Original Article

INVESTIGATION OF DEEP STERNAL WOUND INFECTION AFTER CORONARY ARTERY BYPASS GRAFT AND ITS RISK FACTORS

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ABSTRACT

Objective: To investigate factors that predict sternal wound complications in patients after coronary artery bypass grafting (CABG) because prediction of deep sternal wound infection after surgery, might help us to do some interventions and reduce its consequences.

Methodology: The record of all these patients was reviewed retrospectively. DSWI was defined according to the guidelines of the Centers for Disease Control and Prevention. From Sep 2003 to Sep 2006 a total of 1014 patients who underwent coronary bypass graft surgery in a cross-sectional study was included in this study.

Results: Logistic regression analysis was conducted and the risk factors that significantly predicted sternal wound complications after coronary artery bypass graft surgery included older age, Diabetes mellitus, increasing BMI, and in class three or four of the New York Heart Association functional class. Most infections had a late and the majority of these were caused by staphylococcus epidermidis while other were pseudomonas aeroginosa, streptococcus pneumonia, staphylococcus aureus and one of them was Meticilline resistance. The clinically most fulminate infections were caused by e-coli and presented early after surgery.

Conclusion: Advanced age, diabetes and obesity, NYHA high score were the important risk factors identified. As such we suggest more attention should be paid to these patient. Modifying the risk factor and making decision according to risk factor such as appropriate administration of prophylactic antibiotic in patient with poor physical status, good control diabetes are recommended.

KEY WORDS: Mediastinitis, Wound infection, CABG, Risk factors.

Pak J Med Sci April - June 2008 (Part-I) Vol. 24 No. 2 251-256

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* Received for Publication: November 24, 2007

* Accepted: January 17, 2008

INTRODUCTION

Infection remains the most common cause of postoperative morbidity and mortality.[1] Sternal wound infection (SWI) is a serious infection after cardiac surgery.[2] Deep sternal wound infection (DSWI) is associated with sternal osteomyelitis with or without infected retrosternal space (bone and mediastinitis).[3] The reported incidence of DSWI ranges between 0.15% and 8%,[4] the reported in-hospital mortality can be as high as 20% to up 50%.[1-5-6] SWI following CABG is associated with increased long-term mortality[5] and extend the lengths of stay and increase the cost.[6]

Studies have consistently associated obesity and re-operation with this complication, while

other risk factors such as use of both IMAs, duration and complexity of operation, and the presence of diabetes have been reported inconsistently.[7] Other important factors which can cause infection, include preoperative (Diabetes, hypertension, peripheral vascular disease, renal insufficiency, female sex), intra operative (CPB time) and postoperative variables (prolonged mechanical ventilation, re-exploration for bleeding and nephrologic complication).[8-12]

Identification of modifiable risk factors for sternal infection is essential for the development and institution of practices that decrease the incidence of these infections.[13] The objective of this study was to find out factors that predict sternal wound complications in patients after coronary artery bypass grafting (CABG) because prediction of deep sternal wound infection after surgery, might help us to do some interventions to reduce it's consequences.

METHODOLOGY

DSWI was defined according to the guidelines of the Centers for Disease Control and Prevention, and its diagnosis required at least one of the following criteria:

1. An organism isolated from culture of mediastinal tissue or fluid;
2. Evidence of mediastinitis seen during operation; or
3. Presence of either chest pain, sternal instability, or fever (> 38°C), and either purulent discharge from the mediastinum isolation of an organism isolated from blood culture or culture of drainage of the mediastinal area.[14]

From Sep 2003 to Sep 2006 a total of 1014 patients who underwent coronary bypass graft surgery at Baqyatallah Hospital Center; a university hospital of Baqyatallah University in a cross-sectional study were included. The record of all these patients was reviewed retrospectively. The patients were categorized as those without DSWI (n=1002, Group 1) and those with DSWI (n=12, Group 2). Immediately after suspicion of DSWI, antibiotics were administrated and surgical intervention was made. Fifteen patients were excluded because of the death during first month after of surgery which was not related to infection. The only patient who died with infection was included in our study.

The patients' data included the following variables: age, sex, body mass index (BMI), smoking, hypertension, peripheral vascular disease (whether the patient had peripheral vascular disease as indicated by claudicating either on exertion or at rest, amputation for arterial insufficiency, aorto-iliac occlusive disease reconstruction, peripheral vascular bypass surgery, angioplasty, or stent), diabetes mellitus (defined as a history of diabetes regardless of the duration of disease or need for anti-diabetic agents),length of preoperative hospital stay, functional class according to New York heart association (NYHA), hypercholesterolemia, aortic cross-clamp time, number of grafts, renal Chronic obstructive pulmonary disease, Congestive heart failure, and left ventricular ejection fraction (LVEF). The operation data consisted of the use of cardiopulmonary bypass time (CBP time), and number of diseased vessel. The postoperative data consisted of in-hospital DSWI (mortality within a 30-day period after operation), most common types of microorganism in wound or blood culture, and intubations time, ICU stay.

