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RESEARCH ARTICLE

DETERMINANTS OF SURGICAL SITE INFECTIONS AFTER BREAST SURGERY; OUR INSTITUTE EXPERIENCE.

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Abstract

Background:- Surgical site infections (SSIs) following breast surgery result in increased length of hospital stay, antibiotic utilization, and morbidity. Understanding SSI risk factors is essential to develop infection prevention strategies and improve surgical outcomes. This study aimed to identify the determinants of SSIs after different breast surgical procedures regarding incidence rate, grades, causative organism(s), risk factors and management at Alexandria Medical Research Institute hospital.

Methods:- The study prospectively included all patients admitted to the department of Surgery, Alexandria Medical Research Institute hospital during the period from May 2014 to April 2015 who were planned for breast surgery. Patients were followed up for 30 days after surgery if no prosthesis was placed during the operation and for one year if prosthesis was placed. The determinants of SSIs regarding incidence rate, grades, causative organism(s), risk factors and management were registered.

Results:- The study included 282 patients of whom 31 (11%) developed SSIs. All patients with SSI have been detected during the outpatient follow up within the first 3 weeks after surgery except 4 cases; Two cases with implants (3 and 6 months after surgery) and 2 cases with expanders (7 and 9 months after surgery). Staphylococcus aureus was the most common pathogen (42%). Twelve patients (38.7%) were readmitted for management of SSI. The incidence of SSI had statistically significant association with age ≥60 years, smoking, diabetes, neoadjuvant chemotherapy, BMI >35, type of surgical procedure, prosthesis placement (implant or expander) and seroma formation (P= 0.003, 0.002, 0.04, 0.03, 0.01, 0.03, 0.02 and 0.03 respectively).

Conclusion: SSIs after breast surgery are not uncommon complication and can occur after any type of breast surgery. Microbiological diagnosis (culture and sensitivity testing) is recommended for every case with SSI with the use of empirical broad-spectrum antimicrobial coverage until culture results become available. The incidence of SSI had statistically significant association with age ≥60 years, smoking, diabetes, neoadjuvant chemotherapy, BMI >35, type of surgical procedure, prosthesis placement (implant or expander) and seroma formation.

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Introduction:-

Surgical site infection (SSI) is the most common postoperative complication associated with breast surgery (1) and they are major sources of adverse operation-related events in patients undergoing surgery, including increased morbidity, psychological trauma, additional cost and delay of postoperative adjuvant therapies.(2,3) Knowledge of specific risk factors for SSIs is essential in order to create a SSI risk stratification index specific to breast surgery and other types of surgical procedures.(1). The Centers for Disease Control and Prevention (CDC) developed a standard definition of Surgical site infection (SSI) used by most hospital epidemiologists and infection control practitioners worldwide and specifies surveillance for Surgical site infections (SSIs) for 30 days after operation in procedures without prosthesis , and 1 year after operation when a prosthesis is placed.(4) The rate of breast SSIs range from 1% to 30%, depending on definition of SSIs, type of operation, comorbidities of the patients, time of follow up, Perioperative therapy and reporting institution. It's higher than other clean operations in which the infection rate is less than 5%. (5-9) Many risk factors for SSI after breast surgery have been reported including older age, obesity, heavy alcohol use, (10-13) smoking, diabetes, malignant tumor, previous open biopsy, (14,15) previous chemotherapy or radiation therapy, (13, 16-20) trainee surgeon responsible for the operation, (21) Seroma development, prolonged duration of drainage after operation, (13,20) immediate reconstruction, and lack of antibiotic prophylaxis at the time of operation. (22-24) This study aimed to identify the determinants of SSIs after different breast surgical procedures regarding incidence rate, grades, causative organism(s), risk factors and management at Alexandria Medical Research Institute hospital.

Patients and methods:-

The study prospectively included all patients admitted to the department of Surgery, the hospital of Medical Research Institute, University of Alexandria during the period from May 2014 to April 2015 who were planned for different breast surgical procedures. All patients included in this study were subjected to complete history taking stressing on medical history especially diabetes mellitus (DM), Smoking and previous neoadjuvant chemotherapy in cases of breast cancer. Body Mass Index (BMI) for every patient was registered. All patients included in this study recieved 3rd generation cephalosporin antibiotic immediately before the procedure. The types of surgical procedures were registered and patients were followed up for 30 days after surgery if no prosthesis (implant or expander) and up to one year when there was a prosthesis placed during the operation. The incidence of seroma formation after surgery was registered. Prospective detection was used to identify patients who developed SSIs. The grades of SSIs were identified using Southampton wound scoring system. (25) Diagnosis was based on collecting information from clinical outpatient follow up, patients medical records including reviewing of clinical data (symptoms and signs), investigations (laboratory, histopathology, radiological, etc.), microbiological culture and sensitivity results, and medication charts in addition to reviewing the medical records of the infection control team in the hospital. Infections were identified either during the original surgical admission, at readmission to the hospital, or during outpatient follow up of the surgical wound. Causative organisms were recorded from the microbiological reports. Also we registered how these infections were managed. Results were recorded and tabulated using Microsoft Access (Microsoft Corporation, Redmond Washington, USA). Chi-square tests were performed on the data, and p-values were used to evaluate the data for statistical significance.

