibiotics in patients undergoing breast surgical procedures has been recently demonstrated, the outcomes are still conflicting, particularly in mastectomies. In contrast, inappropriate prescribing and abuse of antibiotics have shown to result in increased microbial resistance.

The aim of this study is to evaluate the impact of antibiotic prophylaxis in mastectomy procedures and to quantify the possible vantage of prophylactic antibiotics on SSI incidence, in order to minimize the potential complications and antibiotic resistance and to improve the outcomes in a wide variety of clinical circumstances.

Materials and methods

Three-hundred consecutive patients underwent mastectomy for breast cancer between May 1st, 2014 and July 11th, 2016 were included into this study. Patients were divided into two groups on the basis of antibiotic prophylaxis. The prophylaxis group received 1.5 g cefuroxime intravenously at anaesthesia (600 mg clindamycin, in case of specific allergy). The control group received no intervention. The primary outcome was the comparison of SSI incidences of the 2 groups. Secondary outcomes were specific wound healing complications at follow-up.

Results

No significant differences in demographic data were detected between the two groups. Intraoperative antibiotics did not reduce the SSI rate (23.2%) in the prophylaxis group when compared to the control [18.8%; relative risk (RR) 1.3; 95% CI: 0.75–2.30, p=0.343]. No adverse reactions were observed.

The most common microorganism isolated was *Staphylococcus aureus* in both groups. Multivariate analysis revealed that prolonged operative time and hematoma occurrence were significant predictors of postoperative infection.

Conclusions

Antibiotic prophylaxis did not decrease SSI incidence after mastectomy for breast cancer surgery. This is somehow contrary to the previous literature and further studies are needed to identify patients who benefits most of antibiotic prophylaxis in mastectomies.

1. Introduction

Breast cancer is considered to be second most common cancer in the world, and the most common cause of cancer related death on women. [1] Surgery is essential part of breast cancer care for both curative and palliative treatments. Like every other surgical procedure, breast cancer surgery has its complications, and surgical site infections (SSI's) are the most common ones [2]. Even though considered as clean operation, with a low chance of contamination and a relatively common procedure, the incidence of SSI ranges from 5 to 28 % according to the literature [3], while the typical incidence of surgical site infections in clean operations is about 3 % [4].

Infection prevention during breast cancer operations have a high priority because studies have shown that the patients affected by SSI's have significantly higher mortality rates, and the overall treatment period ends up being longer and costlier. Other adverse effects of SSI's are delay of the oncological treatments, readmissions, and poor cosmetic results. [5]

Prophylactic antibiotics (PA's) are used to combat these infections. Clinical trials suggest that the PA's can reduce the incidence of SSI's in breast operations [6, 7, 8], even though there is a lot of heterogeneity in the studies carried out about the subject. For example, from the eleven trials that were included in two major reviews [6, 8] only three studied the effect of AP in specifically mastectomies, although the rate of SSI's greatly varies between different types of breast operations [9]. Also, a lot of conflicting results exist, especially when talking about total and radical mastectomies, and operations where the usage of drains are necessary [10, 11].

Prophylactic administration of antibiotics might be one reason of increasing microbial resistance and can cause adverse reactions, as well as *Clostridium Difficile* infections. [4, 12] There is also some evidence concerning that the usage of PA's in breast surgery might conceal the symptoms of an infection instead of preventing it [13].

Recognizing the specific risk factors for SSIs can be used to determine which patients benefit from the use of PA's, this might be a proper way to reduce SSIs in breast cancer surgery [11, 14]. Some of the reported infection risk factors are older age, heavy alcohol intake, obesity, comorbidity, smoking, prolonged operation, transfusion and suboptimal use of drainage. All of the above are thought to be general risks of surgical infections, while breast cancer surgery has further risk factors like previous radiation treatment and chemotherapy, diagnostic biopsy procedures, or possible re-operation. Along with these, the lack of or suboptimal dosing of PA's have been reported as a potential risk factor. [9, 15, 16]

Because of varying outcomes between the studies about the effectiveness of PA's particularly in mastectomies, and the increasing recognition of the adverse effects, there is not a clear consensus about PA administration. Further data about the effectiveness of PA specifically in mastectomies (modified radical mastectomies and total mastectomies without an axillary dissection) are needed to clarify this issue.

