

Prevalence of Sternal Wound Infections and Saphenous Harvesting Site Infection in Patients Undergoing Coronary Artery Bypass Graft Surgery

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Abstract

Introduction: Surgical site infection is a risky complication following coronary artery bypass graft (CABG) surgery that may increase mortality and morbidity. Hence, it seems that further investigation regarding this complication may be necessary, in order to improve prevention and treatment processes.

Objectives: The aim of this study was to determine the frequency of sternal wound infection and saphenous vein wound infection in patients undergoing CABG and its correlation with the determinants.

Methods: This is a cross-sectional study that was undertaken from 2015 to 2019 on 2459 patients undergoing CABG surgery with off-pump and on-pump methods. Demographic and background information of our patients were recorded. After infection, secretions were sampled and cultured.

Results: Results of the study showed that the frequency of sternal and saphenous harvesting site infection in patients was 3.7% (n=91), and these infections were often diagnosed two weeks after surgery (50 patients, 54.9%). Age and sex were identified as two significant risk factors of surgical site infection after CABG surgery (p=0.0001). Most patients came back with an infection two weeks after surgery (54.9%). Gram-positive bacteria had the greatest role in infection (35.2%) with *Staphylococcus epidermidis* acting as the predominant strain (n=13).

Discussion and Conclusion: The results suggested that two factors with a crucial role in the incidence of infection, are female gender and age of 50-60 years old. Diabetes, previously identified in the literature as a risk factor for surgical site infection, did not have a significant effect in this study and further research is warranted.

Keywords: CABG surgery, surgical site, infection, risk factors

1. Introduction

Coronary heart disease has become a major human health concern in recent years. It is the main cause of one third of deaths worldwide, leading to morbidity and diminished functionality of individuals in society (1-2). The risk of coronary heart disease in people with a low socioeconomic status and economic strata is twice as high as other people and the mortality rate of this group is also higher (3). Coronary artery bypass graft (CABG) is the most common treatment for patients with coronary heart disease who have multiple clogged arteries or a narrow left main artery where the patients may require several arterial and venous transplants during surgery. (4) Using one or both internal mammary arteries, radial arteries or a part of the great saphenous vein and its connection with the blocked coronary artery can help establish reperfusion in the clogged coronary artery. However, using a piece

of saphenous vein is still preferred as the most common method of connecting aorta and the coronary artery (5). This surgical method is an effective technique to alleviate or completely eliminate the symptoms of angina pectoris. In other words, surgical treatment is a method to improve the quality of treatment, which leads to a decreased morbidity and mortality. (6 and 4) Despite advances in surgical techniques and pre- and postoperative care, complications such as impaired healing of surgical site infection are still observed. Postoperative infections in patients, are the leading cause of disability after surgery.

These infections may develop in mediastinum and the saphenous vein ulcer. (7) The prevalence of this complication in sternal and leg ulcers after surgery is estimated to be 0.5 to 10% and 1 to 44%, respectively. (8) The surgical site infection following CABG surgery reduces the quality of life in patients, increases the length

of hospital stay and the need for long-term antibiotic treatment, imposing a huge financial burden on both the patient and the health care system. (8,9) As a result, five hundred thousand postoperative infections in the United States have caused about 3.7 million additional days of hospital stay and an excess of \$1.6 billion in costs. (10). Therefore, understanding different dimensions of postoperative infections in patients undergoing CABG is crucial important to prevent such infections and improve subsequent results. Accordingly, given the importance of this issue, we decided to investigate the prevalence of sternal and saphenous harvesting site Infections and its determinants in patients undergoing CABG from 2018 to 2019 in a general hospital in Mashhad.

2. Method

This is a cross-sectional study on patients undergoing CABG at a general university hospital in Mashhad, Iran, from 2015 to 2019. Patients who were willing to participate in the study who had immunodeficiency, took corticosteroids or had active infections in areas other than the sternum and legs were excluded. Finally, 2459 patients were selected and enrolled in the study.

Demographic and clinical information of patients were recorded. To evaluate patients' diabetes, preoperative fasting glucose and patient medications were considered. All patients underwent general anesthesia and based on the patient's condition and the surgeon's decision, surgery was carried out using on-pump and off-pump techniques.

After surgery and transferring the patient to the ICU, the dressing was changed daily and the surgery site was examined by a surgeon for infection. In the case of infection symptoms, further studies were conducted along treatment protocols for patients according to the severity of infection and culture of surgical site secretions. After discharge, patients were monitored for two weeks and one month postoperatively for surgical site infection. All information about sternal ulcer infection and saphenous vein ulcers of patients was recorded and compared.

The present plan has been approved by the ethics

committee of Mashhad University of Medical Sciences (code IR.IAU.MSHD.REC.1398.122).

Descriptive statistics and analytical tests were used to present the results by SPSS software. Independent t-test and Mann-Whitney test were used to investigate the relationship between quantitative variables and Chi-square test was utilized to examine the relationship between qualitative variables.

3. Results

In this study, 2459 patients who had undergone surgery from 2015 to 2019 were enrolled in the study. Of these, 64.4% of patients were male. The mean age of the subjects was 59.7 ± 14.19 years and 36.2% (n=890) had diabetes.

The incidence of infection was documented in 3.7% (n=91) patients, particularly two weeks after surgery (50 patients, 54.9%). 29.7% (n=27) of patients reported infection at the surgical site between two weeks and one month and 15.4% (n=14) over one month after surgery.

