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Postoperative Deep Sternal Wound Infections in Patients Undergoing Coronary Artery Bypass Surgery

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Abstract

Introduction: Open heart surgery is one of the most common surgical procedures performed in developed countries; Coronary Artery Bypass Grafting (CABG), Aortic Valve Replacement (AVR), and Mitral Valve Repair (MVR) being the most common procedures. Our aim of the study is to find out the incidence of DSWI among the patients in of coronary artery bypass grafting during the hospital stay at our institute and risk factors associated with this complication and to formulate a protocol for management of this group of cardiac surgical patients and for minimizing such complications. *Methods:* The is aretro prospective single center observational study. The study consists of 2772 patients who underwent coronary artery bypass grafting surgery between October 2016 and September 2019 at our institute. Patients were divided in two groups based on the CABG and CABG with DSWI. In Group 1 (2706 patients), while in group 2 (66 patients). All the preoperative baseline, intraoperative and postoperative data were collected. *Result:* In our study we have found that Preoperative parameters PAD ($p<0.0001$) and Smoking ($p<0.001$) were significantly higher in group 2 (CABG + DSWI). Higher weight was associated with increased incidence of DSWI 42.4% of patients having BMI ≥ 30 kg/m^2. ($p=0.0082$). Bypass Grafting with LIMA-RIMA had significantly high development rate for DSWI, LIMA-RIMA CABG performed in Group 1 in 372 (13.7%) patients and in Group 2 in 15 (22.7%) ($p=0.0375$). In addition, significant difference to develop DSWI is also founds in High drainage Output (≥ 1 lit), Re-exploration, Reintubation in Group 1 (Non DSWI) with 4.5% (122) patients, 3.88% (105) patients and 4.1% (112) patients while in Group 2 have only 27.2% (18), 28.7% (19) and 24.2%(16) respectively ($p<0.0001$). It had been seen that increase in ICU stay and increase in ventilation stay are again two chief factors to lead DSWI. *Conclusion:* The present study confirms that preoperative parameters like age > 60 years, uncontrolled DM II, HTN, PAD, Smoking, Obesity (BMI ≥ 30) increase the risk of deep sternal wound infection. Intraoperative risk factors like LIMA-RIMA grafting, high rate of blood transfusion (PCV > 3 unit) have prompt to increase incidence of DSWI in postoperative period while postoperative parameters like High drainage output (≥ 1 lit), Re-exploration, Reintubation, Longer mechanical ventilation time have also predispose to develop DSWI.

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Introduction

Open heart surgery is one of the most common surgical procedures performed in developed countries; coronary artery bypass grafting (CABG), aortic valve replacement (AVR), and mitral valve repair (MVR) being the most common

procedures.[1,2] Usually CABG performed in recent times off pump and in small amount of cases done on pump. For open heart surgery, access to the heart is usually gained via sternotomy, dividing the manubrium and sternum longitudinally with a saw. In later years, however, some valvular and coronary bypass procedures have increasingly been performed through partial upper or lower sternotomy[3,4] or minimal right or left thoracotomy.[5,6] These approaches are often technically challenging but the rationale is to reduce pain and other complications that are related to the sternotomy itself, such as surgical site infections (SSIs) and need for reoperations due to bleeding. Our aim of the study is to find out the incidence of DSWI among the patients in of coronary artery bypass grafting during the hospital stay at our institute and risk factors associated with this complication. To formulate a protocol for management of this group of cardiac surgical patients. To suggest preventive measures for minimizing such complications.

Study Design

Retroprospective single center observational study at tertiary referral center. The study consists of 2772 patients who underwent coronary artery bypass grafting surgery between October 2016 and September 2019 at our institute.

Patients were divided in two groups based on the CABG and CABG WITH DSWI. In group 1(2706 patients), while in group 2(66 patients).

Inclusion criteria

- All patients who underwent CABG or CABG with additional procedure from October 2016 to September 2019 at UNMICRC were included,patients operated both in routine in emergency were included. Thesepatients are divided in to two groups.
  - Group 1: Consist of patients who CABG Patient without DSWI
  - Group 2: Consist of patient who are diagnozed with postoperative sternal complications in patients undergoing coronary artery bypass surgery.

Exclusion criteria

Adult Cardiac Surgery other than CABG.

