

Frequency and Antibiotic Susceptibility of *Acinetobacter Baumannii* in Surgical site Infections at Rawalpindi Institute of Cardiology

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Abstract

Acinetobacter is an important nosocomial pathogen to cause infections such as pneumonia, bloodstream infections, meningitis, wound and surgical site infections and urinary tract infections. *A. baumannii* can spread through direct contact with surfaces, objects and the skin of contaminated persons. *Acinetobacter* has acquired resistance to most of the antibiotics and can play havoc in hospital environment due to its ability to survive desiccation and in moist environment in the presence of disinfectants. Currently, there are 32 genospecies of *Acinetobacter* known. Among these, *A. baumannii* is the most important in the clinical context, since it is the most frequently isolated in nosocomial infections and the one associated with the highest mortality rate

Objective: To find out the frequency of *A. baumannii* causing surgical site infections after cardiac surgery and best antibiotic options for its treatment.

Materials and Methods: A retrospective study was carried out to find out bacterial cultures in admitted patients at Rawalpindi Institute of Cardiology with surgical site infections from July 2017 to August 2018. A total of 405 pus specimens collected from patients with suspected surgical site infections were tested for bacterial culture and antimicrobial susceptibility test. Patient profile was noted from centralized hospital data.

Results: Out of total 405 specimens 13 were culture positive for *A. baumannii* (3.2%). Ten isolates were Pan Drug Resistant (PDR).

Conclusion: *A. baumannii* infection although infrequent in our set up is mostly pan resistant. Infection control practices & surveillance are important to avoid its spread in hospitalized patients.

Keywords: acinetobacter baumannii; surgical site infections; coronary artery bypass graft; multi drug resistant; extended drug resistant.

Introduction

Surgical site infections (SSI) can involve any part of the body after incision and surgical procedure. It can occur in skin, organs or implanted materials. [1] It commonly occurs within 30 days after an operation under a special circumstances or within one year if an implant was placed and the infection appears to be related to the surgery. SSIs occur in 15% of all nosocomial infections among surgical patients. Post-operative SSI is the most common healthcare-associated infection in surgical patients, occurring in up to 5 percent of surgical patients. In the United States, between 500,000 to 750,000 SSIs occur annually. [2] Although *Staphylococcus*, *Streptococcus*, *Pseudomonas* spp. commonly cause SSIs yet nosocomial SSI due to *A. baumannii* following Coronary Artery Bypass Graft (CABG) is a serious and costly complication. [3]

A. baumannii is glucose-non-fermentative, non-motile, non-fastidious, catalase-positive, oxidative-negative aerobic gram-negative coccobacilli. *A. baumannii* is one of the most successful pathogen responsible for hospital-acquired nosocomial infections in the modern health care system. Due to the prevalence of infections and outbreaks

caused by multi-drug resistant *A. baumannii*, few antibiotics are effective against it. [4]

It commonly spreads via environmental surfaces, ventilators, dialysis machine, water sources, suction equipment, as a colonizer on skin and mucosal surfaces due to its resistance to commonly used antibiotics and disinfectants which make it difficult to eradicate from hospital environment.[5]

Multi drug resistant (MDR) *A. baumannii* have highest resistance among countries of South East Asia although these have been reported worldwide. [6] Mortality and morbidity rates are high due to its infection. No study has been reported in SSI caused by *Acinetobacter baumannii* in cardiac hospitals in Pakistan.

Materials and Methods

A retrospective study was conducted from 1st July 2017 to 31st June 2018 in Pathology Department of Rawalpindi Institute of Cardiology (RIC), Rawalpindi Pakistan. It is a 272-bedded cardiac hospital located in Rawalpindi and provides both indoor and outdoor cardiac facilities to the patients of Rawalpindi, Islamabad and adjacent areas including patients from AJK and Northern areas.

Inclusion Criteria

All indoor and outdoor patients having SSI which were reported at RIC consecutively included in this study. All indoor and outdoor patients having SSI who reported at RIC were included in this study.

Exclusion Criteria

Specimens collected from patients having no history of surgery were excluded. More over specimens cultured other than surgical sites were also excluded.

Specimens

Specimens from surgical sites including pus, tissues, fluids and aspirates were observed for both culture and antibiotic susceptibility.

Methods of Specimen Collection

Specimens were collected by standardized universal method before any dressing or cleaning procedure of the wound so as to avoid killing of the organism by using antiseptics. Sterile swab was taken by gently rotating

it on the surgical wound site to collect exudate from the wound and was placed into transport medium. Pus aspirates were also collected by standardized method. [7]

Specimen Processing

After receiving specimen in Microbiology Laboratory, it was inoculated on blood agar, chocolate agar and MacConkey agar and culture plates were incubated at 37° C for 24 hours.

