International Journal of Research in Medical Sciences
Nagamani R. Int J Res Med Sci. 2016 Sep;4(9):4033-4036
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20162929

Research Article

Bacterial epidemiology of post-operative infections at a cardiac center

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Received: 08 July 2016
Accepted: 04 August 2016

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ABSTRACT

Background: Cardiac patients belong to a different group in microbiological perspective as infection causing organisms are different from infection causing pathogens in other patients. Postoperative infections in this group are mainly sternal wound infections and blood stream infections. The present study involved patients from a cardiac center in eastern province, Saudi Arabia, who underwent surgery during a 2 years period.
Methods: All positive culture results from cardiac center were collected during this period and data noted. Data included patient demographics, type of surgery/procedure, infection site, infecting organism and the same was analyzed.
Results: A total of 4891 patients underwent surgery/procedure at this center during the study period. Overall infection rate was 2.7%. Coagulase negative staphylococci were the predominant pathogens both in sternal wound and blood stream infections.
Conclusions: This study provided a data base for this cardiac center to formulate antibiotic prophylaxis and treatment guidelines. In microbiology laboratory, criteria for considering these organisms of low virulence as pathogenic were included in the standard operating procedures.

Keywords: Cardiac surgery, Sternal wound, Blood stream infections, *Staphylococci*

INTRODUCTION

Cardiac patients are a group with unique clinical conditions. In general, infection causing agents are a little different from the routinely encountered in other patients. The organisms which are considered of low virulence or no virulence are the pathogens in this setting. Hence it is important to be aware of this pattern and variable virulence of microorganisms for implementing appropriate operating procedures in clinical microbiology laboratory and appropriate treatment guidelines in the clinical areas.

The post-operative infections occurring in cardiac surgery patients may be of deep or superficial sternal wounds, donor site wounds, blood stream and miscellaneous ones. The rate varies between 1.8% upto 4.7%.[1-5] The diagnosis is often difficult to make so a correlation between clinical and microbiological findings should be taken into consideration.[6] This is a prospective study and based on laboratory data collected from microbiology laboratory, and/or infection control data and includes the type of bacterial isolate, type of surgery or the procedure during a two year period at a cardiac center in Eastern Province, Saudi Arabia.

METHODS

All positive culture results from the cardiac center patients were saved in a separate data bank in Microbiology laboratory. A positive culture was considered to be infection by correlating patient's signs and symptoms and presence of pus cells on microscopy in cases of wound swab. Patient demographics were also collected. The data is stratified according to the type of cardiac surgery/procedure. The isolates were analyzed according to the site of infection in these groups along with antibiotic profile.

All specimens for culture were received in microbiology laboratory and processed according to the standard protocols.[7] Specimens were inoculated on sheep blood agar, chocolate agar, MacConkey agar. Gram stained smears from all the specimens, swabs, aspirated material and tissues were examined and evaluated for the presence of inflammatory cells and organisms. All isolates that were growing were subjected to identification (ID) and antibiotic susceptibility testing (AST) by Phoenix BD.[8] If conflict occurred, the ID, and AST were repeated by Vitek II or by API 20 E identification system, BioMerieux, and manual disc diffusion test by Kirby Baur method according to the situation required.[9] Enrichment cultures were also performed and sub cultured routinely after 24/48 hrs. The turnaround time for all cultures was 48 hrs albeit enrichment cultures. Blood cultures were done in BACTEC 9000 series automated system, using aerobic and anaerobic bottles and incubated for 5 days. The positive blood cultures were sub cultured and appropriate ID, and AST performed directly from the blood culture broth by appropriate methods after gram stain result so as to release the result within 24 hrs after the positive signal.

RESULTS

Total no. of patients admitted during this period for surgical procedures were 4891. Total no. of surgical and blood stream infections were 134 in 80 patients. Overall infection rate was 2.7%. There were 43 patients who had surgical site infection and 59 isolates were growing. In six patients multiple episodes of infection occurred. Details of bacteriology of surgical site infection were given in Table 1.

