



### Risk factors associated with surgical site infection after breast surgery

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#### ABSTRACT

Breast surgical site infection is not only one of the main causes of the morbidity and mortality of cases under different types of surgeries, but also it results in longer hospitalization and additional expenses. Identifying various potential parameters related to the occurrence of surgical site infection after the surgery and getting accurate knowledge about them can be beneficial in preventing the surgical site infection. Various types of studies have been conducted to evaluate the possible risk parameters of surgical site infection in every surgery. In this study, we tried to provide a brief review of the available literature regarding the risk factors associated with breast surgical site infection. To this end, we searched the Pubmed database for the relevant articles. We selected eight articles, which have studied the parameters with statistically significant association with the breast surgical site infection. According to our review, further studies with larger sample size can be effective in better evaluating the associated risk factors and presenting the exact effect of some uncertain risk factors of the surgical site infection after breast surgeries.

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#### Introduction

According to the National Nosocomial Infections Surveillance (NNIS) System, surgical site infection (SSI) is known as one of the major causes of the morbidity. Surgical site infections, which appear at the surgical incision, are well-known causes of possible post-operative side effects in every operation. SSI has been mentioned as the third most frequent nosocomial infections. Psychological trauma, morbidity, additional hospitalization and expenses can be the consequences of SSI. The potential risks of infection are present in every surgery, which may be prevented by accurate knowledge about these complications (1). With many newly diagnosed mammary carcinomas annually that the majority of them need surgical resection, it seems necessary and relevant to assess the surgical morbidity especially SSI of the mastectomy operation (2).

Different types of surgeries, length of the surgery, comorbidities and different perioperative interven-

tions lead to noticeable variation in SSI prevalence. Based on different conducted surveys, a wide range of 0.8-26% has been reported as the incidence rate of the surgical site complications after the breast surgeries (3, 4). It is also estimated that the SSI occurs almost in 2% of the mastectomy surgeries. Different definitions for the SSI in every survey, the patients' demographic information, duration of the follow-up after the operation, type of the operation and etc. might be among the parameters, which lead to the broad range of complications reported after the breast operations (5). Based on the centers for disease control and prevention reported criteria, purulent drainage, a positive aseptic culture, any inflammation that causes reoperation and the clinical diagnosis of the physicians are the main parameters that can be considered as SSIs.

Detecting and limiting different risk factors of SSI occurrence after each kind of operation is essential for

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better management of the surgery. Various types of risk parameters of SSI after the breast cancer surgeries have been proposed as following: the increasing age, obesity, excessive alcohol consumption, smoking, diabetes, malignancies, previous open surgeries, chemotherapies, seroma development and lack of preoperative antibiotic prophylaxis. In this study, we briefly reviewed the occurrence rate and the importance of the mentioned risk factors of SSI according to the previous studies conducted on patients with breast surgeries such as mastectomy, breast reconstruction after the mastectomy and breast reduction.

### Literature review

Based on the articles, low doses of antibiotic prophylaxis can increase the risk of breast SSI almost five times regarding to the patients' weight. Due to the patients' weight the administrated dosage of the antibiotic might be different, that is important to be increased specially in obese cases because of the weak penetration of the drugs through the fat tissue. In this regard, by increasing the administrated dosage of the antibiotic in accordance with the increased body mass, the risk of breast SSI may decrease. According to the articles, it is suggested to apply the antibiotic prophylaxis at the surgery time (6). Based on the articles, although prophylactic antibiotics reduce the risk of SSI after the breast surgeries, further studies should be performed to detect the effect of this antibiotic prophylaxis on SSI occurrence after the immediate breast reconstruction (6,7). The cost of treating the SSI in patients without prophylaxis has been higher than the cost of the antibiotic prophylaxis for breast cases, which showed that this was a cost effective strategy for reducing the SSI, especially in obese patients. In some articles, it was proposed that administrating the antibiotics would significantly decrease the risk of SSI only in high risk patients and its application is not essential for all cases (8).

Based on different studies, performing transfusion procedure might be required due to excessive blood loss in some patients and it was associated with increased risk of the SSI. The association between transfusion requirement and increased risk of SSI has been proposed during various surgeries such as spinal surgery and coronary artery bypass graft surgery (9,10).

Mastectomy is an extensive breast surgery in patients with breast cancer. It was proposed that the mastectomy procedure was related with increased rate of SSI incidence (4.4%), while compared with other types of breast surgeries such as breast reduction (1.1%). Interruption of lymphatic drainage, duration of drain and other factors might participate in higher possibility of SSI after the mastectomy compared with other similar breast operations (11).

Based on different studies, previous chest radiotherapy may enhance the rate of SSI following breast surgery (12,13) due to the possibility of decreased

vascularity, hypoxia and fibrosis. However the certain influence of the previous chemotherapy and radiation therapies on the wound healing is still under the consideration (14,15).

Several articles had mentioned the smoking as a considerable independent risk factor for postoperative SSI due to its effects on vascular reconstruction, preventing the adequate blood supply and the negative effect of nicotine on wound healing which may increase the SSI rate approximately 4.9 times. Application of the antibiotic prophylaxis is recommended for smokers (16,17). Based on the study of Sorensen et al., smoking could be considered as a prognostic parameter of SSI after breast surgeries, which might result in skin flap necrosis, epidermolysis and delayed wound healing (18).