Results:-

The study included 282 patients who were admitted to the department of Surgery, the hospital of Medical Research Institute, University of Alexandria during the period from May 2014 to April 2015 who were planned for different breast surgical procedures. Surgical site infections were diagnosed after 31 procedures (11%). The distribution of the studied patients who had SSIs according to the type of surgical procedure is shown in table I. All patients who had SSI have been detected during the outpatient follow up within the first 3 weeks after surgery except 4 patients; Two patients with implants in whom SSIs had been detected 3 and 6 months after surgery and the other 2 patients with expanders in whom SSIs had been detected 7 and 9 months after surgery. The distribution of patients who had SSIs after breast surgery according to the degree of infection (Southampton wound scoring system) is shown in Table II. Staphylococcus aureus (S.aureus) was the most common pathogen isolated (13 patients (42%) of all patients), Streptococcus pyogenes was isolated from 5 patients (16.1%), Escherichia Coli (E. Coli) from 5 patients (16.1%), Pseudomonas aeruginosa from 4 patients (12.9%) and no pathogen was isolated in 4 patients (12.9%). All patients received antibiotics according to culture and sensitivity results. Twelve patients (38.7%) out of the 31 who had SSI were readmitted for management of SSI; Seven patients for 2ry suture after debridement, three patients for removal of the infected prosthesis and two patients for debridement. The risk factors studied to evaluate their association with development of SSIs included age, smoking, diabetes, neoadjuvant

chemotherapy (NAC), BMI, type of surgical procedure, prosthesis placement (implant or expander) and the incidence of Seroma formation. The incidence of SSI had statistically significant association with age ≥60 years, smoking, diabetes, NAC, BMI >35, type of surgical procedure, prosthesis placement (implant or expander) and seroma formation (P= 0.003, 0.002, 0.04, 0.03, 0.01, 0.03, 0.02 and 0.03 respectively). The risk factors studied to evaluate their association with development of SSIs were summarized in table (III). Figures 1 and 2 showed examples of patients that had SSI and included in the studied patients.

Table I:- Distribution of patients who had SSIs according to the type of the surgical procedure submitted.

Surgical Procedure	Number of patients submitted to this procedure (%)	Number of patients submitted to this procedure and developed SSIs (%)
Lumpectomy	**82 (29.1%)**	**3(9.7%)**
MDE	**22 (7.8%)**	**2(6.4%)**
Nipple reconstruction	**8 (2.8%)**	**-**
Lipofilling	**19 (6.7%)**	**-**
C B S	**26 (9.2%)**	**3(9.7%)**
Mastectomy	**80 (28.3%)**	**13(42%)**
Reduction mammaplasty	**14 (5.1%)**	**3(9.7%)**
TRAM	**4 (1.4%)**	**2(6.4%)**
LD	**10 (3.6%)**	**-**
Implant	**9 (3.2%)**	**2(6.4%)**
Expander	**8 (2.8%)**	**3(9.7%)**
TOTAL	**282(100%)**	**31(100%)**

MDE: Major Duct Excision **CBS:** Conservative Breast Surgery
TRAM: Transverse Rectus Abdominis Myocutaneous Flap
LD: Latissmus Dorsi Myocutaneous Flap

Table II:- Distribution of patients who had SSI after breast surgery according to the degree of infection according to Southampton wound scoring system.[25]

Degree of infection	Number of patients who developed this degree of SSIs (%)
SOUTHAMPTON SCORE	
IIB	**4(12.9%)**
IIC	**5(16.1%)**
IIIB	**3(9.7%)**
IIIC	**4(12.9%)**
IIID	**3(9.7%)**
IVA	**5(16.1%)**
IVB	**3(9.7%)**
V	**4(12.9%)**
TOTAL	**31(100%)**

Table III:- Risk Factors associated with the development of SSIs after Breast Surgery.

Risk factor	**No. of patients having this risk factor**	**No. of patients having this risk factor and developing SSIs**	**P-value**
Age(y)			
<60	188/282	9/31	**0.003**
≥60	94/282	22/31	
Smoking	18/282	13/31	**0.002**
Diabetes	54/282	11/31	**0.04**
Neoadjuvant Chemotherapy	32/282	14/31	**0.03**
BMI			**0.01**
≤ 35	102/282	7/31	
> 35	180/282	24/31	
Type of Surgery			**0.03**
Lumpectomy	82 /282	3/31	
MDE	22 /282	2/31	
CBS	26 /282	3/31	
Mastectomy	80 /282	13/31	
Reduction mammaplasty	14 /282	3/31	
TRAM	4 /282	2/31	
Implant	9 /282	2/31	
Expander	8 /282	3/31	
Prosthesis insertion	17/282	5/31	**0.02**
Seroma formation	38/282	16/31	**0.03**

Figure 1:- 47 years old female with right breast cancer submitted for mastectomy with immediate reconstruction with TRAM; She developed SSI at both the breast and abdominal wounds; both wounds were debrided and left to heal by 2nd intention healing.

