# POSTOPERATIVE INFECTIONS FOLLOWING CARDIAC SURGERY

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#### ABSTRACT

## BACKGROUND

Postoperative infections following cardiac surgery are associated with life-threatening complications and prolonged hospitalisation. This in addition to increasing patient morbidity and mortality also proves to be an economic burden to patients and healthcare system.

## MATERIALS AND METHODS

This study was conducted with a view to identify the spectrum of postoperative infections in cardiac surgery patients along with studying the common bacterial isolates and the risk factors associated with the development of infections.

# RESULTS

The incidence of postoperative infections in these patients was found to be 22% with surgical site infections being the commonest. The other infections observed were urinary tract, respiratory and bloodstream infections. The commonest bacterial isolate was Pseudomonas aeruginosa followed by Staphylococci and enteric gram-negative bacilli. In the analysis of risk factors age >45 years, obesity, surgery for coronary artery bypass grafting, operative time of >6 hours and mechanical ventilation for >6 hours were associated with increased risk of infection.

# CONCLUSION

Infections following cardiac surgeries are important cause of postoperative morbidity. Their prevention by reducing modifiable risk factors and implementing proper infection control practices seems to be a best course of action.

#### **KEYWORDS**

Postoperative Infections, Cardiac Surgery, Surgical Site Infections, Risk Factors.

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### BACKGROUND

Cardiac surgeries have become one of the routinely performed surgeries in India. Postoperative infections can ruin the best of surgeries because of associated lifethreatening complications.<sup>(1)</sup> Patients undergoing cardiac surgery are at increased risk for the developing nosocomial infections due to presence of multiple surgical wounds and frequent use of invasive devices for postoperative monitoring.<sup>(2,3)</sup> Postoperative infections not only prolong the hospital stay and recovery time, but they also increases the out of pocket expenditure associated with such procedures. Postoperative infections may take many forms viz. surgical site infection, mediastinitis, respiratory tract, urinary tract and blood stream infections.<sup>(1)</sup>

In spite of numerous advances in reconstructive surgical techniques, the infections following cardiac surgeries are difficult to treat.<sup>(4)</sup> It is therefore imperative to implement adequate measures to reduce these infections. To this end, it is necessary to identify epidemiological risk factors for postoperative infection following cardiac surgery.<sup>(1)</sup>

Financial or Other, Competing Interest: None. Submission 19-05-2017, Peer Review 27-06-2017, Acceptance 03-07-2017, Published 10-07-2017. Corresponding Author: Dr. Jaya Lalwani, Associate Professor, Department of Microbiology, Gandhi Medical College, Royal Market, Bhopal. E-mail: drjaya\_is@yahoo.co.in DOI: 10.14260/jemds/2017/898 This study was conducted with objective to determine the spectrum of postoperative infection associated with cardiac surgery in term of their anatomical location, bacteriological profile and antibiotic sensitivity. We also assessed the determinants of postoperative infection following cardiac surgery.

### MATERIALS AND METHODS Study Design

This was a descriptive study.

#### **Study Duration**

Total duration of surgery was one year. The period of data collection was six months.

#### **Study Setting**

The present study was conducted in a tertiary care hospital of western India.

#### **Study Participants**

Patient of all age groups and both gender undergoing major and minor cardiac surgery in the institute.

#### **Exclusion Criteria**

Person operated at other institute and referred to index institute for any reason.

#### Sample Size

All patients who fulfilled the selection criteria for study participants during the period of data collection were included in the study. Following this, data was collected from a total of 100 patients.

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# Sample Collection

Clinical samples viz. blood, sputum, urine and secretions from site of surgery were collected using aseptic procedure. Considering localising signs and symptoms, various samples like blood, respiratory secretions, urine and wound swabs were collected. The samples obtained were processed using standard bacteriological techniques for microscopy and culture. Antibiotic susceptibility testing of isolate mainly for the first line antibiotics and those used in prophylaxis was done by Kirby-Bauer method.<sup>(5)</sup>

# Data Analysis

The filled questionnaires were cross-checked for completeness of data by authors before entering into SPSS version 20 for data analysis. Descriptive statistics (percentage, frequency, mean, median, etc.) were used to describe the study sample. The associations between postoperative infection and study variable were investigated using Chi-square test. P-values <0.05 were considered significant.

# RESULTS

Of the total 100 patients included in the study, 22 (22.0%) patients developed postoperative infections. Of the total person who developed any type of infection close to 33.0%, patients developed postoperative infections during the follow-up visits (within 30 days) after discharge from the hospital.

The most common type of postoperative infection was surgical site infections. In numerical terms, a total of 14% patients suffered from surgical site infections either at sternal site or leg harvest site. Only 3 patients developed deep-seated infections. Urinary tract infections were the second most common infections in hospitalised patients. All urinary tract infections were catheter associated and occurred predominantly in females. The respiratory tract infection and blood stream infection occurred in 3 patients each.