In one meta-analysis performed in 2012, different variables were studied to assess their relation with increased SSI after breast surgeries (19). According to eight articles studied in the mentioned meta-analysis, increased age, obesity and diseases such as hypertension and diabetes mellitus were the major predictive parameters of SSI. The odd ratios of the proposed risk factors in that meta-analysis are provided in Table 1. Due to the importance of diminishing the occurrence of breast SSI, the presence of these factors in patients should be evaluated before the surgery.

The presence of postoperative hematoma and seroma are other potential factors for SSI, which should be noticed by surgeons after the surgery.

Drainage and drainage time, bleeding during the operation, the selected operation procedure are other different risk factors of SSI, which can be managed and controlled to decrease the possibility of the SSI occurrence. We summarize the information of the studies considered the breast SSI associated risk factors in Table 1. The estimated odd ratios of the major risk factors of the breast SSI are also presented in Table 2.

Based on several studies, diabetes mellitus and hyperglycemia were reported to be among the major causes of the postoperative SSI and some nosocomial infections (20-22). The exact mechanism by which elevated blood glucose results in more infections in diabetic patients and higher morbidity and mortality of nondiabetic cases is not certain (23,24).

### Conclusion

The knowledge about the potential risk factors associated with breast SSI can be beneficial in better managing, controlling and reducing the occurrence of the SSI and developing the quality of patients' treatments. Some risk factors of the breast SSI are only dependent on the surgery and can be limited by the operation. According to the observed data in the studied articles, even the low portion of the SSI are serious complication and the incidence of superficial infections can result in major morbidity, longer hospitalization of the patient and higher costs. Psychological traumas,

**Table 1.** Detailed information of risk factors associated with the SSI occurrence after the breast surgery

Author Year Reference	Intervention	Outcome measure	Result
<b>Bertin 1988 (16)</b>	Breast surgery (1994-1995) - case:18 - control: 37	SSI*	Significant associations: - Obesity: cases vs. control: 78% vs. 40% (p-value=0.02) - Increased age: cases vs. control:66 years vs. 56 years (p-value=0.005)
<b>Rey 2005 (25)</b>	- cases:15 - control:45	SSI	Significant factors - Duration of surgery: cases vs. control: 71.7 min vs. 37.4 min (p-value<0.01) - Presence of drainage: cases vs. control: 26.7% vs. 6.7% (p-value=0.04) Not significant factors Obesity: p-value=0.88 Preoperative needle localization:p-value=0.88
<b>Gao 2010 (26)</b>	- cases: 5 - control:20	SSI	- Drainage time longer than 10 days vs. less than 10 days: p-value=0.009 - Adjuvant chemotherapy grade III vs. without adjuvant chemotherapy: p-value= 0.043
<b>Brewer 2000 (27)</b>	- case:17 - control:34	Breast cellulitis complicating breast conservation therapy	Significant factors - Ecchymosis: p-value=0.021 - Hematoma drainage: p-value=0.01 - Lymphedema, odd ratio (OR): 10. 154 - Previous number of breast seroma aspirations, OR: 3.445
<b>Vilar-Compte 2004 (28)</b>	Breast surgeries (2000) Follow-up for 30 days, 3 times a week - case:76 - control:154	SSI	Significant factors - Obesity, OR:2.5 - Previous chemotherapy, OR:2.3 - Second drainage tube, OR:3.7 - Drainage duration≥19 days, OR:2.9 - Surgery approach, OR:3.1
<b>Olsen 2008 (29)</b>	Mastectomy, breast reconstruction, breast reduction (1998-2002) - case: 57 - control: 268	SSI	Significant independent risk factors - Breast implant insertion, OR:5.3 - Suboptimal prophylaxis, OR:5.1 - Transfusion, OR:3.4 - Mastectomy procedure, OR:3.3 - Previous irradiation, OR:2.8 - Smoking, OR:2.1
<b>Vilar-Compte 2009 (30)</b>	Breast surgeries (2001-2005) 30 days follow up - cases: 441 - control:1149	SSI	Significant associated factors: - Age≥58 years, OR:1.83 - Preoperative chemoradiation, OR:3.47 - Presence of hematoma, OR:3.05 - BMI"≥30.8, OR:1.58 - Surgery duration≥160 min, OR:1.73
<b>Vilar-Compte 2006 (31)</b>	Mastectomy (2001)	SSI	Significant associated factors: - Previous chemoradiation, OR:3.6 - Surgeries at evening shift, OR:1.9 - Second drainage, OR:2.8

\*SSI: Surgical site infection; \*\*BMI: Body Mass Index

**Table 2.** The reported odds ratio of the major risk factors of breast SSI based on a meta-analysis in 2012

Risk factor	Odd ratio	Confidence interval 95%
Age	1.73	1.41-2.12
BMI	1.96	1.63-2.37
Diabetes mellitus	1.88	1.47-2.39
Hypertension	1.69	1.34-2.14

morbidity and additional expenses are different consequences of SSI after different surgeries. Based on various case-control studies and some meta-analysis, some factors can be mentioned as the most significant risk factors for the breast SSI including patient age, the patient's body mass index (BMI), diseases such as diabetes mellitus and hypertension and etc. It is recommended to evaluate the presence of the mentioned risk factors

preoperatively for better managing and controlling the occurrence of the SSI.

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## Conflict of Interest

The authors declare no conflict of interest.

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