The aim of this study is to evaluate the impact of antibiotic prophylaxis in mastectomy procedures and to quantify the possible vantage of prophylactic antibiotics on SSI incidence, in order to minimize the potential complications and antibiotic resistance and to improve the outcomes in a wide variety of clinical circumstances.
We hypothesized that the administration of prophylactic antibiotic should lower the incidence of SSI's in patients undergoing mastectomy for breast cancer.

2. Materials and methods

2.1. Participants

A retrospective chart review of all consecutive patients who underwent MRM for oncological reasons between May 1st, 2014 and July 11th, 2016 in Turku University Hospital was performed. A change in our departments policy regarding to the use of antibiotics during that time made it possible to obtain enough patient data with and without the usage of prophylactic antibiotics.

Patient inclusion criteria was that there was total mastectomy or radical mastectomy performed without any immediate reconstructions. Patients were identified through the hospitals surgical registry, and the data was retrieved from electronic databases.

Patient exclusion criteria was that the mastectomy was performed as a prophylactic treatment, skin or nipple sparing mastectomy was performed or an immediate reconstruction was carried out.

Data on demographics, comorbidities, and defect characteristics were collected meticulously from patient records.

For the purpose of this study, patients were divided into two groups, depending if they had received prophylactic antibiotics. The prophylaxis group had received 1500mg cefuroxime or 600mg clindamycin intravenously at anesthesia, while the control group received no intervention.

2.2. Procedures and techniques

Mastectomy was performed to men and women who had been diagnosed with breast cancer that was not suited for local excision, or if the patient was unsuited for radiation therapy.

Procedures used were modified radical mastectomy and total mastectomy with sentinel node biopsy. In the operations breast tissue was removed in one block, and the anatomical boundaries for the resection were the clavicle superiorly, the sternum medially, the inframammary fold inferiorly, and the latissimus along the pectoralis major fascia laterally. After that the axillary dissection was performed, unless sentinel node biopsy was free of cancer.

2.3. Definitions and criteria

The primary outcome measure was the surgical site infection (SSI) incidences in the two groups. Secondary outcomes included any surgical site occurrence (SSO), and specific complications such as fat or skin necrosis, wound dehiscence, hematoma, seroma.

Obesity was defined as a body mass index greater than or equal to 30 kg/m^2. Any patient who smoked tobacco within 1 month of surgery was considered an active smoker.

Surgical-site occurrence was defined as any complication involving the operated breast. Infection (SSI) was defined as an infectious process (cellulitis/abscess) requiring treatment with intravenous or oral antibiotics with or without surgery. SSIs occurred within 30 days after the operation and with at least one of the following criteria; purulent drainage from the incision, organisms isolated from cultures obtained from fluids of the incision and one or more clinical symptoms of infection (pain, local swelling, redness, hot incision site) or diagnosis of SSI by attending physician. A positive microbiology swab result alone was not considered as enough evidence for infection.

Wound dehiscence was defined as a skin breakdown with full-thickness skin separation extending over 2 cm with or without infection; skin necrosis involved clearly demarcated necrotic skin edges over 1 cm in width. Fat necrosis was considered as a palpable firmness 1 cm or greater in diameter that persisted beyond 3 months postoperatively. Hematoma and seroma are subcutaneous collections of blood or serous fluid, respectively, requiring percutaneous or operative drainage.

Haemorrhage includes all cases of haemorrhage requiring blood transfusion (intra- or post-operatively), and those requiring intervention for post-operative haematoma (emergency exploration or delayed aspiration).

Superficial wound infections which resolves without antibiotic treatment and minor wound dehiscence not requiring specialist dressing care is not included as complications. Scarring complications include hypertrophic or painful scars and any scars requiring surgical revision.

Anaesthetic and medical complications: any anaesthetic (e.g. intubation or induction difficulty), respiratory or cardiovascular complications are included.