After receiving specimen in Microbiology Laboratory, it was processed by inoculating it on blood, chocolate and MacConkey agar and incubated plates at 37°C for 24 hours. The colony morphology typically showed is 1 to 2mm, non-pigmented, domed and mucoid colonies with smooth to pitted surfaces. [8]

Identification of gram negative rod was observed on microscopic examination by gram staining. Oxidase test was negative and confirmatory biochemical testing was done by using API 20E and NE (Biomerieux France) after incubation at 37°C for 24 hours. Acinetobacter does not reduce nitrate which is its distinguishing feature from Enterobacteriaceae. Indole is negative, glucose is not fermented. Antibiotic susceptibility was done by Kirby Bauer Disc Diffusion Technique and results were interpreted as per CLSI guidelines M100-S27. [8]

Results

Out of 405 pus cultures 13 (3.2%) were culture positive results for *A. baumannii* whereas 180 (44.4%) were culture negative and 212 (51.4%) were positive for other isolated organisms [figure 1].

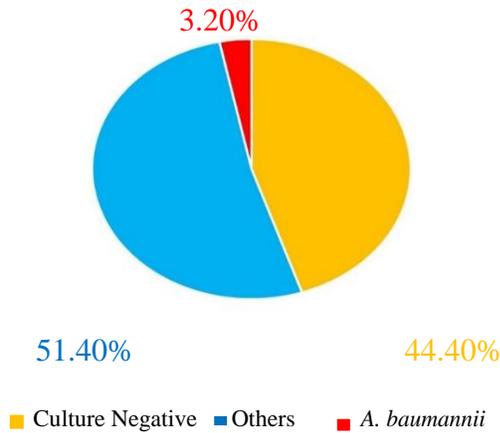
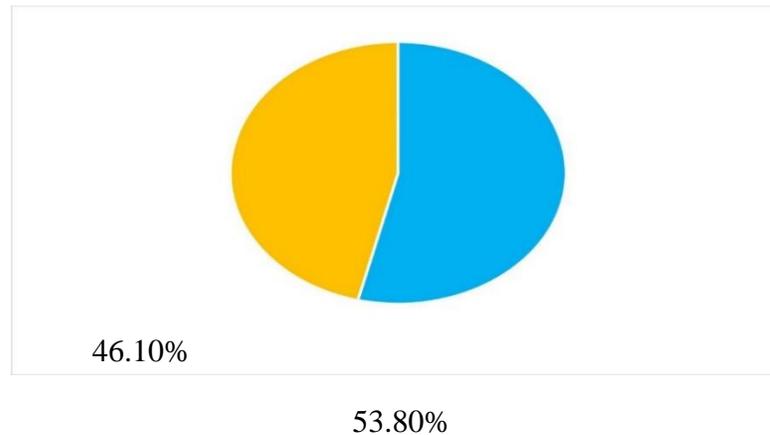


Figure 1: Frequency of *A. baumannii* and other isolates

Out of total 13 positive samples 7 were male patients and 6 were female patients [Figure 4].



■ Male ■ Female

Figure 2: Sex Distribution in Patients with *A. baumannii*

SSIs depend upon the type of surgery performed and the hospital environment. The prevalence of pathogen varies from place to place and hospital to hospital. The age distribution of all *A. baumannii* positive cases

was above 30 and among them 8 were those having CABG while remaining 5 had different surgical procedures.

Serial No.	Sex	Age	Surgery	Disease
1.	Female	33	REDO-MVR	Redo-MVR
2.	Female	58	CABG	DVCAD
3.	Male	53	CABG	TVCAD
4.	Male	48	CABG	TVCAD
5.	Male	71	CABG	TVCAD
6.	Female	35	BANTAL	Aortic dissection
7.	Male	47	Wound closure	Infection wound
8.	Female	65	CABG	TVCAD
9.	Male	54	CABG	TVCAD
10.	Female	48	CABG	TVCAD
11.	Female	34	Wound closure	Infection wound
12.	Male	59	CABG	TVCAD
13.	Male	60	REDO-MVR	REDO-MVR

Table 1: Profile of Infected patients

Out of 405 specimens 180 (44.4%) culture negative and other culture positive isolates were *Coagulase Negative Staphylococcus* 70 (17.3%), *Staphylococcus aureus* 68(16.8%), *Enterobacter* spp. 28(6.9%), *Escherichia coli* 10(2.5%), *Pseudomonas aeruginosa* 10(2.5%), *Klebsiella* spp. 8(1.9%), *Streptococcus* spp.4(1.0%), *Enterococcus* spp.4(1.0%), *Bacillus* spp. and *Diphtheroids* 4(1.0%), *Candida* spp. 4(1.0%), *Serratia* spp. 2(0.5%)[Figure 5].

