

# Bacterial Profile of Surgical Site Infections and their Antibigrams in Patients Undergoing Coronary Artery Bypass Graft Surgery

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## ABSTRACT

**Introduction:** Surgical site infections are associated with patient morbidity, longer duration of hospital stay and excess hospital costs. Study objective was to determine frequency of various micro-organisms isolated from surgical site infections and their Antibigram in Cardiac surgery unit.

**Material and methods:** This study was conducted at pathology laboratory of Punjab Institute of Cardiology, Lahore for a period of 10 months from May 2017 to February 2018. A total of 200 pus samples were collected from patients suffering from Surgical Site Infections. Samples were cultured on MacConkey agar and Chocolate agar and were incubated at 37°C for 24hrs. Organisms were identified on the basis of colonial morphology, Gram staining and biochemical tests. Antimicrobial sensitivity testing was performed on Muller Hinton agar by using modified Kirby-Bauer disc diffusion technique and E-strips.

**Results:** Out of 200 cultures, bacterial growth was obtained from 43%. Among total isolates, 58% were Gram positive and 42% were Gram negative bacteria. Most frequently isolated organism from wound swabs was Staphylococcus aureus (41.9%) followed by Coagulase negative Staphylococcus (14%). Gram negative bacteria isolated were Klebsiella from 10%, Enterobacter from 10%, E.coli from 8%, Acinetobacter from 4% and Pseudomonas aeruginosa from 4% of surgical wounds. All Gram Positive organisms were resistant to Penicillin, 80% to Erythromycin, 64% to Ciprofloxacin, 64% to Methicillin and 28% Amikacin. All were susceptible to Vancomycin and Linezolid. In case of Gram negative organisms, all isolates were resistant to Ampicillin, 94.5% to Ceftriaxone, 83.3% to Cefepime, 83.3% to Aztreonam, 72.2% to Amoxicillin/clavulanate, 50% to Ciprofloxacin, 44.5% to Piperacillin-Tazobactam, 33% to Amikacin, 33.3% to Cefoperazone-sulbactam and 27.8% were resistant to Imipenem

**Conclusion:** Gram positive pathogens were most common cause of surgical site infection in cardiac surgery patients. However, significant proportion of infections were caused by Gram negative pathogens

**Keywords:** Surgical Wound Infection, Coronary Artery Bypass, Healthcare associated infection, Drug Resistance, Length of Stay, Microbial Sensitivity Tests

## INTRODUCTION

Surgical site infections (SSI) are among most common nosocomial infections and are encountered in approximately 2%-5% of patients undergoing surgery. SSIs are associated with longer duration of hospital stays and excess hospital costs. In patients suffering from SSI mortality rate can be

as high as 77%.<sup>1</sup> Excess costs of SSI depends on the micro-organism and type of surgical procedure involved.<sup>1</sup> However, approximately 60% of SSIs are preventable and their rate can be reduced by using clinical practice guidelines.<sup>2,3</sup>

SSI can be categorized as deep incisional SSI, superficial incisional SSI, or organ/space SSI. SSI are defined as infection occurring within 30 days of any surgical procedure and can involve; skin and subcutaneous tissue of the incision; fascia and muscle layers or may involve any organ or part of the body that has been operated upon respectively.<sup>4</sup>

Judicious and appropriate use of antimicrobials, for appropriate period can lead to reduction in number of surgical wound infections. Careful observation and monitoring of evidence based guidelines can be effective in this regard.<sup>5</sup>

SSIs are encountered worldwide and are caused by a wide variety of pathogens. The organisms responsible for causing wound infection vary depending upon surgical procedure involved, surgical units and hospitals in which patient was operated upon.<sup>6</sup> Despite a lot of preventive measures SSIs are ranked second most common healthcare associated infection (HAI), and account for 20% of all nosocomial infection even in developed countries.<sup>4</sup> Multi drug resistance (MDR) among isolates responsible for causing SSIs is a major problem while prescribing antimicrobial drugs for SSIs.<sup>7</sup> The study was conducted to know the frequency of various organisms and their drug susceptibility pattern responsible for causing surgical site infections in a cardiac surgery unit.

## MATERIAL AND METHODS

This cross-sectional study was conducted at pathology laboratory of Punjab Institute of Cardiology, Lahore for a period of 10 months from May 2017 to February 2018. A total of 200 pus samples were collected from patients suffering from Surgical site infections. Samples were cultured on MacConkey agar and Chocolate agar and were incubated at

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37°C for 24hrs. Organisms were identified on the basis of colonial morphology, Gram staining and biochemical tests. Antimicrobial sensitivity testing was performed on Muller Hinton agar by using modified Kirby-Bauer disc diffusion technique and E-strips.

**Inclusion Criteria:** No discrimination was made on the basis of age or gender, properly labeled samples of cardiac surgery patients with suspected surgical site infection were selected for study.

