MICROBIAL SPECTRUM OF CARDIAC IMPLANTABLE ELECTRONIC DEVICE INFECTIONS - A TERTIARY CARDIAC CENTER EXPERIENCE

Sabeen Khurshid Zaidi, Syed Mohammad Imran Majeed, Azmat Hayat, Muhammad Iqbal, Waqar Ali

Armed Forces Institute of Cardiology & National Institute of Heart Diseases, Rawalpindi

ABSTRACT

Objective: The objective of the study was to determine the microbiological spectrum of cardiac implantable electronic device (CIED) infections.

Study Design: Case series

Place and Duration of Study: Armed Forces Institute of Cardiology / National Institute of Heart Diseases AFIC/NIHD from January 2011 to Nov 2013.

Patients and Methods: A total of 15 pus samples from patients with possible CIED infection out of 814 patients with implantable CIEDs were processed. Thirteen patients with positive cultures out of fifteen were included in the study. Clinical evidence of CIED infection included signs of inflammation and purulent drainage. A CIED infection was microbiologically confirmed based on culture yield. Blood cultures were carried out in all patients with suspected CIED infection along with trans-oesophageal echocardiography (TOE), wherever clinically indicated to exclude bacteremia and lead endocarditis.

Results: Sixty nine percent of patients with culture proven CIED infection were females and 31% were males. The mean age of patients was 61 years (range 53-70 years). Devices included 11 PPMs, 1 ICD and 1 CRT. The most frequent organisms were gram-positive (77% of isolates); with Coagulase-negative *Staphylococci* (CoNS) predominating in particular Methicillin Resistant *Staphylococcus epidermidis* (MRSE) in 46.4% cases followed by Methicillin Sensitive *Staphylococcus epidermidis* (MSSE) in 15%. Non tuberculous *Mycobacterium fortuitium* was isolated from pus in two patients; with PPM and ICD implants respectively. MRSA was isolated in only 01 PPM infection with evidence of lead endocarditis on TOE. *Pseudomonas* species was isolated from pus in one patient with CRT implant.

Conclusion: CIED infections are more often caused by *Staphylococci* predominantly CoNS, although atypical Mycobacteria can be implicated.

Keywords: Cardiac implantable electronic device, Microbiological

INTRODUCTION

The use of cardiac implantable electronic devices (CIEDs) including permanent pacemakers (PPMs),implantable cardioverter defibrillators (ICDs) and Cardiac resynchronization therapy (CRT) devices has increased significantly over the last decade. The device recipients are significantly older with co-morbidities making them prone to CIED infections[1,2]. Although implantation of these devices is carried out under sterile conditions and with the use of prophylactic antibiotics but despite these measures CIED infection remains a challenging complication[3]. Rates of PPM infection have varied in the past between 0.13 % and 19.9 %[4,5].

CIED infections can be classified into subcutaneous pocket infections and deeper lead endocarditis. Pocket infections occur when the subcutaneous pocket containing the device is involved. Lead endocarditis can occur when the transvenous portion of the lead is involved along with endovascular infection. Infections are usually limited to the pocket. PPM endocarditis accounts for approximately 10% of PPM infections[6].

The microorganisms causing CIED infections can be acquired endogenously from skin flora or via nosocomial transmission[7]. The

Correspondence: Maj Sabeen Khurshid Zaidi, AFIC/NIHD Rawalpindi.
Email:
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aim of the study was to determine the microbial spectrum of CIED infections in our set-up.

PATIENTS AND METHODS

Setting

All successive patients with CIED pocket infections who underwent CIED insertion at our hospital; a 270 bedded tertiary cardiac center, Armed Forces Institute of Cardiology / National Institute of Heart Diseases AFIC/NIHD,between January 2011 and November 2013[13]. Patients with positive cultures out of 15 were included in the study.CIED pocket infection was defined as having clinical signs and symptoms of local infections including erythema, tenderness, wound dehiscence, erosion, and pus discharge, plus microbiological confirmation based on results of cultures of intraoperatively collected pus samplesfrom the pocket site. CIED-related endocarditis wasdiagnosed if both major Duke criteria were met, including microbiological evidence and echocardiographic evidence of right-sided infective endocarditis[8].

Pus samples from patients with suspected CIED infection were microbiologically examined with Gram and Ziehl - Neelsen stains, and by culturing on solid media including blood agar, Chocolate agar, MacConkey agar, and Sabouroud agar. Blood cultures were processed as per standard procedures. Gram negative rods were identified by colony morphology using standard biochemical tests and bacteriological techniques with API 20 NEbioMérieux, France[9,10]. Identification of *Staphylococcal* isolates was carried out on the basis of colony morphology using the standard biochemical tests including catalase, DNase and coagulase production, growth and susceptibility to bacitracin and novobiocin. *Staphylococcus* species were identified biochemically via colorimetric reactions using the API™ staph bioMérieuxFrance[11].Antimicrobial susceptibility pattern was determined according to the break points indicated by the Clinical and Laboratory Standard Institute[12,13].

Data analysis

The data had been analyzed using SPSS Version 18.0. Frequencies and percentages were calculated for qualitative variables while mean and standard deviation (SD) were calculated for quantitative variables.

