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Original Research Article

Comparative Antimicrobial Susceptibility Patterns Of Bacterial Isolates From Postoperative Wound Infections

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Abstract: Wound infection is one of the major health issues that are caused and provoked by the incursion of pathogenic microorganisms. Information on intrinsic pathogens and sensitivity to antimicrobial agents and topical agents is crucial for successful treatment of various types of surgical wounds. The main objective of this study is to determine the antimicrobial susceptibility pattern of bacterial isolates from postoperative wound infection and their sensitivity towards antibiotics. Here in this study, the resistance patterns are highlighted. Pus swabs and aspirates were collected from 108 patients where standard bacteriological procedures were followed to identify the bacterial etiology. To confirm the isolates, morphological, microscopical and biochemical procedures followed. Further, it was extended to analyze the presence of resistant patterns against various antibiotics. The antibiotic susceptibility pattern of Gram negative bacteria showed higher resistance against the antibiotics, including ceftriaxone, cotrimaxazole, amikacin, ciprofloxacin and ampicillin. Gram positive bacterial isolates, maximum resistant pattern observed in ampicillin, cotrimaxazole, erythromycin, ceftriaxone, ciprofloxacin and oxacillin. In conclusion, it is highlighted that gram negative bacterial isolates against nine antibiotics, five showed maximum resistance. Out of ten antibiotics, six showed resistant against gram positive bacterial isolates.

Key words: Postoperative wound infections, bacterial pathogens, resistant patterns

Introduction

Nosocomial infection is defined as an infection acquired in hospital by a patient who was admitted for a reason other than that infection. The infection occurring in a patient in a hospital or other health care facility in whom the infection was not present or incubating at the time of admission and this include infections that are acquired in the hospital but appear after discharge [1,2]. These infections constitute a major public health problem worldwide and resulting in major causes of morbidity and mortality, functional disability, emotional suffering and economic burden among the hospitalized patients [3]. The most common types of hospital acquired infections (HAIs) that could occur in a hospital set up are surgical wound and other soft tissue infections, urinary tract, respiratory and blood stream infections.

Post-surgical wound infections can occur from the first day onwards for many years after surgery, but commonly occurs between the 15th and 20th days after any type of surgeries [4]. It may originate during the surgery and considered as a primary wound infection or may occur after the surgery from sources in the ward or as a result of some complications and referred as secondary wound infection and can be characterized by various combinations of the signs of infection including pain, tenderness, warmth, erythema, swelling, drainage, etc. [5]. Most post-surgical wound infections are nosocomial and vary from one hospital to the other and even within a given hospital and they are associated with increased morbidity and mortality [4,6]. The infection site may be limited to the suture line or may become widespread in the surgical site and the infecting pathogens are variable, depending on the type and location of surgery and antibiotics received by the patient.

A complex interplay between host, microbial, and surgical factors ultimately determines the prevention or the establishment of a wound infection. The most common group of bacteria responsible for SSIs is *Staphylococcus aureus* [7,8]. *Pseudomonas aeruginosa* is an epitome of opportunistic nosocomial pathogen, which causes a wide spectrum of infections and leads to substantial morbidity in immuno compromised patients [9]. Risk factors other than

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microbiology can be due to systemic factors affecting the patient's healing response, local wound characteristics, or operative characteristics. Its risk depends on the bleeding, the amount of devitalized tissue created and the need for drains within the wound, obesity and diabetes mellitus [4,8]. They are the third most frequent nosocomial infection, associated with increased hospital stay, costs, and use of antimicrobial agents. Antibiotic resistance can be controlled by appropriate antimicrobial prescribing, prudent infection control, new treatment alternatives, and continued surveillance [10].

Due to increasing in the usage of antibiotics in the health care industry, the resistance rate gets increased. Thus, this study highlighted the importance of bacterial etiology and its antibiotic resistant patterns from the post-operative wound cases. Further, this report may assist the clinicians to select the appropriate antibiotics for patient management in hospital acquired infections.

Materials and Methods

After confirming the isolates by morphological, microscopical and biochemical methods, the isolates were subjected to antimicrobial sensitivity pattern using the Kirby Bauer method. Galleries of antibiotics were used, including ampicillin - AMP (10µg), amikacin – AMK (30µg), cotrimoxazole – COT (1.25/ 23.75µg), ciprofloxacin – CIP (5µg), cefotaxine – CTX (30µg), piperacillin/ tazobactum –P/T (180/18µg), imipenem – IPM (10µg), meropenem – MRP (10µg), ceforperazone – CPZ (75µg) against gram negative bacterial isolates. For gram positive bacterial isolates tested for ampicillin – AMP (10µg), erythromycin – ERY (15µg), clindamycin – CD (2µg), oxacillin – OX (1µg), gentamycin – GEN (10µg), cotrimazole – COT (1.25/23.75µg), tetracycline – TET (30µg), ciprofloxacin – CIP (5µg), cefotaxine – CTX (30µg) and vancomycin - VAN(30µg) were used.

McFarland 0.5 standard was prepared by adding 99.55ml of 1% sulphuric acid and 0.5ml of 1.175% barium chloride and this solution was dispersed in tubes for the turbidity comparison with inoculum that are inoculated in the broth for surface seeding on Mueller Hinton agar plates. The turbidity compatibility was adjusted to 1.5 X 10^8 CFU/ml.