Following parameters were compared between the two groups:

Preoperative Baseline Parameters	Intraoperative Parameters	Postoperative Parameters
• Age • Sex • Diabetes Mellitus • Hypertension • COPD • CRF • H/O Anaemia • Hypoalbuminemia • Leucocytosis • Vessels Involvement • Lv Function	• Planned or Emergency • LIMA • BIMA • Use of PCV • No of Grafts • Types of Wiring • Type of Skin Closure • Perioperative Antibiotics	• Use of IABP • Ventilation Hours • 3rd Day Total Count • 3rd Day Serum Albumin • Reexploration • ICU Stay • Mortality

Patients and Methods

Population

From October 2016 to September 2019, 2772 consecutive cardiac surgical procedures through a midline sternotomy were performed at the UNMICRC Hospital. Our computerized registry was surveyed for those patients with a diagnosis of sternal wound infection, then a manual chart review was performed on these patients.

Deep sternal wound infection was defined according to the guidelines of the Centers for Disease Control and Prevention, with patients meeting at least one of the following criteria:

(1) An organism is isolated from culture of mediastinal tissue or fluid;

(2) Evidence of mediastinitis is seen during operation; or

(3) One of the following, chest pain, sternal instability, or fever (.38°C), is present and there is either purulent discharge from the mediastinum or an organism isolated from blood culture or culture of drainage of the mediastinal area.

Perioperative Management

Patients were showered and shaved the day of their operation. All patients received intravenous cefuroxime or cefuroxime plus gentamycin, preoperatively and for 48 hours postoperatively. The operative field was painted with povidone-iodine solution and the skin was covered with an iodoform-impregnated adhesive plastic sheet (Ioban; 3M, Brookings, SD). The skin was incised with a scalpel and electrocautery was used to open the presternal layers and pericardium. Bone wax was used only if sternal bleeding was profuse. Internal thoracic arteries were harvested as pedicled in situ

grafts when used for coronary bypass. Sump drains were placed in the mediastinum, and chest tubes were inserted into the pleural spaces if opened. The sternum was closed with stainless steel wires. The presternal space was obliterated with two layers of absorbable suture, and the skin was closed with a subcuticular absorbable suture. Patients were extubated when they were hemodynamically stable, normothermic, and ventilating spontaneously. All drains were removed the morning after operation or when drainage was less than 25 mL/h.

Management of Infection

Sixty six of the 2772 patients (2.38%) were diagnozed with DSWI on the same admission as their cardiac surgical procedure. All discharged patients with wound infections are readmitted to our institution under the attending cardiovascular surgeon. Patients were started on broad-spectrum antibiotics when the diagnosis of sternal wound infection was made. 66 patients with DSWI underwent surgical therapy. Patients underwent either sternal debridement with primary closure (n=45) or sternectomy with muscle flap reconstruction (n=21) at the discretion of the attending surgeon. In general, however, patients underwent prompt, simple sternal debridement, without closed irrigation, if the infection was thought to be localized to a small section of the sternum and there was little or no purulent drainage. Patients received flap reconstruction if there was evidence of mediastinitis, if a large amount of purulent drainage was present, or if the majority of the wound was thought to be involved. All flap reconstructions were performed by the UNMICRC plastic surgery unit.

Study Variables

Multiple variables were recorded prospectively and analyzed retrospectively as predictors of DSWI. Patients were divided into two groups: those with DSWI (n=66) and those without DSWI (control patients, n=2706). Comparisons of baseline demographics and intraoperative and postoperative variables were made between the two groups of patients to identify predictors of DSWI.

Statastical Analysis

A nonrandomized control trial was held between October 2016 to September 2019 to study of risk factors and outcomes of deep sternal wound infection in patients who underwent coronary artery bypass surgery.

Result

Table 1: Patient Characteristics, Comorbidities, and Procedure Related Variables.