Table 1: Microorganisms isolated in surgical site.

Sternal wound		Donor site	
Organism	**No.**	**Organism**	**No.**
Coag. Neg. *staphylococci*	23	*Ps. aeroginosa*	9
S. aureus	5	*E. coli*	3
CA MRSA	1	*Enterobacter spp.*	3
MRSA	1	*K. pneumoniae*	3
Enterococci	5	*Serratia marcescen*	1
Corynebacterium spp	1		
Candida spp	1		
E. coli	1		
Ps. aeroginosa	1		
Enterobacter spp	1		

MRSA- methicillin resistant Staph aureus, CA MRSA – community acquired methicillin resistant *S. aureus*

Bacteremia was seen in 37 patients, among whom 25 were adults, 12 were pediatric group. 18 of the adult patients underwent coronary artery bypass graft (CABG) and 7 others had valve repairs. In the pediatric patients, 3 children had repair of coarctation of aorta (COA), 4 had ventral septal defects (VSD) closure, and 3 had other procedures. The bacteriology of these infections is shown in Table 2.

Table 2: Microorganisms isolated in blood.

Gram positive	No.	Gram negative	Total
Coag. neg staphylococci	20	*Ps. aeruginosa*	5
MRSA	1	*E. Coli*	4
Enterococci	4	*Serratia marcescence*	2
S. pneumoniae	1	*K. pneumoniae*	2
Viridans streptococci	1	*Steno. maltophilia*	1
Corynebacterium spp.	2	*F. Oryzihabitans*	1
Candida spp.	5	*Chryseomonas luteola*	1
		Actinobacillus actinometemcomitans	1

MRSA – Methicillin resistant *S. aureus*

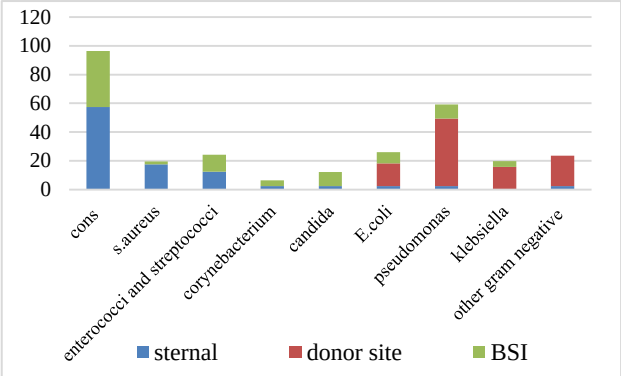

Figure 1: Incidence of bacteria by site of infection.

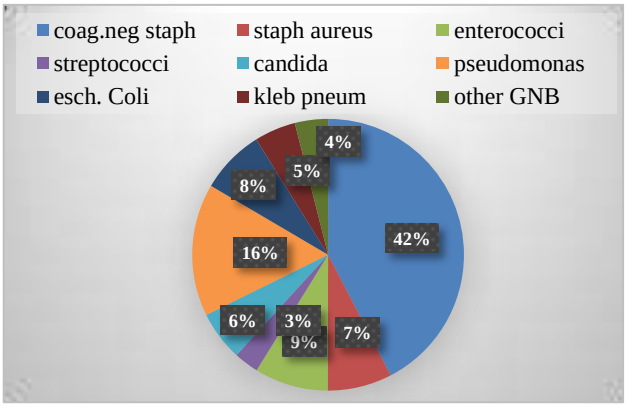

Figure 2: Incidence of pathogens in post cardiac surgery cases.

DISCUSSION

The most frequent site of infection following cardiac surgery is the surgical site infection: sternal wound which

may be deep or superficial, and donor site, usually the saphenous vein. Superficial sternal wound is the common among the SSI. The infection rates vary from 3.5% in superficial wounds to 1% in deep sternal wound.[1-5] In the present study the rate of infection is concurrent with other study groups.