**Exclusion criteria:** Improperly labeled samples, samples collected from non-surgical sites, old stored samples and samples from Non-cardiac patients were excluded.

**RESULTS**

Out of total 200 specimens, bacterial growth was obtained from 86 (43%) cultures while 114 (57%) of the samples were labeled no growth. Out of 86 cultures; (36) 42% were Gram Negative isolates and (50) 58% were Gram Positive isolates. Frequency of various isolates isolated from surgical wounds

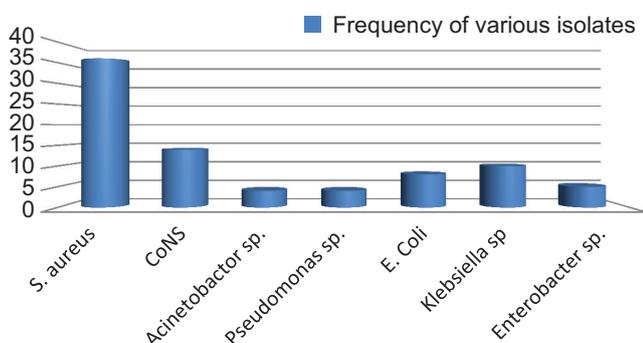


Figure-1: Frequency of various isolates in wound swabs

is shown in Fig-1.

Out of total 50 gram positive bacteria, 36 (72%) were Staphylococcus aureus (S. aureus) while 14 (28%) were Coagulase negative Staphylococcus (CoNS). Out of 36 S. aureus isolates, 24 (66.7%) were Methicillin Resistant Staphylococcus aureus (MRSA) while 12 (33.3%) were MSSA. Frequency distribution of various gram positive and gram negative isolates are shown in Fig-2,3.

Antimicrobial susceptibility test was performed and drug sensitivity pattern of Gram positive isolates is shown in

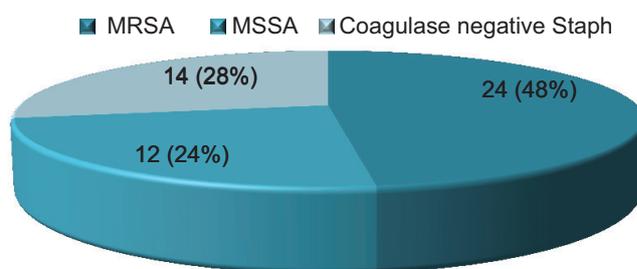


Figure-2: Frequency distribution of gram positive isolates

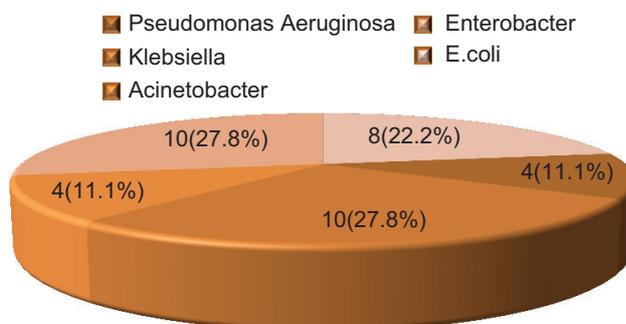


Figure-3: Frequency distribution of gram negative isolates

Antimicrobial drug	Staphylococcus aureus		Coagulase negative Staph (n=14)	Total (n=50)
	MRSA (n=24)	MSSA (n=12)		
Amikacin	12(50%)	10(83.3%)	14(100%)	72%
Augmentin	0(0%)	8(66.7%)	4(28.6%)	24%
Erythromycin	6(25%)	6(50%)	2(14.3%)	20%
Linezolid	24(100%)	12(100%)	14(100%)	100%
Penicillin	0(0%)	0(0%)	0(0%)	0%
Ciprofloxacin	4(16.6%)	8(66.7%)	6(42.9%)	36%
Vancomycin	24(100%)	12(100%)	14(100%)	100%
Fusidic Acid	12(50%)	12(100%)	6(42.9%)	60%
Cefoxitin	0(0%)	12(100%)	6(42.9%)	36%

**Table-1:** Antimicrobial susceptibility pattern of gram positive isolates

Antimicrobial drugs	Pseudomonas Aeruginosa (n=4)	Klebsiella (n=10)	Acinetobacter (n=4)	Enterobacter (n=10)	E.coli (n=8)	Total (n=36)
Amikacin	4(100%)	6(60%)	0(0%)	8(80%)	6(75%)	66.7%
Amoxycillin/clavulanate	0(0%)	4(40%)	2(50%)	0(0%)	4(50%)	27.8%
Ceftriaxone	2(50%)	0(0%)	2(50%)	0(0%)	0(0%)	5.5%
Cefepime	4(100%)	0(0%)	2(50%)	0(0%)	0(0%)	16.7%
Ciprofloxacin	4(100%)	8(80%)	2(50%)	2(20%)	2(25%)	50%
Pipperacillin-Tazobactam	2(50%)	6(60%)	2(50%)	6(60%)	4(50%)	55.5%
Cefoperazone-sulbactam	2(50%)	6(60%)	2(50%)	8(80%)	6(75%)	66.7%
Imipenem	4(100%)	6(60%)	2(50%)	8(80%)	6(75%)	72.2%
Aztreonam	4(100%)	0(0%)	2(50%)	0(0%)	0(0%)	16.7%

**Table-2:** Antimicrobial susceptibility pattern of gram negative isolates

Table-1. Results of antimicrobial sensitivity test of Gram negative isolates are shown in Table-2.