A **B**

Figure 2:- Two patients with SSIs; **A:** MRM for right breast cancer with fish-tail plasty**; B:** Therapeutic mammaplasty for right breast cancer

Discussion:-

Understanding surgical site infection (SSI) risk factors after breast operation is essential to develop infection-prevention strategies and improve surgical outcomes. (26) We reported higher rate of SSIs (11%) than reported by Degnim et al. (2.7%) (27), Leinung et al. (4.5%) (28), Olsen et al. (4.7%) (29) and Abeer Omar et al. (2.3%)(30); but lower than that reported by Vilar-Compte et al. (18.9 % (30) Abeer Omar et al (30) attributed their lower rate of SSIs in their study to the concept of decreasing postoperative length of hospital stay so the follow up of the patient is mainly carried out on an outpatient basis. During outpatient visits, when the SSI develops and requires no readmission, surgeons may not document the infection in the patient's records and may not request microbiological sampling of the wound. This is primarily due to fear of medical malpractice claims or negligence especially in a surgery classified as a clean one like breast surgery.(30) We considered this bias is not present in our study for two reasons: the first: we have taken our data from two sources: files of Surgery department and files of infection control unit, the second; Our Institute specialized breast clinic has its own files in which all data are registered by residents who have fixed modules to be filled with follow up data and photos. In our study; Twelve patients (38.7%) out of the 31 who had SSI were readmitted for management of SSI; Seven patients for 2ry suture after debridement, three patients for removal of the infected prosthesis and two patients for debridement while In another study;(12) Sixty two percent were readmitted for management of SSI. We attributed the lower rate of readmission in our study to that only 12 patients (38.7%) out of the 31 who had SSIs had severe grades of SSIs (Grade IV and V). In the present study; despite the fact that S. aureus was the primary pathogen isolated from SSIs (42%); Gram negative bacteria (E. Coli and Pseudomonas aeruginosa) were isolated in 29% of cases representing a significant finding. Other studies reported the same results (32). However, Mukhtar et al. (33) reported Gram negative bacteria as the most common isolated pathogens. These findings support the importance of the use of empirical broad-spectrum antimicrobial (not only targeting S.aureus) coverage until culture results become available. 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 (34). To omit the effect of this factor; All patients who were submitted for any procedure recieved 3rd generation Cephalosporin antibiotic immediately before the procedure as 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. in our study; thirteen patients (42%) out of the 31 who had SSIs were submitted to mastectomy which is similar to the results of another study (35) which concluded that mastectomy was associated with increased rate of SSI incidence when compared to other types of breast surgeries which may be attributed to the interruption of lymphatic drainage and duration of drainage which may participate in higher possibility of SSI after the mastectomy compared to other similar breast operations. We agreed with these explanations but we can add that mastectomy is still the commonest major submitted procedure (28.3%). In the present study; We concluded smoking as a significant risk

factor for developing SSIs after breast surgery which matched with several articles which had mentioned smoking as a considerable independent risk factor for postoperative SSI due to its effects on preventing the adequate blood supply and the negative effect of nicotine on wound healing which increases the SSI rate. (36,37). 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 (37). In one meta-analysis performed in 2012, different variables were studied to assess their relation with increased SSI after breast surgeries (39). According to eight articles studied in the mentioned meta-analysis; increased age, obesity, DM, presence of postoperative seroma and selected operative procedure were the major predictive parameters of SSI which are similar to our results which concluded age ≥60 years, diabetes, BMI >35, type of surgical procedure and seroma formation as statistically significant risk factors for SSI after breast surgery. The presence of these factors in patients should be evaluated before the surgery to be managed and controlled to decrease the possibility of the SSI occurrence. We concluded increased risk of SSIs with immediate placement of prosthesis (implant or expander) after mastectomy (P=0.02) which is similar to many studies (40-42); but really we cannot conclude whether the implant alone is responsible for the increased risk of SSI, or if it is the combination of mastectomy followed by immediate placement of prosthesis that confers increased risk of SSI as we had no control group with mastectomy with delayed prosthesis insertion. Finally; we concluded that receiving NAC had statistically significant association with the incidence of SSI which is supported by the results of many recent studies. (13, 16-20) but differs from the results of Olsen et al (35) who were unable to detect any association between SSI and NAC.

Conclusion and recommendations:-

SSIs after breast surgery are not uncommon complication and can occur after any type of breast surgery. Microbiological diagnosis (culture and sensitivity testing) is recommended for every case with SSI with the use of empirical broad-spectrum antimicrobial (not only targeting S. aureus) coverage until culture results become available. The incidence of SSI had statistically significant association with Age ≥60 years, Smoking, Diabetes, Neoadjuvant Chemotherapy, BMI >35, Type of surgical procedure, Prosthesis placement (Implant or expander) and Seroma formation. The knowledge about these 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. We recommend further studies with larger volume of cases to confirm the results and to study more risk factors.

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Conflict of Interest:-

The authors declare no conflict of interest.

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