2.4. Statistical Analysis

Means and standard deviations were used to summarize continuous variables, whereas frequencies and percentages were used to present the categorical clinical characteristics. A multivariable logistic regression model was applied to identify the independent predictive factors for SSI. A backward model selection approach was used to select the predictive factors. All tests were two-sided. A value of $p < 0.05$ was considered significant. IBM SPSS statistical software (IBM SPSS 25.0.0.1, Chicago, Illinois 60606, U.S.A) was used for all statistical analyses.

3. Results

A total of 300 patients were included in this study, prophylaxis group had 155 patients, while control group had 145. The only significant difference in the patient demographics between the groups was in the number of smokers (30.2 % in prophylaxis group and 19.3 % in control group, p=0.032). Other than that, no notable differences between the groups were found regarding to age, BMI, any comorbidity, diabetes, HTA, lipid disease, depression, use of omega-3 or BRCA mutation positivity (Table 1).

Comparing the perioperative parameters between the two groups, significant difference was noted in three parameters; estimated blood loss (ml, mean ± SD) (113.5 ± 124.0 in prophylaxis group, 76.6 ± 63.9 in control group, p=0.004), duration of follow-up (months, mean ± SD) (27.0 ± 8.0 in prophylaxis group, 29.3 ± 7.4 in control group, p=0.011) and in amount of sentinel node operations (51.0 % in prophylaxis group, 69.7 % in control group, p=0.001). No notable differences were found regarding to operative time, resection weight, length of hospital stay or the number of double mastectomies or axillary dissections. [table 2]

The overall incidence of SSI's was 21 % (63/300), with 36 patients (23.3 %) from prophylaxis group and 27 (18.8 %) from the control group. There were no statistically significant differences in incidences of any, superficial or deep infections (p=0.343, p=0.980, p=0.507, respectively) between the two groups. Overall, no significant differences between the incidence of other postoperative complications (seroma, hematoma, wound dehiscence and skin necrosis) between the study groups was found either. [table 3]

In 23.8 % (15) of the cases where infection was diagnosed, microorganism was isolated. The most common microorganism isolated was *Staphylococcus Aureus* in both study groups. There were no statistical differences in culture results between the groups (p=0.793, Table 4).

Univariate analysis showed significant variables associated to any infection occurrence: BMI (OR 3.3 per unit of change, CI 95% 1.4 – 4.9, p<0.001), breast resection weight (OR 58.6 per unit (g) of change, CI 95% 61.0 – 291.7, p=0.003), operative time (OR 19.5 per unit (min) of change, CI 95% 11.9 – 27.0, p<0.001), hematoma (OR 10.1, CI 95% 1.9 – 53.3, p=0.001) and seroma (OR 2.9, CI 95% 1.4 – 6.2, p=0.004). Multivariate analysis revealed that operative time (OR 1.0, CI 95% 1.0 – 1.1, p=0.005) and hematoma (OR 11.1, CI 95% 1.0 – 116.7, p=0.045) and the occurrence of hematoma requiring intervention were significant predictor of surgical site infection (Table 5).

4. Discussion

Antibiotic prophylaxis did not significantly reduce the rate of SSI. The incidence of SSI's was 21%, which is roughly what is expected in mastectomies according to the literature [9], although smaller numbers such as 14.2% have also been reported [11].

From the variables that were associated to any infection occurrence in this study, BMI of 25 or over is a well-documented risk factor [17], and the size of breast resection, which was also associated to higher incidence of SSI's, can be considered to be connected to the patients' weight. Findings concerning hematoma and operative times as potential risk factors is also in line with recent studies [15].

Relatively few studies exist of the subject at hand, considering how large population is affected by breast cancer diagnosis and following treatments. A recent review (Jones 2014) exists on the subject, including most of the major studies from the previous reviews, suggesting that the antibiotic prophylaxis reduces SSI's in those involved in non-reconstructive breast cancer surgery. However, a lot of heterogeneity exists within the studies included in reviews, comparing different antibiotics, with different dosages and the lengths of follow-ups ranging from 5 to 42 days. Also, a variety of different operations were used in these studies and many of the trials group all types of breast surgeries together. Some of the studies included non-malignant cases, cosmetic procedures and surgeries that were some other than breast surgeries. With the knowledge that the incidences and potential risk factors are different in each types of operations [10], it seems wise to suggest that more studies are needed to determine the usefulness of antibiotic prophylaxis in mastectomies specifically.