	CABG without DSWI (n=2706)	CABG with DSWI (n=66)	Total patients (n=2772)
Age (years)	58.32 ± 8.74	65.98 ± 5.08	<0.0001
<40	39 (1.4%)	0	0.3259
40-60	1356 (50.1%)	0	<0.0001
> 60	1311 (48.4%)	66 (100%)	<0.0001
Sex			
Male	2200 (81.3%)	48 (72.7%)	0.0788
Female	506 (19.7%)	18 (27.2%)	
Hypertension	1078 (39.8%)	17 (25.7%)	0.0207
DM	1021 (37.7%)	66 (100%)	<0.0001
COPD	392 (14.4%)	13 (19.6%)	0.2363
Smoking	872 (32.2%)	34 (51.5%)	0.0009
PAD	237 (8.7%)	29 (43.9%)	<0.0001
Preoperative Dialysis	15 (0.5%)	0	0.5441
BMI			
18.5-24.9	1152 (42.57%)	19 (28.7%)	0.0250
25.0-29.9	806 (29.78%)	19 (28.7%)	0.8602
≥ 30	748 (27.64%)	28 (42.4%)	0.0082
H/O Anemia	726 (26.82%)	20 (30.3%)	0.5296
Hypoalbumin	195 (7.2%)	9 (13.6%)	0.0481
HbA1C	1571 (58.1%)	56 (84.8%)	<0.0001
Leukocytosis	589 (21.7%)	31 (46.9%)	<0.0001

	CABG without DSWI (n=2706)	CABG with DSWI (n=66)	Total patients (n=2772)
Vessel Involved			
SVD	131 (4.84%)	2 (3.03%)	0.4971
DVD	1020 (37.7%)	28 (42.4%)	0.4336
TVD	1557 (57.5%)	36 (54.5%)	0.6271
Urgency operation			
Emergency	536 (19.8%)	15 (22.7%)	0.5569
Planned	2170 (80.1%)	51 (77.2%)	
Ejection Fraction Categories			
> 50%	1338 (49.4%)	32 (48.4%)	0.8768
30-50%	814 (30.1%)	19 (28.7%)	0.8213
<30%	554 (20.4%)	15 (22.7%)	0.4734
LIMA	2490 (92%)	61 (92.4%)	0.9025
LIMA-RIMA	372 (13.7%)	15 (22.7%)	0.0375
No of Graft			
1	76 (2.8%)	2 (3.03%)	0.9127
2	1158 (42.7%)	29 (43.9%)	0.8515
3	918 (33.9%)	26 (39.3%)	0.3542
4	543 (20.1%)	9 (13.6%)	0.1962
5	8 (0.3%)	0	–
6	3 (0.1%)	0	–
Type of wiring			
Simple Interrupted	1121 (41.4%)	31 (46.96%)	0.3666
Fig Of Eight	1585 (58.5%)	35 (53.03%)	
Type of skin suture			
Skin Matteres	425 (15.7%)	10 (15.1%)	0.9025
Subcuticular	2281 (84.2%)	56 (84.8%)	
PCV > 3 units	1389 (51.3%)	24 (36.3%)	0.0009
IABP	202 (7.4%)	3 (4.5%)	0.3704
High drainage Output (≥ 1 lit)	122 (4.5%)	18 (27.2%)	<0.0001
Reexploration	105 (3.88%)	19 (28.7%)	<0.0001
Reintubation	112 (4.1%)	16 (24.2%)	<0.0001
Ventilation stay (hrs)	18.36 ± 12.85	22.10 ± 14.36	0.0418
ICU Stay (days)	3.45 ± 1.72	3.89 ± 1.99	0.0409
Mortality	114 (4.21%)	14 (21.1%)	<0.0001
Preoperative Antibiotic			
Cefuroxime	1461 (54%)	34 (51.5%)	0.6900
Cefuroxime + Gentamycin	1245 (46%)	32 (48.4%)	

- In our study, there was increasing age with Group 2 (CABG + DSWI) which is evident from Table 1. In Group 2 all patients were above 60 years of age. While there was no sex prediction in both Groups. Hypertension, COPD and preoperative dialysis was not having difference in both Groups. DM-II one of the most important factor which was evident in Group of patients having DSWI. ($p<0.001$). PAD ($p<0.0001$) and Smoking ($p<0.001$) were significantly higher in Group 2 (CABG + DSWI) respectively. Higher weight was associated with increased incidence of DSWI 42.4% of patients having BMI ≥ 30 kg/m^2. ($p=0.0082$)
- Though, one third of the patients having anemia preoperatively, but equally associated in the both groups. But hypoalbuminemia has shown higher prediction for DSWI. ($p=0.0481$). Control of DM II is most important determinant as long term uncontroled glucose level with higher HbA1C level of our patients. ($p<0.0001$). Group 2 (CABG + DSWI) having higher incidence of leukocytosis (46.9%) which could be a preoperative parameter to be seen with caution before planning g of surgery. Involvement of SVD, DVD, or TVD does not having significant correlation with DSWI. We have taken both emergency and planned cases