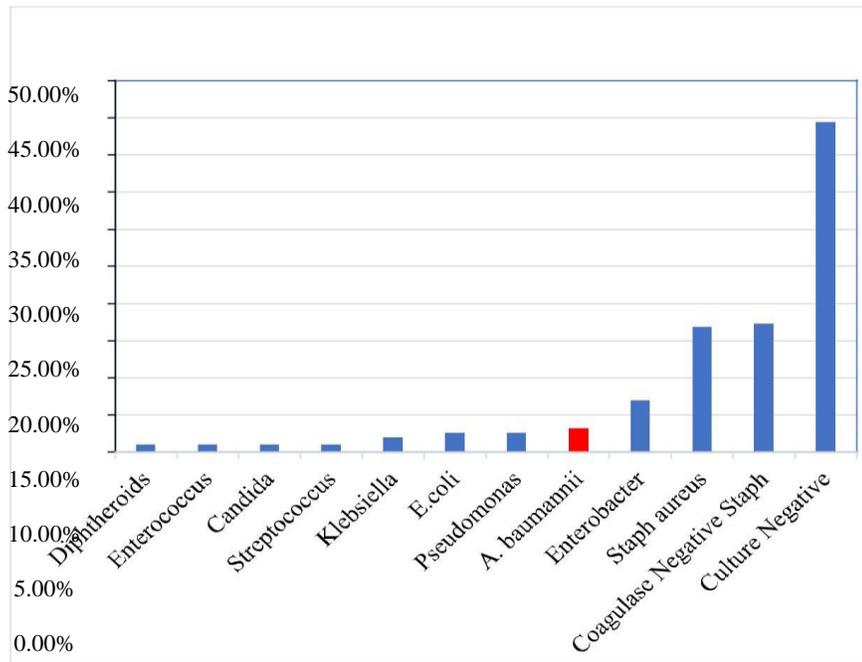


Figure 3: Frequency of bacterial species isolated from clinical specimens

Out of 13 positive *A. baumannii* isolates 10 isolates were pan resistant and 3 isolates showed partial susceptibility to antibiotics. Among these, the first isolate was sensitive to Amikacin, Gentamycin, Ciprofloxacin, Chloramphenicol, Tazobactam/Piperacillin, the Second isolate to Levofloxacin, Sulphamethoxazole, Meropenem, Imipenem, Ciprofloxacin and the third isolate to Meropenem, Imipenem, Amikacin and Gentamycin.

Antibiotics	Sensitive Out of 13	Sensitivity %	Resistant Out of 13	Resistance %
Amikacin	02	15.3%	11	84.6%
Augmentin	0	0%	13	100%
Gentamycin	02	15.3%	11	84.6%
Aztreonam	0	0%	13	100%
Cefixime	0	0%	13	100%
Ceftriaxone	0	0%	13	100%
Piperacillin\Tazobactam	01	7.7%	12	92.3%
Imipenem	02	15.3%	11	84.6%
Meropenem	02	15.3%	11	84.6%
Ciprofloxacin	02	15.3%	11	84.6%
Levofloxacin	01	7.7%	12	92.3%
Sulphamethoxazole	01	7.7%	12	92.3%
Tigecycline	0	0%	13	100%
Doxycycline	0	0%	13	100%

Polymyxins	0	0%	13	100%
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Table 2: Antibiotic susceptibility Pattern

Discussion

A. baumannii has emerged as the causative agent of nosocomial infection due to increased use of invasive procedures, overuse of broad spectrum antimicrobials and prolonged duration of stay in the hospital. Development of resistance against antimicrobials is a major problem in the treatment of *Acinetobacter* infections. Although they are considered as pathogen of mild virulence, they can rapidly acquire resistance. [9]

A. baumannii is an opportunistic pathogen. It has a high incidence among immunocompromised individuals, particularly those who have experienced a prolonged hospital stay. [10] It may colonize the skin as well as being isolated in high numbers from the respiratory, surgical and oropharynx secretions of infected individuals. [11] In recent years, it has been designated as a “red alert” human pathogen, generating alarm among the medical community, arising largely from its extensive antibiotic resistance spectrum. [12]