When it comes to the bacteriology of the infections, various studies show different predominant organism causing infection. In this study, the predominant pathogen is coagulase negative staphylococci including *S. epidermidis*. Many studies find similar observation while some show S. aureus to be the one causing infection more frequently.[4,5,12,15]

It is a commonly known fact that staph aureus nasal colonization is more in hospitalized patients and Staph aureus colonization is a risk factor for post-operative wound infection on the other hand, coagulase negative *staphylococci* are known to be opportunistic pathogens, part of the resident flora on the skin, and difficult to be removed during skin disinfection.[13] Our study's finding agrees with other studies in that coagulase negative *staphylococci* (CoNS) were the major pathogens.[2-4,6]

The presence of staphylococci at the close proximity i.e on the skin or nose constitute a potential source for causing infection. Other endogenous flora like corynebacterium spp also has the potential. They are most often resistant to many antibiotics. Another fact that contributes to the interpretation dilemma is CoNS infection does not show the classical signs and symptoms like purulent discharge and inflammation at the site.[4] The wound appears clean with a serous discharge, or sometimes non healing wound. In fact CoNS infection is associated with sternal dehiscence.[6]

Its hydrophobic nature and ability to produce slime coupled with antibiotic resistance makes it the ideal pathogen in this context.[6] Antibiotics penetrate the slime poorly and also the concentrations of the antibiotics that reach the sternum are low. All these factors predispose to the sternal dehiscence. This innocent looking wound gives rise to dilemmas on one hand for the microbiologist to pronounce it as pathogen and on the other hand whether to treat it or not to the surgeon. It is recommended that multiple samples as well as molecular techniques will improve the bacteriological diagnosis.[6]

In the present study incidence of S. aureus infections is considerably low. It is a routine practice to screen all the admitted patients for MRSA in the nose and other areas before going for surgery except in emergency cases.

During this it was observed that Staph aureus colonization was very low, less than 1%. Probably this is the reason for the low incidence of S. aureus infection. Lonneke GM Bode et al showed that the rate of nasal colonization with staph aureus was 18.34% and that nasal application of mupirocin would reduce the rate of infection with this pathogen.[13] They presented their study results about the role of mupirocin application in S. aureus nasal colonizers in reducing the infection rate (3.4% in mupirocin group vs 7.7% in placebo group.)

Other pathogens in sternal wound included a few of gram negative bacilli. On the contrary they had a major role in donor site infection in this study. The saphenous vein was used most of the times, and this site is close to the perineal area which would be colonized easily with gram negative bacteria rather than the CoNS.

The next common infection in this group was blood stream infection. Majority of these infections were also due to CoNS. One patient with MRSA at sternal wound showed the same also in the blood. As in wound infections, the innocuous bacteria like Corynebacterium spp. also had appeared in the blood. Patients with BSI more frequently were seen in patients admitted in ICU. BSI due to gram negative bacilli mostly appeared within 5-7 days after the surgery.

Gram negative bacilli can translocate more efficiently from GIT or inflamed pulmonary tissues. Candida spp. often causes BSI in patients on total parenteral nutrition (TPN) therapy. In our study all candida BSI were seen in pediatric group who were on TPN.

All the studies concur in the observation that patients with co morbidities were more prone for developing infections. High body mass index, prolonged surgery, antibiotic prophylaxis, prolonged length of hospital stay, multiple blood transfusions, reoperation and many other factors were proven to contribute to the infection risk.[1-3,5,13-15]

Attention to these issues could result in a decrease in the infection rates. Good patient preparation, aseptic technique, appropriate antibiotic prophylaxis may help in better outcomes. It is recommended that emerging technologies like using microbial sealants offer the ability to seal and immobilize skin flora for the duration of a surgical procedure.[15]

Insertion of prosthetic devices to provide relief for an increasing array of symptoms is a major advance in medical therapeutics but created diseases of medical process - infections of prosthetic devices. Though rare, infections of both partially and fully implanted devices produce major morbidity and mortality and expense. In one of our patients with prosthetic valve, *Actinobacillus actinomycetemcomitans* caused endocarditis after 6 months of insertion.