Table-1: Antibiogram of staphylococcus epidermidis isolates (n=8)

Antibiotics	Sensitive isolates	
	Number	Percentage
Rifampicin	6	75.0
Cotrimoxazole	4	50.0
Linezolid	8	100
Minocycline	7	87.5
Oxacillin	2	25
Ciprofloxacin	2	25
Moxifloxacin	4	50
Levofloxacin	4	50
Gentamicin	4	50
Amikacin	5	62.5
Vancomycin	8	100
Teicoplanin	5	62.5
Amoxicillin/Clav-ulanic acid	1	12.5
Erythromycin	4	50
Clindamycin	4	50
Cefuroxime	1	12.5

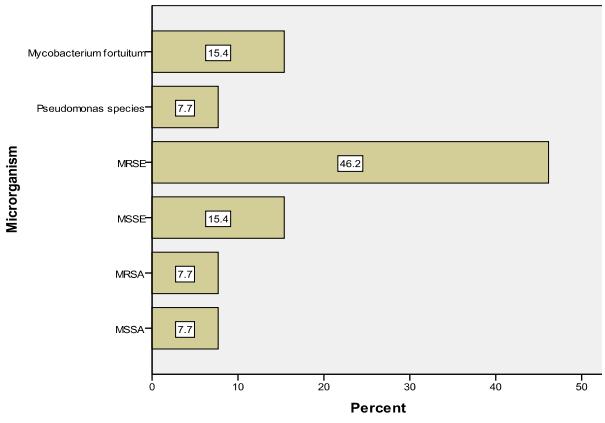

Figure-1: Microbial profile of CIED infections (n=13)

RESULTS

During the study period 13 patients had culture proven pocket infections. Sixty nine percent of patients with culture proven CIED infection were females and 31% were males. The mean age of patients was 61 years (range 53-70 years). The most frequent organisms were gram-positive (77% of isolates); with Coagulase-negative *Staphylococci* (CoNS) predominating in particular Methicillin Resistant *Staphylococcus epidermidis* (MRSE) in 46.2% cases followed by Methicillin sensitive *Staphylococcus epidermidis* (MSSE) in 15.4% (figure-1). Non tuberculous *Mycobacterium fortuitum* was isolated from pus in two patients; with PPM and ICD implants respectively. MRSA was isolated in only 1 (7.7%) PPM infection with evidence of lead endocarditis on TOE and blood culture. Pseudomonas spp was isolated from pus in one (7.7%) patient with CRT implant.

The *Mycobacterium fortuitum* isolate from the only ICD implant pocket infection was sensitive in vitro to co-trimoxazole, doxycycline, linezolid, amikacin, cefoxitin and ciprofloxacin. The *Mycobacterium fortuitum* isolate from PPM pocket infection was sensitive in vitro to amikacin, cefoxitin, cotrimoxazole, doxycycline and ciprofloxacin. The *Pseudomonas* isolate from the only CRT pocket infection was sensitive in vitro to gentamicin, amikacin, ceftazidime, imipenum, meropenum, ciprofloxacin and pipracillin/tazobactum. The only Methicillin sensitive *Staphylococcus aureus* (MSSA) isolate from PPM pocket infection was sensitive in vitro to erythromycin, flucloxacillin, cotrimoxazole, vancomycin, linezolid, and ciprofloxacin. The Methicillin Resistant *Staphylococcus aureus* (MRSA) isolate from the PPM pocket infection and concomitant Lead endocarditis was sensitive in vitro to vancomycin, linezolid, cotrimoxazole, rifampicin and chloremphenicol. Only 25% of *Staphylocooccu sepidermidis* isolates were sensitive in vitro to oxacillin, and all isolates were sensitive in vitro to vancomycin and linezolid as shown in table-1.

DISCUSSION

This is the first study in Pakistan to report the microbiology of CIED infections, although pacemaker infections have been reported as a significant complication[14].The microbial profile of CIED infections can help in treating these infections empirically.

CIEDs are implanted in a relatively older cohort of patients as shown in our study. These patients have existing co- morbidities making them prone to development of infections[3].

In this study, *Staphylococcus* is yielded as the most common cause of CIED infections, with the majority due to Coagulase negative strains. Methicillin-resistance is common in our set up. In a large contemporary study by Jan et al[15] the most common isolate was *Staphylococcus* from CIED infections with Coagulase negative strains predominating and a high frequency of Methicillin resistance. Chua et al[16] have similarly reported Coagulase negative *Staphylococci* followed by *Staphylococcus aureus* as the major microbial aetiology of CIED infections in a large prospective cohort study conducted at a 1,000-bed tertiary referral center in Cleveland, Ohio[17].

Some studies have reported a low prevalence of methicillin-resistant CoNS in individuals with no healthcare contact and no recent antibiotic exposure; yet a high frequency of CIED infections due to multi drug-resistant staphylococci[18] suggests that the healthcare environment may be implicated in acquisition of infection.

CIED infection is the result of the interaction between the host, device and the microorganism involved. Initial attachment of bacteria to the device is mediated by physical and chemical properties of the device and the bacterial surface. CIEDs like all foreign bodies are prone to biofilm formation[19]. Staphylococci have microbial surface components reacting with adherence matrix molecules that allow the pathogen to establish a focus of infection[7]. The isolation of staphylococci as the major pathogen implicated in our study supports this fact.

Most PPM infections that have been reported were limited to the pocket with PPM endocarditis implicated inabout 10% of PPM infections[20]. We report only one case of Lead enocarditis with MRSA as the aetiology.

Gram negative organisms are rarely implicated in CIED infections[7] which correlates with our findings where the only gram negative organism was *Pseudomonas*. CIED infections due to *Mycobacterium fortuitum* have been reported byHemmersbach-Miller et al[21] in both ICD and PPM infections similar to our findings.

All of the staphylococcal isolates in our study were sensitive in vitro to Linezolid. Similar findings were seen in the study conducted by Jan et al[15].

CONCLUSION

CIED infections are more often caused by *Staphylococci* predominantly CoNS, although atypical *Mycobacteria* can be implicated.

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