Previous prospective studies did not support the use of prophylactic antibiotics, [11, 13, 14] while one retrospective study by Yetim et al. [18] suggested that antibiotic prophylaxis is justified, however, a collagen plus gentamycin sulphate sponge was inserted into the surgical wound instead of intravenous antibiotics as in other studies. Despite the methodological differences, the results of our study were in line with the previous studies.

Current National guidelines for antibiotic use in breast surgery do not provide unisonous instructions on this issue, particularly AP usage in mastectomies for high risk patients. [20]

The strength of this study includes the homogeneity of the procedures conducted, as well as consistent surgical technique, and the relatively large sample size compared to other studies about SSI incidences in mastectomies with the exclusion of local excisions. Included patients were consecutive, without withdrawing. Most of the patients had at least one control visit to the same department where surgery was performed, and follow-up was relatively long.

The major limitation of this study was due to its retrospective nature. Surgeries were also conducted by 15 different surgeons with various level of experience, although similar dissection technique was used.

There were also some significant differences in the study groups. Because the lack of proper randomization between the groups, and the chance that the operating surgeon could have prescribed the prophylaxis for the patients he or she felt were in the risk of SSI at the time, there is a possibility that the control group has more low-risk patients. That would also explain why there was significantly more smokers and blood loss in the prophylaxis group and could be the main reason for the results where more infections occurred in the prophylaxis group, albeit the amount not being statistically significant. Smaller amount of sentinel node operations in prophylaxis group could be because of more operations proceeding straight to the axillary dissection, which could have also been considered as a risk factor for SSI. However, no significant differences in axillary dissections between the groups were noted. Difference between the follow-up times exists because of the chronological sequence of the study groups and can be considered insignificant.

A large part of the superficial infections was also diagnosed outside the hospital, by physicians with a varying amount of expertise in surgery. That could have inflated the numbers of superficial infections, since it's not unprecedented to confuse the normal healing process of large surgical incision with an infection.

From the base of this study, defining the impact of antibiotic prophylaxis in high-risk operations as well as further quantifying said risk factors should be focused on. There's also some evidence that the bacterial profiles in healthy and cancerous breasts are different [21], which could be one of the reasons for different results in oncological and aesthetic surgery.

With the evidence of this study and the other similar ones, it might be justified to reconsider the routine use of prophylactic antibiotic in clean non-reconstructive mastectomies. However, the patient specific and perioperative risk factors should still be considered and carrying out further studies about those factors leading to higher risk of SSI's in controlled environment might be beneficial. The isolation of specific microbe from infected wound should be pursued, as it would help determining the antibiotics best suited for prophylaxis.

5. Conclusions

Findings of this retrospective study does not support the routine use of antibiotic prophylaxis in mastectomy, and more studies about the subject are needed. Even though this study has its limitations, the results are similar to the ones from previous studies. The exact identification of specific predictors for SSI in mastectomies might reduce the unnecessary use of antibiotics.

Disclosure of potential conflicts of interest

No potential conflicts of interests were disclosed.

References

1. Ferlay J, Soerjomataram I, Ervik M. Cancer incidence and mortality worldwide: sources, methods and major patterns in GLOBOCAN 2012. Int J Cancer. 2015;136:359–386.

2. El-Tamer MB, Ward BM, Schifftner T, Neumayer L, Khuri S, Henderson W. Morbidity and mortality following breast cancer surgery in women: national benchmarks for standards of care. Ann Surg. 2007 May;245(5):665-71.

3. 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 Oct;37(8):674-9. doi: 10.1016/j.ajic.2009.02.010. Epub 2009 Jun 24.

4. Ierano C, Nankervis JA, James R, Rajkhowa A, Peel T, Thursky K. Surgical antimicrobial prophylaxis. Aust Prescr. 2017 Dec; 40(6): 225–229. Published online 2017 Nov 14.