More than 90% (n=82) of patients had sternal wound infection and 9.9% (n=9) suffered harvesting site infection. The main infectious agents were gram-positive in 35.2% (n=32), gram-negative in 29.7% (n=27) and unknown sources in 35.2% (n=32) of patients. Staphylococcus epidermidis (40.6%) had the highest prevalence among gram-positive microbes, and Escherichia coli (29.6%) and Klebsiella pneumoniae (29.65%) were most prevalent among gram-negative microbes. Two cases of Candida albicans were also reported.

Patients were classified into three age groups: below 50 years of age (10%), 50 to 60 years (64%) and above 60 years (26%). The highest rate of infection was observed in the age group of 50 to 60 years. There was also a significant difference between the age groups in this regard ($p=0.0001$).

Chi-square test showed that the distribution of infection in women (n=52) was significantly higher than in men (n=39) ($p=0.0001$).

There was no significant difference between diabetic (n=39, 4.3%) nondiabetic (n=53, 3.4%) patients in terms

Table 1. Distribution of infection type in patients undergoing CABG surgery

Type of infection	Observed (%)
Pseudomonas aeruginosa	3(3.3%)
Klebsiella pneumoniae	8(8.8%)
Citrobacter freundii	2(2.2%)
Escherichia coli	8(8.8%)
Acinetobacter	5(5.5%)
Proteus Mirabilis	2(2.2%)
Staphylococcus epidermidis	13(14.3%)
Group D streptococcus	9(9.9%)
Coagulase-negative staphylococci	1(1.09%)
Staphylococcus lugdunensis	1(1.09%)
Staphylococcus saprophyticus	4(4.4%)
Staphylococcus aureus	4(4.4%)
Staphylococcus haemolyticus	1(1.09%)
Candida albicans	2(2.2%)

4. Discussion

The results of our study suggested that the frequency of sternal and saphenous harvesting site Infections in patients undergoing CABG surgery in our hospital was 3.7%. This rate was 54.9% two weeks after surgery, 29.7% from two weeks to one month after surgery, and 15.4% more than one month after surgery. Nine patients developed leg infections. Also, our study suggested that the frequency of infection varied significantly between the three age groups of patients so that the frequency was higher in the age group of 50 to 60 years than in the age groups of less than 50 and more than 60 years. Moreover, a significant difference in the frequency of infection was observed in relation to patient sex. The prevalence of infection was higher in females (5.9% versus 2.5% in males). Similarly, the prevalence of infection among diabetic patients was higher than non-diabetic patients (4.3% vs. 3.4%) but the frequency infection distribution based on diabetes was not significantly different.

In a 2014 cross-sectional study by Si et al. in Australia on 14546 patients with sternal ulcer infection, 518 suffered sternal ulcer infection and 1184 developed leg infection. Also, among isolated pathogens, methicillin-susceptible *Staphylococcus aureus* (28.3%), *Pseudomonas aeruginosa* (18.3%), methicillin-resistant *Staphylococcus* (14.6%) and *Enterobacter* (6.7%) were reported.

Finally, it was found that surgical site infection with gram-negative organisms were increasing and a severe underlying disease could deteriorate complications related to surgical site infection (8). In our study, gram-positive bacteria were the most common infectious agents.

In the 2017 study of Si et al. in Brazil, 1,500 patients underwent cross-sectional surgery. The results demonstrated that obesity, diabetes, smoking, use of internal thoracic artery and the type of surgery (on-pump) increased the possibility of sternal ulcer infection in patients (9). The results of our study suggested that diabetes was not a risk factor for postoperative infection. This discrepancy may be due to differences in sample size, patient demographics, inclusion and exclusion criteria, the manner of controlling the effect of confounders and finally sampling method.

The cohort study of Abdou et al. in 2018 on 1500 patients reported that 45 patients (8.2%) had sternal infections, of whom 21 developed superficial infections (46.7%) and 24 (53.3%) a deep sternal infection. Average interval between surgery and infection was 6 days. About 75% of patients were diagnosed with the infection in advance of discharge. The average length of stay in hospital due to sternal infection was 16 days. One patient died over this period. Microbial agents were diagnosed in 30 patients, *Staphylococcus aureus* in 31% and *Enterobacteriaceae* in 27% of patients. Sternal infection was not associated with smoking, diabetes, or body mass index (11). The results of this study, aligned with our findings, reveal that the most common infectious agents are gram-positive bacteria.

A 2016 study in Tehran also reported that 0.3% of patients developed leg infection and 3.3% suffered sternal infection after CABG (12), which is largely compatible with the results of the present study.

Surgical site infection is a rare but life-threatening complication of cardiac surgery and the rate of postoperative complications in these patients is considerably higher than others (7). In some studies, it has been suggested that taking measures such as controlling a set of known risk factors and monitoring the administration of appropriate antibiotics before and after surgery can be effective in reducing the incidence of infection (13).

One of the limitations of the present study was the small number of risk factors, which warrants further studies in this field.

5. Conclusion

The results showed that two factors, being between 50 to 60 years of age and being a female have a key role in the incidence of infection. Diabetes, previously identified as a risk factor for surgical site infection in the literature, did not show a significant effect in this study and more research is warranted to shed more light on this issue.

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