SSIs are one of the common post-operative complications. Apart from bacterial contamination of wound, various patient and environment related factors play role in development and outcome of SSIs. The present study is undertaken to study the frequency of *A. baumannii* SSIs after cardiac surgery and its antimicrobial susceptibility. The prevalence of pathogen varies from place to place and hospital to hospital. [13]

Most of the isolates were considered as highly resistant to Imipenem, Amikacin, and Ampicillin/Sulbactam. MDR *Acinetobacter* spp. is defined as those isolates resistant to more than three classes of antibiotics (Penicillins and Cephalosporins, Fluoroquinolones and Aminoglycosides). An isolate is classified as extended drug resistant (XDR) when it is resistant to three classes of antimicrobials described above (MDR) and is also resistant to Carbapenems. Pan drug resistant isolate define as that is resistant to Polymyxins and Tigecycline. [14]

CDC considers *A. baumannii* is a serious public health hazard due to its resistance to multiple antibiotics. [15]

SSI are still common in patients despite great advances in surgical techniques such as prophylactic antibiotics, disinfection and sterilization. Numerous studies have reported nosocomial infections after cardiac surgery to exceed 20%. The incidence of nosocomial infections was reported as 16% in the study by (Lomtadze et al) and 8.3% in the study by (Davoodi et al). [16]

Microbiological evidence suggests that 5% of open heart surgery patients develop nosocomial infections. The health authorities need to take measures at the ministerial and regional levels in order to reduce this under-reporting. [16]

A. baumannii has emerged as an important pathogen affecting any age group but in our study, it is most commonly found in patients between 30-70 years. In a previous study the most common age group effected by *A. baumannii* was between 42-68 years. [17] It is probably due to early onset of IHD in patients requiring Cardiac surgery.

A. baumannii was reported in surgical wound infection in Turkey and Saudi Arabia in 8.3% and 8.6% cases respectively. In another study reported in Saudi Arabia, the frequency of *A. baumannii* was 22.2% in wound infections. [18]

A. baumannii Infections were frequently isolated in males (53.8%) than females (46.10%) in our study. It is similar to results reported in a study from Saudi Arabia where out of 131 patients operated, 93 (71%) were males. The higher number of males may be due to the fact that males are more prone to develop cardiovascular diseases than females that require surgery [19].

A. baumannii infections are associated with major risk factors such as post-surgical, catheterization, extended hospital stays and prolonged antibiotic usage. *A. baumannii* isolated from normal skin and mucous

membranes are reported to cause serious and sometimes fatal infections [20].

Since, our study is based in a cardiac set up *A. baumannii* infections were found in cardiac patients having diseases like Triple or Double Vessel Coronary Artery Disease (TVCAD) or (DVCAD), Redo-Mitral Valve Replacement Surgery (Redo- MVR), aortic dissection and open-heart surgery. Infection occurred in patients who were admitted to ICU for stabilization after a surgical procedure and required mechanical ventilation.

Infectious complications after cardiac surgery occur in 5% to 21% of cases. [21] Major infectious complications increase postoperative mortality by more than 5 times and prolong recovery. [22] Forty seven percent of these patients require more than 14 days in the hospital compared with 5.9% of patients without a major infection. [23] As a result, infectious complications often increase the cost of care. [24] However, infectious complications can be reduced with many simple interventions, by risk factor modification preoperatively to postoperative risk factor vigilance in the ICU.

In a review, the most common sites of infection reported were respiratory tract (45.7% - 57.8%), surgical site (27.7%), and catheters or devices (20.5%-25.2%) occurring perioperatively or within the first 12 months of surgery. [25]

In our study out of 405 specimens commonly isolated culture positive organisms are *Coagulase Negative Staphylococcus* 70 (17.3%), *Staphylococcus aureus* 68 (16.8%), *Enterobacter* spp. 28 (6.9%), *Escherichia.coli* 10 (2.5%), *Pseudomonas aeruginosa* 10 (2.5%), *Klebsiella* spp. 8 (1.9%), *Streptococcus* spp. 4 (1.0%), *Enterococcus* spp. 4 (1.0%), *Bacillus* spp. and *Diphtheroids* 4 (1.0%), *Candida* spp. 4 (1.0%), *Serratia* spp. 2 (0.5%) along with *A. baumannii* (3.2%) (Fig. 3). Similar to our study a bacteriological study of SSIs carried out in a tertiary care hospital at India concluded that overall frequency of SSI was 6.17%. Most common isolates were *Staphylococcus aureus*, *Coagulase negative Staphylococci* (CONS), *E. coli* and *Pseudomonas aeruginosa*. The frequency of Methicillin Resistant *Staphylococcus aureus* (MRSA) was 8.6%. The maximum frequency was among patients operated on emergency basis in surgical department. [26]