5. Kirkland KB, Briggs JP, Trivette SL, Wilkinson WE, Sexton DJ. The impact of surgical-site infections in the 1990s: attributable mortality, excess length of hospitalization, and extra costs. Infect Control Hosp Epidemiol. 1999 Nov;20(11):725-30.

6. Jones DJ, Bunn F, Bell-Syer SV., Prophylactic antibiotics to prevent surgical site infection after breast cancer surgery. Cochrane Database Syst Rev. 2014 Mar 9

7. Barr S, Topps A, Barnes N, Henderson J, Hignett S, Teasdale R, et al. Infection prevention in breast implant surgery–A review of the surgical evidence, guidelines and a checklist. EJSO. 2016;42(5):591–603.

8. Tejirian T, DiFronzo LA, Haigh PI. Antibiotic Prophylaxis for Preventing Wound Infection after Breast Surgery: A Systematic Review and Meta-analysis. J Am Coll Surg. 2006 Nov;203(5):729-34. Epub 2006 Sep 7.

9. Villar-Compte D, Jacquemin B, Robles-Vidal C, et al. Surgical site infections in breast surgery: case-control study. World J Surg. 2004;28:242–246.

10. Gupta R, Sinnett D, Carpenter R, Preece PE, Royle GT. Antibiotic prophylaxis for post-operative wound infection in clean elective breast surgery. Eur J Surg Oncol. 2000 Jun;26(4):363-6.

11. Cabaluna ND1, Uy GB, Galicia RM, Cortez SC, Yray MD, Buckley BS. A randomized, double-blinded placebo-controlled clinical trial of the routine use of preoperative antibiotic prophylaxis in modified radical mastectomy. World J Surg. 2013 Jan;37(1):59-66. doi: 10.1007/s00268-012-1816-5.

12. Karam G, Chastre J, Wilcox MH, Vincent JL. Antibiotic strategies in the era of multidrug resistance. Crit Care. 2016 Jun 22;20(1):136. doi: 10.1186/s13054-016-1320-7.

13. Wagman LD, Tegtmeier B, Beatty JD, Kloth DD, Kokal WA, Riihimaki DU, et al. A prospective, randomised double-blind study of the use of antibiotics at the time of mastectomy. Surgery, Gynecology and Obstetrics 1990;170(1):12-6.

14. Yang S, Liu G, Tang D, Cai. Evaluation Intravenous Drip Cephazolin Prophylaxis of Breast Cancer Surgery Site Infection. J Craniofac Surg. 2017 Sep;28(6):e527-e531. doi: 10.1097/SCS.0000000000003780.

15. Olsen MA, Lefta M, Dietz JR, et al. Risk factors for surgical site infection after major breast operation. J Am Coll Surg. 2008;207:326–335.

16. Penel N, Yazdanpanah Y, Chauvet MP, et al. Prevention of surgical site infection after breast cancer surgery by targeted prophylaxis antibiotic in patients at high risk of surgical site infection. J Surg Oncol. 2007 Aug 1;96(2):124-9.

17. Gulluoglu BM, Guler SA, Ugurlu MU, Culha G. Efficacy of prophylactic antibiotic administration for breast cancer surgery in overweight or obese patients: a randomized controlled trial. Ann Surg. 2013 Jan;257(1):37-43. doi: 10.1097/SLA.0b013e31826d832d.

18. Yetim I, Ozkan OV, Dervişoglu A, Erzurumlu K, Canbolant E. Effect of local gentamicin application on healing and wound infection in patients with modified radical mastectomy: a prospective randomized study. J Int Med Res. 2010 Jul-Aug;38(4):1442-7.

19. Vazquez-Aragon P, Lizan-Garcia M, Cascales-Sanchez P, Villar-Canovas MT, Garcia-Olmo D. Nosocomial infection and related risk factors in a general surgery setting: a prospective study. Journal of Infection 2003;46(1):17-22.

20. Adwall L, Liljegren G, Olsson L, Wärnberg F. Antibiotic prophylaxis in breast surgery? Yes, but not for everyone. Quality data from the Uppsala county council provides draft for guidelines. Lakartidningen. 2013 Jan 30-Feb 5;110(5):213-5.