but we did not find difference between two groups. Which shows that if proper precautions taken preoperatively as well as intraoperatively emergency surgery does not increase risk for DSWI. We found that there was no difference in incidence of DSWI when we compare mild, moderate, severe LV dysfunction (mild = >50%, moderate=30-50%, sever = < 30%) shown again emphasis that even with low LVEF patient's sternal wound heals normally. There was definite significant impact of single or bilateral IMA use during CABG. Patients with bilateral IMA grafting having DSWI high incidence. (p=0.0375). Blood transfusion alone proven risk factor for DSWI was reattrited as our study found that group having more than 3 unit of PCV was having high incidence of DSWI.

- There was no changed in the sternal wound infection in relation to number of grafts, type of wiring, or type of skin closure indication that any methodology when properly performs gives equal results. Preoperative antibiotic protocol also not showing difference between the two groups. Thus indicates all of most used regimes are equally effective. (Table 1)

Post-CABG DSWI occurred in 66(2.38%) of the 2772 patients**.**

In Group 1 (non DSWI) patients undergone CABG at age < 40 are 1.47% (39), age between 40–60 are 50.36% (1356) and age ≥ 60 are 48.4% (1311) while in Group 2 100% (66) patients are of age ≥ 60. Group 1 (non-DSWI, n=2706) patients were comprised of 81.3% (2200) males and 19.7% (506) females, while Group 2 (DSWI, n=66) patients were composed of 72.7% (48) males and 27.3% (18) females at (p=0.0788) (Table 2).

In Group 1 diabetes mellitus was found in 1027 patients while in Group 2 it is found in all 66 patients so Diabetes mellitus (37.7% *vs* 100%) Groups 1 and 2, respectively (p < 0.0001) is the most significant factor. Similarly, Hypertension, Smoking and PAD was found in 39.8% (1078), 32.2% (872), 8.7% (237) in Group 1 and 25.7% (17), 34 51.5% (34) and 43.9% (29) with (p<0.01) respectively.

On the contrary

Other factors such as COPD, preoperative Dialysis, and history of anemia had no such significant impact on the incidence of DSWI. In Group 1 COPD was present in 14.4% (392) while 19.6% (13) in Group 2. Only 15 (0.5%) patients were undergone preoperative Dialysis in Group 1 and no one needed preoperative Dialysis in Group 2. 26.82% (726) patients had history of anemia in Group 1 and 30.3% (20) in Group 2. (Table 3)

In Group 1 (non DSWI) patients undergone CABG with BMI at normal range with 42.57% (1152), overweight 29.78% (806), and obesity (27.64%) 748 while in Group 2 have 28.7% (19), 28.7% (19) and

Table 2: Age and Gender Wise Distribution.

	CABG Without DSWI (n=2706)	CABG with DSWI (n=66)	P value
Age (years)	58.32 ± 8.74	65.98 ± 5.08	<0.0001
<40	39 (1.4%)	0	0.3259
40-60	1356 (50.1%)	0	<0.0001
> 60	1311 (48.4%)	66 (100%)	<0.0001
Male	2200 (81.3%)	48 (72.7%)	0.0788
Female	506 (19.7%)	18 (27.2%)	

Table 3: Pre OP Risk Factors Wise Diatribution.

	CABG Without DSWI (n=2706)	CABG with DSWI (n=66)	P value
Hypertension	1078 (39.8%)	17 (25.7%)	0.0207
DM	1021 (37.7%)	66 (100%)	<0.0001
COPD	392 (14.4%)	13 (19.6%)	0.2363
Smoking	872 (32.2%)	34 (51.5%)	0.0009
PAD	237 (8.7%)	29 (43.9%)	<0.0001
Preoperative Dialysis	15 (0.5%)	0	0.5441

42.4% (28) respectively significant to normal range and obesity (p<0.0001). (Table 4)

Patients with Hypoalbuminemia are 13.6% (9) in Group 2 is higher than 7.2% (195) in Group 1 (p=0.0481). Similarly HbA1c was high in 58.1% (1571) in Group 1 and 84.8% (56) in Group 2 (p<0.0001). Moreover, leukocytosis is also significantly more present 46.9% (31) in Group 2 than 21.7% (589) in Group 1 (p <0.0001).(Table 5)

In the present study, due to vessel involved; SVD 4.84% (131) *vs* 3.03% (2); DVD 37.7% (1020) *vs* 42.4% (28); TVD 57.5% (1557) *vs* 54.5% (36) respectively in Group 1 and Group 2 shown this factor had no major role in development of DSWI (Table 6).