Regarding the antibiotic profiles of the pathogens isolated, there were not many multi drug resistant organisms. MRSA infections were also less compared to other studies. The coagulase negative staphylococci were though methicillin resistant, the mechanism of this resistance is not fully understood in this organism. The

usual cephazolin antibiotic prophylaxis showed no contradicting outcomes in the patients.

CONCLUSION

The present study showed bacterial pathogen results agreeing with those of other authors at the same time not very difficult to treat pathogens. The study provided a data base of the pathogens prevalent in this center and helps in appropriate antibiotic prophylaxis and treatment guidelines. Efforts could be made to look into possible ways to reduce the infections further more.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Ottino GM, De Paulis R, Pansini S, Rocca G. Major sternal wound infection after open heart surgery: A multivariate analysis of risk factors in 2,579 consecutive operative procedures: the annals of thoracic surgery. 1987;44(2):173-9.
2. Leplletier D, Perron S, Bizouarn P, Caillon J, Drugeon H. Jean- Luc MICHAUD Surgical site infection after cardiac surgery: incidence, microbiology and risk factors., Inf. Contr. & Hosp. epidemiology. 2005;26(05):466-72.
3. Chen LF, Arduino JM, Sheng S, Muhlbaier LH, Kanafani ZA, Harris AD, et al. Epidemiology and outcome of Major post operative infections following cardiac surgery: risk factors and impact of pathogen type. Am J Inf Control. 2012;40(10):963-8.
4. Sharma M, Berriel-Cass D, Baran JR. Sternal surgical site infection following CABG prevalence, microbiology and complications during a 42 month period inf. Control and hospi. Epidemio. 2004;25(06):468-71.
5. Jonkers D, Elenbass T, Terpoten P, Niceman F, Stobberingh E. Prevalence of 90 days post operative infections after cardiac surgery, Eur J.Cardio thorac surgery. 2003;23:97-102.
6. Tammelin A, Hambreus A, Stahle E. Mediastinitis after cardiac surgery: improvement of bacteriological diagnosis by use of multiple tissue samples and strain typing. J. Clin. Micro. 2002;40,8:2936-41.
7. Wound and soft tissue cultures, Mary K. York, Susan E Sharp, Philip G Bowler, 2006, Hand book Of Procedures in Microbiology, 3.13.11-3.13.2.1, ASM press.
8. BD Phoenix technical manual. https://www.bd.com/ds/technicalCenter/clsi/clsi-Phoenix_GramNegative_V5.15_V4.31.pdf.
9. bioMérieux enlarges its pathogen identification capability on VITEK® MS. Available at: http://www.biomerieux-diagnostics.com/.
10. Clinical and laboratory standards institute, M100-S24 performance standards for antimicrobial susceptibility testing. standard@clsi.org
11. BD BACTEC 9000 Technical manual. www.bd.com>clsi.
12. Chaudhuri A, Shekar K, Coulter C. Posy operative deep sternal wound infection: making an early microbial diagnosis, Eur J Cardio thorac Surgery. 2012;41:1304-130.
13. Bode LGM, Kluytmans JAJW, Wertheim HFL. Preventing surgical site infection in nasal carriers of *S. aureus*. The New Engl J med Jan. 2010;362,1:9-17.
14. Stahle E, Tammelin A, Bergstrom R, Hambreus A, Nystrom SO, Hansson HE. Sternal wound complications-incidence, microbiology and risk factors: European J cardio thorac surgery. 1997;11:1146-53.
15. Owens CD, Stoesse K. Surgical site infections, epidemiology, microbiology & prevention. J Hosp. infection. 2008;70:2:173-9.

Cite this article as: Nagamani R. Bacterial epidemiology of post-operative infections at a cardiac center. Int J Res Med Sci 2016;4:4033-6.