21. Urbaniak,C, Gloor G B, Brackstone M, Scott L, Tangney M, Reid G. The Microbiota of Breast Tissue and Its Association with Breast Cancer. Appl Environ Microbiol. 2016 Aug 15; 82(16): 5039–5048.

Table 1. Demographics of patients at time of study.

	Prophylaxis Group (n = 155)	*Control Group (n = 145)*	*p-value*
Age (mean ± SD)	67.5 ± 14.6	64.8 ± 15.3	0.108
BMI (kg/m^2, mean ± SD)	27.5 ± 6.1	26.4 ± 5.4	0.107
Any comorbidity	114 (73.5%)	105 (72.4%)	0.825
Diabetes	15 (9.7%%)	15 (10.3%)	0.847
HTA	75 (48.4%)	63 (43.4%)	0.391
Lipid disease	33 (21.3%)	26 (18.1%)	0.483
Depression	6 (3.9%)	7 (4.8%)	0.684
Smokers	45 (30.2%)	27 (19.3%)	0.032
Omega-3	8 (5.5%)	4 (2.6%)	0.199
BRCA	1 (0.6%)	4 (2.8%)	0.153

Table 2. Comparison of perioperative parameters in the two groups of patients.

	Prophylaxis Group (n = 155)	*Control Group (n = 145)*	*p-value*
Operative time (min, mean ± SD)	97.0 ± 27.7	97.9 ± 28.5	0.787
Double mastectomy	16 (10.3%)	8 (5.5%)	0.125
Resection weight (g, mean ± SD)	683.2 ± 393.6	662.8 ± 370.8	0.663
Estimated blood loss (ml, mean ± SD)	113.5 ± 124.0	76.6 ± 63.9	0.004
Sentinel node	79 (51.0%)	101 (69.7%)	0.001
Axillary dissection	103 (66.5%)	87 (60.0%)	0.247
Hospital stay (days, mean ± SD)	3.59 ± 1.12	4.62 ± 3.20	0.081
Follow-up (months, mean ± SD)	27.0 ± 8.0	29.3 ± 7.4	0.011

Table 3. Postoperative complications.

	Prophylaxis Group (n = 155)	*Control Group (n = 145)*	*P-value**
Complications	41 (26.5%)	37 (25.7%)	0.882
Any infection	36 (23.2%)	27 (18.8%)	0.343
Superficial infection	26 (16.8%)	24 (16.7%)	0.980
Deep infection	14 (9.0%)	10 (6.9%)	0.507
Seroma (requiring drainage)	113 (72.9%)	100 (69.0%)	0.453
Hematoma (requiring intervention)	2 (1.3%)	5 (3.5%)	0.268
Wound dehiscence	17 (11.0%)	13 (9.0%)	0.577
Skin necrosis	4 (2.6%)	0 (0.0%)	0.124

Table 4. Culture results in allocated study groups.

	Prophylaxis Group (n = 155)	*Control Group (n=145)*	*P-value**
Microrganisms, n (%)	7 (4.5%)	8 (5.5%)	0.793
S. aureus	3 (1.9%)	5 (3.4%)	
S. epidermidis	2	0	
C. perfringes	0	1	
S. betahemolyticus	0	1	
P. disiens	0	1	
St.lugdunensis	1	2	
Pseudomonas aerginosa	1	0	

Table 5. Significant univariate variables put into a multivariate model for any infection occurrence.

	Odds ratio*	**95% Confidence interval**	*p-value*
Any infection			
	Univariate Analysis		
BMI	3.3	1.7-4.9	<0.001
Operative Time	19.5	11.9-27.0	<0.001
Breast resection weight	58.6	61.0-291.7	0.003
Hematoma	10.1	1.9-53.3	0.001
Skin necrosis	0.2	0.1-0.2	<0.001
Seroma	2.9	1.4-6.2	0.004
Any comorbidity	1.5	0.8-3.0	0.194
	Multivariate Analysis		
Operative time	1.0	1.0-1.1	0.005
Hematoma	11.1	1.0-116.7	0.045

* For continuous variables and discrete variables, odds ratios represent degree of risk per unit of change.