Table 2 summarises the proportion of postoperative infection and the type of cardiac surgery performed on patients. The three most common bacteria isolated from the postoperative infection were Pseudomonas aeruginosa, Staphylococci and Enterobacteriaceae. Various risk factors associated with development of postoperative infections in cardiac surgeries patients are summarised in Table 4.

Type of Infection	No. of Infected Patients (n)	%			
Surgical site infection (sternal site + leg harvest site)	14	14.0			
Urinary tract infection	6	6.0			
Respiratory tract infection	3	3.0			
Bloodstream infection	3	3.0			
No infection	74	74.0			
Table 1. Distribution of Study Participants Based					
on the Types of Infections Observed (n=100)					

**Type of Surgery Total Patients** Infected Patients n (%) SSI UTI RTI BSI Mitral valve replacement 30 5 (16.66) 3 3 -Atrial septal defect closure 3 (14.28) 1 2 21 --Coronary artery bypass grafting 19 8 (42.10) 6 1 2 2 Closed mitral valvotomy 7 ----3 (50) Total correction of tetralogy of Fallot 2 6 1 Patent ductus arteriosus ligation 6 Aortic valve replacement 5 1 (20) 1 Double valve replacement 4 2 (50) 1 1 3 Open mitral valvotomy \_ Ventricular septal defect 1 --\_ \_ Pulmonary valvotomy 1 \_ 100 22 14 6 3 Total 3 SSI- Surgical site infections, UTI- Urinary tract infection, RTI- Respiratory tract infection, BSI- Blood stream infection Table 2. Distribution of Study Participants by the Type of Cardiac Surgery and Postoperative Infections (n=100)

A Few patients have undergone more that one surgical procedures out of total 100 patients.

Isolates	SSI		UTI	DTI	DCI	Tatal	0/	
	Sternal	Leg	UII	KII	821	Total	%	
Pseudomonas aeruginosa	5	1	2	1	-	9	23.07	
Coagulase-negative staphylococci	4	1	1		1	7		
Methicillin resistant	3	-	1	-	1	5	17.95	
Methicillin sensitive	1	1	-		-	2		
Staphylococcus aureus	2	1	1	1	1	6		
Methicillin resistant	1	-	1	1	-	3	15.38	
Methicillin sensitive	1	-1	-	-	1	3		
Klebsiella pneumonia	3	-	1	1	1	6	15.38	
Escherichia coli	1	1	2	-	-	4	10.25	
Proteus mirabilis	2	-	-	-	-	2	5.13	
Proteus vulgaris	-	-	1	-	-	1	2.56	
Nonfermenter gram-negative bacilli	1	-	1	-	-	2	5.13	
Acinetobacter spp.	1	-	-	-	-	1	2.26	
Streptococcus pyogenes	-	-	-	1	-	1	2.26	
Table 3. Distribution of Different Isolates According to Their Types of Infections								

Risk Factor	<b>Total Patients</b>	Infected Patients	%	<b>Chi-Square Statistics</b>	P Value					
Age										
0-15	20	2	10		0.041					
16-45	61	12	19.67	3.5						
>45	19	8	42.1							
Gender										
Male	44	11	25	0.74	0.092					
Female	56	11	19.64	0.74						
Body Mass Index (in kg/m <sup>2</sup> )										
<25	60	12	20		0.029					
25-30	27	5	18.51	4.8						
>30	13	5	38.46							
Diabetes Mellitus										
Yes	3	1	33.33	1 5 2	0.047					
No	97	21	21.64	1.32	0.047					
Smoking										
Yes	5	2	40	0.72	0.078					
No	95	20	21.05	0.72						
Type of Operation										
Coronary artery bypass grafting	19	8	42.1		0.09					
Valve surgery	49	8	16.32	0.64						
Surgery for congenital heart disease	35	6	17.14							
Duration of Surgery										
≤6 hours	88	16	18.18	1 80	0.041					
>6 hours	12	6	50	1.09						
Blood Transfusion										
≤4 units	28	6	21.42	0.81	0.071					
>4 units	72	16	22.22	0.01						
Mechanical Ventilation										
≤6 hours	70	10	14.28	0.79	0.074					
>6 hours	30	12	40	0.79						
Table 4. Comparison of Presence of Risk Factors in Infected and Uninfected Patients										

## DISCUSSION

Surgery induces systemic and local changes in the immune defense mechanisms of the host. Cardiac surgery causes considerably greater stress on the host defenses. In cardiac surgery, the patient may be exposed to hypothermia, cardiopulmonary bypass, relative arterial hypotension throughout much of the procedure and the use of one or both internal mammary arteries for grafting. Exposure of blood to cardiopulmonary bypass depletes serum complements and immunoglobulins. Furthermore, protein denaturation and chylomicron aggregation may contribute to small vessel occlusion and tissue hypoxia. In the setting of hypothermia, neutrophils have reduced chemotaxis, impaired phagocytosis of Staphylococci and diminished peroxide production.<sup>(6,7)</sup>

Nosocomial infections following cardiac surgery are associated with prolonged hospitalisation, development of multiorgan dysfunction and increased hospital morbidity and mortality.<sup>(8)</sup> Understanding the epidemiology of these infections and the risk factors associated with them will prove to be of utmost importance in the prevention of these infections.