Even urgency of surgery did not make any significant difference in development of DSWI, 19.8% were emergency surgery and 80.1% were planned surgery in Group 1 where 22.7% were emergency and 77.2% were planned surgery in Group 2 (Table 7).

The ejection fraction categories, EF > 50% was in 49.4% (1338) and 48.4% (32) patients; EF 30-50% was in 30.1% (814) and 28.7% (19) patients; EF < 30% was in 20.4% (554) and 22.7% (15) patients in Group 1 and Group 2 respectively (Table 8).

Table 4: BMI Parameters.

BMI (kg/m2)	CABG Without DSWI (n=2706)	CABG with DSWI (n=66)	P value
18.5-24.9	1152 (42.57%)	19 (28.7%)	0.0250
25.0-29.9	806 (29.78%)	19 (28.7%)	0.8602
≥ 30	748 (27.64%)	28 (42.4%)	0.0082

Table 5: Abnormal Biochemical Parameters.

	CABG Without DSWI (n=2706)	CABG with DSWI (n=66)	P value
H/O Anemia	726 (26.82%)	20 (30.3%)	0.5296
Hypoalbuminemia	195 (7.2%)	9 (13.6%)	0.0481
HbA1C	1571 (58.1%)	56 (84.8%)	<0.0001
Leukocytosis	589 (21.7%)	31 (46.9%)	<0.0001

Table 6: Vessel Involved.

Vessel Involved	CABG Without DSWI (n=2706)	CABG with DSWI (n=66)	P value
SVD	131 (4.84%)	2 (3%)	0.4971
DVD	1020 (37.7%)	28 (42.4%)	0.4336
TVD	1557 (57.5%)	36 (54.5%)	0.6271

Table 7: Urgency Operation.

Urgency operation	CABG Without DSWI (n=2706)	CABG with DSWI (n=66)	P value
Emergency	536 (19.8%)	15 (22.7%)	0.5569
Planned	2170 (80.1%)	51 (77.2%)	

Table 8: Ejection Fraction Categories.

EF Categories	CABG Without DSWI (n=2706)	CABG with DSWI (n=66)	P value
> 50%	1338 (49.4%)	32 (48.4%)	0.8768
30-50%	814 (30.1%)	19 (28.7%)	0.8213
<30%	554 (20.4%)	15 (22.7%)	0.4734

Table 9: CAG Categories.

CAG	CABG Without DSWI (n=2706)	CABG with DSWI (n=66)	P value
LIMA	2236 (92%)	61 (92.4%)	0.9025
LIMA-RIMA	372 (13.7%)	15 (22.7%)	0.0375

Table 10: Postoperative Parameters.

Post-operative parameters	CABGWithout DSWI (n=2706)	CABGwith DSWI (n=66)	P value
PCV > 3 units	1389 (51.3%)	24 (36.3%)	0.0162
IABP	202 (7.4%)	3 (4.5%)	0.3704
High drainage Output (≥ 1 lit)	122 (4.5%)	18 (27.2%)	<0.0001
Reexploration	105 (3.88%)	19 (28.7%)	<0.0001
Reintubation	112 (4.1%)	16 (24.2%)	<0.0001
Ventilation stay (hrs)	18.36 ± 12.85	22.10 ± 14.36	0.0418
ICU Stay (days)	3.45 ± 1.72	3.89 ± 1.99	0.0409
Mortality	114 (4.21%)	14 (21.1%)	<0.0001

Table 11: Type of Wiring Parameters.