There were three prophylactic antibiotic regimens (only Cefazolin, Cefazolin + Gentamycin, and Cefazolin + Amikacin). All the prophylactic antibiotics were administered as a single dose 30 minutes before surgery and continued up to 48 hours after CABG at 3-hour intervals. Cefazolin was given 1gr. every 8 hours; those with a weight >80 received 2gr. Gentamycin and Amikacin were dispensed 1mg/kg/dose and 5mg/kg/dose, respectively.

Numerical variables were presented as mean ± SD, and categorized variables were summarized by percentages. Missing data were present in less than 5% of records. Unadjusted relative risks were determined;

the x^2 test or Fisher exact test was used, as appropriate, and 95% confidence intervals were determined. For continuous variables, the mean values and SDs were used to describe the data and the Student t test was used to compare values between groups. Stepwise multiple logistic regression was performed .Variables identified as possibly significant in the bivariate analysis (P >0.10) were entered into the model, after categorization of continuous variables, to obtain maximum likelihood estimates. These analyses were performed using SPSS software, version 14.0 (SPSS). All P values were 2-sided and P values less than 0.05 were considered statistically significant. The study protocol was approved by the Ethics Committee of Baqatallah University.

RESULTS

From patient who underwent a CABG procedure during the study period, the mean age was 60.4 ± 9.9 years (mean ± SD); there was 813 men (80.2%) and 201 women (19.8%). Of these patients, 12 (1.2%) had an infection during one month after cardiac surgery, including five (0.5%) with an admission diagnosis of infection in first 10 day's after surgery. The comparison of patients with DSWI to patients without DSWI is shown in Table-I.

Risk factors for deep sternal wound infection identified by univariate analysis include age (P= 0.030), increasing body mass index (BMI) (P < 0.000), Renal failure (P < 0.00), diabetes mellitus (P = 0.03), bypass time (P = 0.02), and

Table-I: Pre-intra and postoperative characteristics among patients with and without SWI

Variables	*Without sternal wound infection*	*With sternal wound infection*	*P valueUnivariate Analysis*
Age (mean±SD)	60.38±9.98	66.25±8.13	0.030
BMI (mean±SD)	27.44±4.27	35.10±3.11	0.000
Female %	199 (19.6%)	2 (0.2%)	NS*
Smoking %	247(24.4%)	2 (0.2%)	NS
Diabetes %	442 (43.7%)	9 (0.9%)	0.033
Hypercholesterolemia %	312 (30.8%)	3 (0.3%)	NS
Hypertension %	546 (53.8%)	3 (0.3%)	NS
LVEF (mean±SD)	45.89±9.94	48.08±10.10	NS
Graft number (mean±SD)	3.09±1.13	3.25±1.35	NS
Cross clamp time (minute) (mean±SD)	40.49±14.11	48.91±11.13	0.024
Bypass time (minute) (mean±SD)	72.39±23.37	75.25±15.55	NS
NYHA III and IV score %	282 (27.8%)	10 (9.9%)	0.000
Renal failure %	11(1.1%)	1(0.1%)	NS
Chronic obstructive pulmonary disease %	12 (1.2%)	0 (0 %)	NS
Congestive heart failure %	502(49.5%)	6(0.6%)	NS
Peripheral vascular disease %	10(1 %)	0(0%)	NS
Number of diseased vessels (mean±SD)	1. 8±0.72	2.41±0.66	NS
Intubation time (Hour) (mean±SD)	7.59±2.16	7.83±2.32	NS
Preoperative hospital stay (Day) (mean±SD)	1.5±0.50	1.66±0.65	NS
Ward Stay before wound infection (Day) (mean±SD)	3.33±0.88	3.23v±0.92	NS
ICU stay (Day) (mean±SD)	1.69±0.71	1.91±79	NS

Body mass index, BMI; New York heart association, NYHA; left ventricular ejection fraction, LVEF
*NS, Non Significant

in class three or four of the New York Heart Association functional class (P= 0.00).