## DISCUSSION

Emerging drug resistance in causative organisms is attributing towards resultant high morbidity and mortality rates associated with SSIs.<sup>7</sup> Therefore, this study was conducted to predict possible pathogens and their drug susceptibility pattern in patients undergoing cardiothoracic surgeries. In this study, *Staphylococcus aureus* (*S. aureus*) was most frequent pathogen responsible for causing 41.9% of SSIs. Approximately, 66.7% of the *S. aureus* isolates that contributed towards significant proportion of SSIs were methicillin resistant *Staphylococcus aureus* (MRSA), against which beta-lactam antibiotics commonly used for prevention and treatment of SSIs, were ineffective while 33.3% were methicillin susceptible *Staphylococcus aureus* (MSSA). A study by Baum SE documented that up to 65% of surgical wound infections after coronary artery bypass graft surgery were caused by MRSA.<sup>8</sup> Furthermore, infections caused by MRSA have a higher attributable mortality, results in longer duration of hospital stays, and excess costs as compared to clean non-infected surgical wounds or infected by MSSA.<sup>8,9</sup> Treatment options for infections caused by MRSA are limited and frequent and long term use of drugs of last resort against these organisms can lead to emergence of resistant strains.<sup>8</sup>

In this study, CoNS was the second most frequent organism isolated from 14% of SSIs. Several studies documented patient's endogenous organisms to be responsible especially CoNS to be responsible for causing SSIs in cardiothoracic surgeries.<sup>10</sup> A study by Ridderstolpe L isolated CoNS from 39.6% of sternal wound infections, followed by *S. aureus* from 16.5% of SSIs.<sup>11</sup> Another study by Kühme T et al found CoNS and *S. aureus* as most frequent cause of sternum wound infection in pts with cardiothoracic surgeries.<sup>12</sup>

Gram negative bacteria were isolated from 42% of SSIs. Members of family enterobacteriaceae including *Klebsiella* were isolated from 10%, *Enterobacter* from 10% and *E. coli* from 8% cases of SSIs. These gram negative bacteria are members of colon but if they reach and contaminate surgical wounds that can result in SSIs. *Acinetobacter* which is member of skin flora and can cause nosocomial infections was isolated from 4% of cases. *Pseudomonas Aeruginosa*, a nosocomial pathogen was isolated from 4% of SSIs. A study by Manyahi J reported gram negative bacteria (77.5%) as more frequent cause of SSIs as compared to gram positive organisms (22.5%).<sup>7</sup> The most prevalent etiological agent being *Pseudomonas aeruginosa* (16.3%), followed by *Staphylococcus aureus* (12.2%) and *Klebsiella pneumoniae* (10.8%).<sup>7</sup> SSIs caused by *Pseudomonas aeruginosa* in cardiothoracic surgeries are not frequent; however, *Pseudomonas* can survive in hospital environment and contaminate tap water, hospital equipment and antiseptic solutions and thus leads to nosocomial outbreaks.<sup>13</sup> SSIs can be prevented and their rate can be reduced by implementation of SSI prevention bundle based on proper skin antisepsis and appropriate antibiotic administration can lead to decrease

in.<sup>14</sup> Therefore, keeping record of prevalent pathogens and their antibiograms plays a crucial role in preventing SSIs.

## Limitations of study and future recommendations

However, such studies are recommended and should be conducted in hospitals and healthcare setting. These studies can predict prevalent pathogens in that area or healthcare setting but may vary from one setting to another. Therefore such studies and surveillance assays should be performed routinely in every institute or hospital so as to prevent spread of nosocomial pathogens, to prevent wound contamination by such pathogens and prophylactic and empiric antimicrobial therapy could be administered while keeping possible pathogens and their drug susceptibility profiles in view.

## CONCLUSION

*S. aureus* and CoNS were the most common cause of surgical site infection after CABG however Gram negative pathogens were also responsible for significant number of SSIs. Exact knowledge of prevalent pathogens responsible for wound infection in a surgical unit can help in making strategies and preoperative preventive measures to control the transmission and spread of such nosocomial pathogens. Monitoring and keeping record of Antibiograms of pathogens responsible for causing SSIs can guide for appropriate selection of drugs and thus can lead to reduction in rate of such infections.

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