Type of wiring	CABG Without DSWI (n=2706)	CABG with DSWI (n=66)	P value
Simple Interrupted	1121 (41.4%)	31 (46.96%)	0.3666
Figure of Eight	1585 (58.5%)	35 (53.03%)	
Type of skin suture			
Skin Matteres	425 (15.7%)	10 (15.1%)	0.9025
Subcuticular	2281 (84.2%)	56 (84.8%)	

In Group 1 (non DSWI) and Group 2 (DSWI) respectively 2490 (92%) and 61 (92.4%) patients undergone Coronary Artery Bypass Grafting with LIMA but it has been seen that patients undergone coronary Artery Bypass Grafting with LIMA-RIMA had significantly high development rate for DSWI, LIMA-RIMA CABG performed in Group 1 in 372 (13.7%) patients and in Group 2 in 15 (22.7%) (p=0.0375). (Table 9)

Another factor to make significant difference to develop DSWI is transfusion of PCV >3 units, in Group 1 (Non DSWI) 51.3% (1389) patients were transfused with PCV >3 units while in Group 2 only 36.3% (24) were transfused with PCV> 3 units (p<0.0162). To assess the effectiveness of preoperative intraaortic balloon pump (IABP) placement before CABG in Group 1 was 7.4% (202) and in Group 2 was 4.5% (3). In addition, significant difference to develop DSWI is also founds in High drainage Output (≥ 1 lit), Reexploration, Reintubation in Group 1 (Non DSWI) with 4.5% (122) patients, 3.88% (105) patients and 4.1% (112) patients while in Group 2 have only 27.2% (18), 28.7% (19) and 24.2%(16) respectively (p<0.0001). It had been seen that increase in ICU stay and increase in ventilation stay are again two chief factors to lead DSWI. Average ICU stay in Group 1 was 3.45 1. ± 72 days and in Group 2 it was 3.89 ± 1.99 days.(P 0.0409) Average ventilation stay in group 1 was 18.36 12 ±.85 hours and in Group 2 it was 22.10 14 ±.36 hours. (P 0.0418). The in-hospital mortality rate in Group 1(non-DSWI) and Group 2 (DSWI) were 1.1% (29) and 10.60% (7) respectively. (P < 0.001). (Table 10)

To assess the effectiveness of intraoperative sternal wiring strategies Simple Interrupted 41.4% (1121) and Fig of Eight 58.5% (1585) in Group 1 while in Group 2 was 46.96% (31) and 53.03% (35) respectively. To assess the effectiveness of intraoperative skin suturing techniques skin matteres 15.7% (425) and Subcuticular 84.2% (2281) in Group 1 while in Group 2 was 15.1% (10) and 84.8% (56) respectively (Table 11).

In the present study, Group 2 (DSWI) patients have wound culture positive with such organisms as Pseudomonas 19(28.7%), S. Aureus 14(21.2%), Klebsiella 10(15.1%), Anaerobic 9(13.6%), Streptococcus 6(9.1%). While 8(12.1%) patients have found would culture negative. The management wise distribution, it was found that in Group 2 (DSWI) were rewiring were 68.1% (45) and Flap closure were 31.8% (21) respectively Fig. 1.