The incidence of postoperative infections following cardiac surgery in this study was found to be 22% with surgical site infections being the commonest. None of the patients suffered from prosthetic valve endocarditis or organ space infections like mediastinitis during the study period.

Pseudomonas aeruginosa was the commonest organism and constituted 23.07% of total isolates. It was mainly recovered from infections of wounds and urinary tract. The antibiotic prophylaxis in cardiac surgery patients being directed mainly against staphylococci might be responsible for this. Coagulase-negative Staphylococci and Staphylococcus aureus were the next most common organisms mainly isolated from surgical sites. The other isolates were enteric bacteria, mainly Klebsiella species, Escherichia coli and others.

Gram-positive organisms showed resistance to penicillin, cefazolin and oxacillin, whereas gram-negative organisms were mainly resistant to ampicillin, gentamycin and amikacin. Both of them were found to show resistance to cotrimoxazole, tetracycline and ciprofloxacin. Majority of resistant organisms were isolated from patients during their hospital stay indicating that these organisms were hospital acquired.

As all the urinary tract infections were catheter associated, which was removed by fifth postoperative day, these infections were observed in the early postoperative period only. Blood stream infections also tended to occur in the early postoperative period, which may be due to seeding of organisms from skin, bypass machine and other invasive devices into blood circulation.

Wound infections were rarely seen in the first postoperative week and mainly observed in second week up to 15<sup>th</sup> postoperative day. This might be due to use of antibiotics at local site during operation and intravenous antibiotics in the early postoperative period.

The percentage of infection in patients >45 years of age is 42.1% as compared to 10-20% in younger patients. As with other reports, systemic infections like respiratory and bloodstream infections were more common in the elderly patients.<sup>(9,10)</sup> Whereas in the younger age group, surgical site

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and urinary tract infections were more frequently observed. However, no significant difference in the incidence of infection in male and female patients was observed.

The incidence of infection in obese patients (BMI >30 kg/m2) was almost double of that observed in non-obese patients. The possible reasons for it include ineffective distribution of prophylactic antibiotics, adipose tissue providing good nidus for infection and difficulty in vascular graft harvesting.<sup>(1)</sup>

Infected patients had considerably longer preoperative hospital stay (median 14 days) as compared to uninfected ones (median 8 days). The longer hospital stay may lead to patients being exposed to resistant strains in hospital environment that are less sensitive to agents used for prophylaxis.

The rate of infection in patients undergoing CABG surgery was much greater than that those undergoing valvular heart disease surgeries. This may be due to the fact that patients undergoing CABG were usually elderly and had multiple surgical wound superadded with other risk factors.

Infections occurred much more commonly in patients with operative time of >6 hrs. as compared to those with <6 hrs. Contamination of surgical field is likely to be time related and also prolonged operations can be complicated predisposing patients to infections.<sup>(1)</sup> Also, mechanical ventilation for >6 hrs. was also associated with increased incidence of infection in the present study.

Diabetic patients are at increased risk of developing infections defence due to compromised host mechanisms.<sup>(1,9,11)</sup> Current cigarette smoking also predisposes to infection by causing vasoconstriction.(12) Although, increased incidence of infections were found in these patients, very few of them had these risk factors and hence these variables could not be reasonably assessed as risk factor.

The present study had the limitation of not being able to assess all the risk factors reported to be associated with development of infection in the cardiac surgery patients.

# CONCLUSION

The incidence of infection in cardiac surgery patients was 22%. Various types of infections observed were wound infections- 14%, urinary tract infections- 6%, respiratory tract infections- 3% and blood stream infections- 3%. The commonest isolate was Pseudomonas aeruginosa followed by CONS and Staphylococcus aureus. Age >45 years, obesity, surgery for CABG, operative time of >6 hrs. and mechanical ventilation for >6 hrs. were associated with increased incidence of infection.

Despite numerous advances in surgical techniques and antibiotic treatments, infections following cardiac surgeries are difficult to treat. Thus, prevention by reducing modifiable risk factors and implementing proper infection control practices seems to be a best course of action.

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