The Mueller Hinton agar plates with inoculum on surface were further impregnated with the antibiotic discs with known concentrations was placed appropriately (not closer than 25mm). Later the plates were incubated at 37°C for 18 to 24 hours for the observation of zone of inhibition around the discs. The sizes of the zones of inhibition were interpreted by referring to the CLSI standards and reported as susceptible, resistant and towards resistant (intermediate).

Results

The antibiotic sensitivity pattern of the gram negative bacterial isolates from patients showed high resistance against the antibiotics, including ceftriaxone, cotrimaxazole, amikacin, ciprofloxacin and ampicillin. In *Escherichia coli*, the maximum resistance was found against cotrimaxazole (89.5%) and ampicillin (84.3%), in *Klebsiella pneumoniae*, the maximum resistance identified against cotrimaxazole (81.2%) followed by cefotaxime (69.7%). The minimum resistance was observed against *Pseudomonas aeruginosa* and non-fermenting gram negative bacilli and the detailed descriptions were depicted in table 1.

Table 1: Antibiotic susceptibility pattern of gram negative bacterial isolates

Bacterial isolates	Antibiotic resistance patterns								
	AMP	AMK	COT	CIP	CTZ	P/T	IPM	MRP	CPZ
Escherichia coli (n=19)	16 (84.3)	2 (11.5)	17 (89.5)	15 (79.9)	15 (79.9)	2 (11.5)	0	2 (11.5)	-
Klebsiella pneumonia (n=16)	-	3 (19.7)	13 (81.2)	7 (43.7)	11 (68.7)	0	0	2 (12.5)	-
Citrobacter sp. (n=4)	2 (50)	2 (50)	3 (75)	2 (50)	3 (75)	0	0	0	-
NFCNB (n=4)	-	3 (75)	-	2 (50)	-	0	0	0	2 (50)
Pseudomonas aeruginosa (n=4)	-	2 (50)	-	0	1 (25)	0	0	0	0

[Figure in parenthesis denoted percentages]

Table 1: Antibiotic susceptibility pattern of gram positive bacterial isolates

Bacterial isolates	Antibiotic resistance patterns								
	AMP	ERY	CD	OX	GEN	COT	TET	CIP	VAN
MSSA (n=40)	33 (82.5)	18 (45)	5 (12.5)	0	13 (32.5)	31 (77.5)	8 (20)	21 (52.5)	0
MRSA (n=11)	11 (100)	7 (63.6)	4 (36.4)	11 (100)	5 (45.5)	9 (81.8)	4 (36.4)	9 (81.8)	0
CONS (n=25)	22 (88)	14 (66)	2 (8)	10 (40)	3 (12)	19 (76)	3 (12)	3 (12)	0

[Figure in parenthesis denoted percentages]

Among Gram positive isolates, Methicillin resistant *Staphylococcus aureus* (MRSA) showed maximum resistance to ampicillin, oxacillin and further followed by cotrimaxazole and ciprofloxacin. Among Methicillin sensitive *Staphylococcus aureus* (MSSA), the maximum resistance was found to ampicillin and cotrimaxazole. In the case of coagulase negative staphylococci (CONS) showed maximum resistance to ampicillin and cotrimaxazole. Thus, in all gram positive isolates, the maximum resistance was found to ampicillin and cotrimaxazole and the detailed description of resistance pattern was tabulated in table 2.

Discussion

Hospital acquired infections become prominent in post-surgical wards and intensive care units due to the surgical interventions and its procedures, further those places are much more important in rapid multiplication of the antibiotic resistant bacterial strains [11,12]. A total of 108 post-operative pus samples enrolled in this study provided 134 bacterial isolates of both gram positive and gram negative types. Out of which, gram positive and gram negative isolates was supported 82 (61.2%) and 52 (38.8%) respectively.

The predominant isolates of gram positive revealed MSSA, CONS and MRSA, and gram negative *E. coli, K. pneumoniae*, *Citrobacter* sp etc. Antimicrobial resistance pattern of GNBs showed high level of resistance to cotrimaxazole and ampicillin, whereas in gram positive bacterial isolates, ampicillin and cotrimaxazole. Without overlapping, the isolates showed maximum resistance to particular groups of antibiotics. These data revealed that the high level resistance to β-lactams among gram negative and emerging hospital acquired MRSA. These observations are alarming since virtually all the patients are prescribed first or second generation cephalosporins as prophylaxis before surgery [2,12]. Oxacillin and vancomycin were the most effective drugs against *S. aureus* and resistance to these drugs is also soon expected.

Despite advances in the operative techniques and better understanding of the pathogenesis of wound infection, postoperative wound infection continues to be a major source of morbidity and mortality for patients undergoing operative procedures. Its rate varies in different countries, different areas and even in different hospitals [13,14]. Despite modern surgical and sterilization techniques and prophylactic use of good antibiotics, postoperative wound infection remains a major contributory factor of patient's morbidity [15,16]. The universally acceptable rate of 2% can be achieved by taking proper measures to improve the environment of our operation theaters and wards and the method of sterilization and prophylactic gram-negative coverage [13,17]. Due to the antibiotic misuse (unnecessarily prescribing higher antibiotics without any proper reports), more resistant bacterial pathogens evolved leads to further treatment failure and prolonged treatment of using the much higher antibiotic class.

Conclusion

Preoperative prophylaxis using appropriate antibiotics (including dosage, duration, selection bias, predetermined research on common isolates) would reduce the outbreak and challenges (severe morbidity and mortality) in post-surgical wound infections.

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