Logistic regression analysis was conducted and the risk factors that significantly predicted sternal wound complications after CABG surgery included older age (odds ratio [OR] = 1.128, 95% confidence interval [CI] 1.038-1.227), increasing BMI (OR = 1.355, 95% CI 1.209-1.518), Diabetes (OR 1.723, 95% CI.530-1.934), and in class three or four of the New York Heart Association functional class (OR = 4.186, 95% CI 1.970-8.897). Most infections had a late (median 8 days after surgery), and the majority of these were caused by staphylococcus epidermidis (41.7%). Other reported infection according to culture included pseudomonas aeroginosa (16.7%), streptococcus pneumonia (16.7%), Meticilline resistance staphylococcus aureus (16.7%) and e-coli (8.3%). The clinically most fulminate infections were caused by e-coli and presented early after surgery (2 day's after surgery) the patient with infection and renal failure died three days after surgery.

By surgical intervention and systemic administration of cephtriaxone and Vancomycine, all patients with DSWIs caused by all major, clinically important bacterial species were treated. Because of important role of anaerobic pathogen clindamycin was used.

DISCUSSION

Cardiothoracic surgery is associated with higher postoperative infection rates. It increases the length of hospital stay and cost of treatment.[15] It is therefore important to identify adequate evidence to reduce the incidence of postoperative infection. And identify the epidemiology of postoperative infections. The overall rate of deep sternal wound infection in this study was 1.2% and seems to be in the acceptable range.

This study like other studies confirms the predominance of gram positive and aerobics as the primary cause of DSWI. The major pathogens in this study were gram positive; the remaining infection was accounted for by gram negative organism. although in some report *S.areeus* are the first cause of DSWI but there are survey[16] that *S.epidermis* like our study is more frequent and it may be related skin flours and doing not enough or correct skin disinfection before surgery.

Cephazolin and amikacin regimen is a broad spectrum regimen and has a good cover against *S.areus* that count for serious mortality and morbidity. The other risk factor counted for *S.Areus* in literature are diabetes, immune compromise, and recent antibiotic use, low BMI and close contact with individuals with risk factors.[17] In our study most of the patients had increased BMI. With appropriate use of Vancomycin, all infected patients were treated successfully.

Among patient characteristics, Grade III, IV NYHA score, diabetes and obesity showed a statistically significant relation with SWI. Other studies have also been identified these as risk factors.[18]

Most patients undergoing operation in Grade III, IV NYHA score are in poor physical condition. Often, the poor condition will continue intra and after the postoperative period and in these patients with frequent use of IABP, intravenous catheter and endotracheal tube frequently have to be kept in place longer. This condition cause an infectious barrier malfunction and microorganisms migration to the mediastinal wound.

The possible reasons for obesity being a risk factor include ineffective dose of prophylactic antibiotic, difficulty of proper skin preparation, adipose tissue providing a good substrate for infection and difficulties in vascular graft harvesting. Administration of Cephazolin does not seem to be sufficient in patient having weight less than 80 and have BMI more than 30.

Older age has been associated with many complication after surgery, Hung Ku reported With a 1-year increase in patient age, the risks of sternal SSI would be increased 14 percent[19] which may be related to systemic organ damage. Cruse and Foord[20] have demonstrated that in patients over the age of 66 years the chances of developing wound infection are twice as great as in patients between 21-50 years of age.

Use of CPB may induce suppression of the immune system.[21] Duration of surgery can be a risk factor. Operations lasting for more than two hours are associated with increased infection rates.[22] The longer the duration of surgery the more environmental exposure, hence a higher infection rate is expected. It is also reported that OPCABG is associated with reduced risk of infections as compared with CABG with CPB.[23]

Many other risk factors have been implicated in wound infection. It has long been assumed that wound infections are common amongst patients with multiple preexisting diseases.[24] However organ failure (such as Renal failure in our study), is a significant risk factor. Blanchard[25] reported preoperative renal failure as a risk factor for SWI extension, chronic renal failure in Iranian heart score is mentioned as a risk factor and outcome in Iranian cardiac surgery[26] that is independent of the stage of CKD and assumes that the benefit of coronary revascularization exceeds the risk for renal failure as a result of the evaluation/ intervention.[27] We suggest more investigation for newer prophylactic regimen for these patients.

CONCLUSIONS

Advanced age, diabetes and obesity, NYHA high score were the important risk factors identified for deep sternal wound infection after CABG. As such we suggest that more attention should be paid to these patients. Modifying the risk factor and making decision according to risk factor such as appropriate administration of prophylactic antibiotic in patient with poor physical status, good control of diabetes are recommended.

ACKNOWLEDGEMENTS

The authors thank member of Medical Students' Scientific Research Centre' Zahra Farrokhi Barfe, Yaser Saaidi and Farid Mokhtari who participated in the data collection.

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