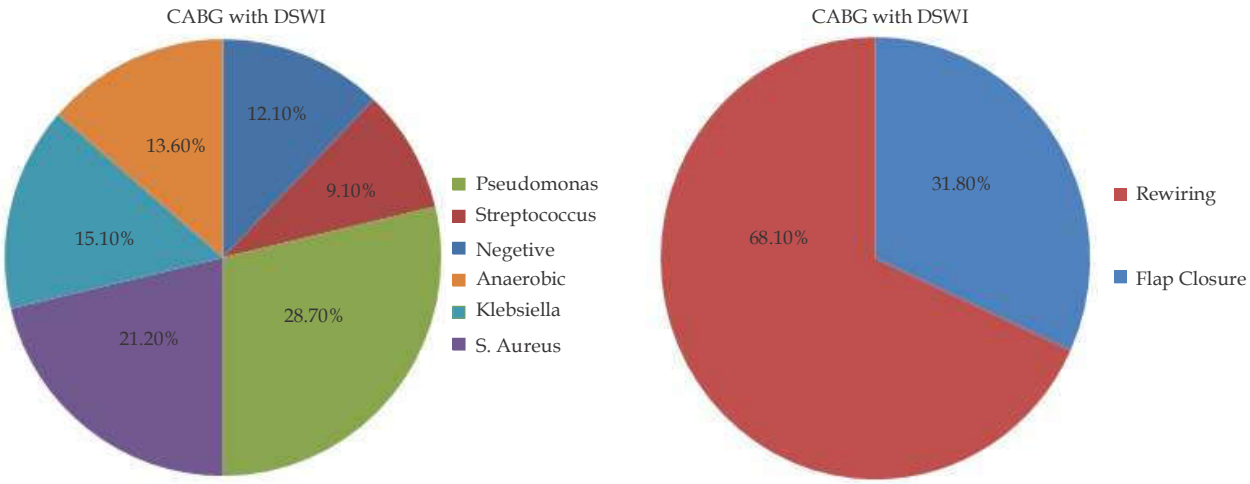

Fig. 1: Bacteriology Wise Distribution and Management Wise Distribution.

Table 12: Postoperative Antibiotic.

Postoperative Antibiotic	CABG Without DSWI (n=2706)	CABG with DSWI (n=66)	P value
Cefuroxime	1461 (54%)	34 (51.5%)	0.6900
Cefuroxime + Gentamycin	1245 (46%)	32 (48.4%)	

Positive factors in mortality of DSWI.

Sr No	Age	Sex	HTN	DM II	Smoking	PAD	Reex	Reintu	PCV> 3	BMI > 30 (kg/m2)	Total
1	67	M	–	+	+	–	+	–	+	–	3
2	60	M	+	+	+	+	–	+	–	+	6
3	60	F	+	+	–	–	+	–	+	–	4
4	64	M	–	+	+	–	–	+	–	–	3
5	75	M	–	+	–	+	–	–	+	–	3
6	61	F	–	+	+	–	+	–	+	–	4
7	67	M	+	+	+	–	+	+	–	+	6
8	67	M	–	+	+	–	+	–	+	–	4
9	67	F	+	+	–	+	–	–	–	–	3
10	61	M	–	+	+	–	–	+	+	–	4
11	60	F	–	+	–	–	+	–	–	+	3
12	62	M	–	+	+	+	–	–	+	–	4
13	69	F	+	+	–	+	–	–	+	–	4
14	60	F	+	+	+	–	+	–	+	–	5

To assess the effectiveness of perioperative antibiotics such as Cefuroxime 54% (1461) and Cefuroxime + Gentamycin 46% (1245) in Group 1 while in Group 2 was 51.5% (34) and 48.4% (32) respectively (Table 12).

Discussion

In the present study, incidence of DSWI in all CABG patients were 2.38%. Reported incidence of DSWI in different study groups were ranging from 0.9-3.2% which is comparable with our results.[7–11]

Diabetes Mellitus being the most common factor to develop DSWI as 100% of our DSWI patients were diabetic. 21.1% of our DSWI patients had positive wound culture with S. aureus was the most common cause in both superficial and DSWI, which in line with the results of similar research in the literature (33–70%).[7,8,12,13]

There are multiple preoperative factors shows positive prediction for DSWI like old age > 60 years, uncontrolled DM II, HTN, PAD, Smoking, Obesity (BMI ≥ 30) were positive predictors for DSWI ($p < 0.05$). Crabtree TD et al. also stated same

positive predictors for DSWI. Intraoperative risk factors like LIMA-RIMA grafting, high rate of blood transfusion (PCV > 3 unit) have also associate with increased incidence of DSWI in postoperative period. ($p<0.05$) [14]

In addition, postoperative parameters like high drainage output (≥ 1 lit), reexploration, reintubation, longer mechanical ventilation time have also predispose to develop DSWI. ($p<0.05$) which was comparable with the data provided by Ridderstolpe L et al.[15] DM, Age >60, Re-exploration for bleeding were also significant in the multivariate analysis. It is important to note that hypoalbuminemia is not viewed as significant risk factors by any other related investigations, which necessitates further research for elucidation and clarity.Interestingly, the factors that other studies type of wiring, poor LVEF, plan or emergency Surgery, had no influence on DSWI in our patients.[11,12,16]

We compared the effect of two different prophylactic antibiotic regimens which were routinely used in our hospital (only Cefuroxime, Cefuroxime + Gentamycin) on the development of DSWI. All these prophylactic antibiotics were given as a single dose preoperatively and continued up to 48 hours postoperatively. The results showed no significant difference between the these groups, and these findings are compatible with other studies provided by Kaiser AB.[17] The addition of aminoglycoside to Cefuroxime failed to reduce the rate of DSWI. We, therefore, employed only Cefuroxime as the prophylactic antibiotic (one dose preoperatively, which was continued for 48 hours after operation).