A. baumannii cause skin or soft tissue infections outside the military population leading to 2.1% of ICU-acquired skin or soft tissue infections. *A. baumannii* was isolated from soldiers with open tibia fractures in Iraq or Afghanistan war. [27]

A. baumannii is a nosocomial pathogen and due to its resistance pattern, it is one of the leading cause of SSIs in our setup. Antibiotic susceptibility pattern of *Acinetobacter* spp. against various antibiotics in the present study showed (15.3%) susceptibility to Meropenem, Imipenem, Gentamicin, Ciprofloxacin & Amikacin whereas for Piperacillin/Tazobactam combination, Levofloxacin and Trimethoprim/Sulphamethoxazole it was (7.7%). All isolated were resistant to Augmentin, Aztreonam, Cefixime, Ceftriaxone, Tigecycline, Doxycycline and Polymyxins (Table 2). A study from India reported antibiotic susceptibility of *Acinetobacter* species to Meropenem (86%), Piperacillin Tazobactam (76%), Amikacin (67%), Ampicillin/ Sulbactam (58%), Gentamicin (50%), Ciprofloxacin (49%), Ceftazidime (40%), Tetracycline (31%), Cotrimoxazole (29%), Ceftriaxone (21%) and Cefepime (18%).²⁸

In another Study 52.5% cultures yielded significant growth and only 3% *Acinetobacter* spp. were isolated. Maximum (56.9%) isolates were obtained from pus/swab, followed by blood (13.1%) and urine (12.4%). Elderly age, being inpatients, longer duration of stay in the hospital, associated co-morbidity, and invasive procedure were found to be significant risk factors in the setup investigated. Out of 3% *A. baumannii* isolates, 54.7% were resistant to more than three classes of antibiotics

MDR and 5.8% were resistant to all commonly used antibiotics PDR. Majority of the isolates were sensitive to Imipenem, Meropenem, and Piperacillin/Tazobactam, and showed resistance rates of 19%, 22%, and 23%, respectively.²⁹

In a study from Brazil where in a six-month period, 1333 patients were admitted to the five ICUs included. The mean age of the participants was 53.2 years, and 59.4% were male. Most patients (98.4%) had previously taken antimicrobials and 68.2% had used two or more classes of antimicrobial drugs. The most commonly used drugs were 3rd- and 4th-generation Cephalosporins (71.4%) and Carbapenems (50.8%). [30]

Another study at Pakistan reveals that isolation rate of *Acinetobacter* was high from the respiratory specimens, followed by wound samples. Antibiotic susceptibility of the isolates revealed that the resistance to Cefotaxime and Ceftazidime was the most common, in 710 (99.2%) specimens each, followed by the resistance to Gentamicin in 670 (93.6%) isolates, and to Imipenem in 651 (90.9%) isolates. However, almost all isolates were susceptible to Tigecycline, Colistin, and Polymyxins B. [31] In an international study in ICUs, the *Acinetobacter* infection rate was 19.2% in Asia, 17.1% in Eastern Europe, 14.8% in Africa, 13.8% in Central and South America, 5.6% in Western Europe, 4.4% in Oceania and 3.7% in North America [32].

Global data reveals that multidrug-resistant *A. baumannii* is emerging as

a common hospital- and community-acquired infection that is difficult to treat. It is a very resistant and aggressive organism that infects patients with weakened defences like ICU patients and those with invasive devices. [33]

It is important to notify multi drug resistant *A. baumannii* (MDR-Ab). For patients colonized or infected with MDR-Ab maximum isolation precautions require a private room and one to one nursing. Each patient with MDR-Ab needs dedicated equipment and universal precautions should be followed to attend patients with MDR-Ab.

Conclusion

The frequency of *A. baumannii* infections in our study is 3.20% in surgical site infections. SSI is more common in males (53.80%) than females (46.20%). Most of these isolates were pan resistant. In order to decrease the spread of *A. baumannii* infections and reduce its resistance, it is important to promote the rational use of antimicrobials, with implementation and monitoring of the Antibiotics Stewardship Program in hospitals. Hand hygiene and barrier nursing are important to prevent its spread.

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