The perioperative mortality rate of our patients was 21.1% for Group 2 (DSWI) versus 4.21% for Group 1 (non-DSWI), which is relatively similar to that in other reports.[12,13]

In our institute, DSWI is managed by irrigation and rewiring (if possible) or pectoralis muscle flap in proportion to the condition of the patients and their wounds. Nonetheless, we managed most of our cases (mediastinitis) with irrigation and rewiring.[7]

Our use of suture techniques for skin closure in all the cases precluded a comparison between the rates of DSWI in the 2 techniques of subcuticular and transcutaneous (mattress suture technique). In our study no significant changes in incidence of DSWI in both techniques however comparison was made by Ozalp Karabay, who demonstrated an increased rate of DSWI when the intracutaneous suture technique was used relative to the transcutaneous method (16% versus 2%, respectively).[18]

We are inclined to believe that the high rate of DSWI in our institute inspite of meticulous preoperative, operative, and postoperative care of patients. We suggest that a single broad-spectrum antibiotic (Cefuroxime) be utilized as a prophylactic antibiotic in CABG patients without the addition of aminoglycoside.

Despite being cautious in perioperative management of CABG patients, we have to optimize our preoperative workup by means of controlling uncontrolled DM II, HTN by means of optimizing preoperative medication and nutrition to overcome Hypoalbuminemia.

Intraoperatively we should do meticulous work to achieve good hemostasis so that rate of reexploration and demanded blood transfusion can be avoided, which are also risk factors for DSWI. In our study, when we analyzed our patients who died during postoperative course with DSWI. We noticed that there are 9 risks factor which are in variably present in most of the patients, they are mainly age >60 years, DM, HTN, Smoking, PAD, Reexploration, Reintubation, PCV >3 units, BMI >30 kg/m^2. In all these cases minimum 4 out of 9 were present means 4 or more factors present there are highly predispose to mortality.

We have noticed that despite of taking all precautions from preoperative, intraoperative and postoperative such as high incidence of DM among the population, poor nutritional status, and habit of smoking, tobacco use and associated with background from which they are coming (it may affect personal hygiene level which may impact high incidence of DSWI).

- Some of modifiable risk factors like,
- Proper selection of patients
- Control of DM
- Weight control
- Abstinence of tobacco and smoking
- Proper planning of conduit
- Minimizing reexploration and post-operative bleeding
- Minimizing blood transfusion in post-operative period
- Possible early extubation

These steps helps to minimise incidence of DSWI as well as complications related to DSWI in postoperative period of patients of CABG.

Conclusion

Deep sternal wound infections are serious and life threatening complications of open heart surgery. Despite the great advances in prevention and treatment, many patients suffer from great morbidity and even mortality due to these infections. It is therefore, important to prevent them, but also take adequate step in management of it to improve the outcome of treatment.

DM, Age >60, Reexploration were significant in our multivariate analysis. The incidence of DSWI was 2.43% with mortality rate of 14%. The addition of aminoglycoside to the prophylactic antibiotic with Cefuroxime had no effect in decreasing the rate of DSWI. A host factors, ranging from control of the sterility chain and good hand washing to methodical preoperative, operative, and postoperative care, contributed to relatively good results.

The present study confirms that preoperative parameters like age> 60 years, uncontroled DM II, HTN, PAD, Smoking, Obesity (BMI ≥ 30) increase the risk of deep sternal wound infection. Intraoperative risk factors like LIMA-RIMA grafting, high rate of blood transfusion (PCV > 3 unit) have prompt to increase incidence of DSWI in postoperative period while postoperative parameters like High drainage output (≥ 1 lit), Reexploration, Reintubation, Longer mechanical ventilation time have also predispose to develop DSWI.

By control of modifiable risk factors, we drastically decrease occurrence of DSWI in patients of CABG which significantly improve outcome and results, since CABG is most commonly performed cardiac procedure and we should aim reduce mortality and morbidity due to DSWI.

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