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ARTICLE

Nosocomial Infections in a Surgical Department, Tripoli Central Hospital, Tripoli, Libya

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Abstract

Background: *Pseudomonas. aeruginosa* is an established cause of nosocomial infections among surgical patients and infants in neonatal intensive care units. **Objective:** We aimed, firstly to identify the prevalence of *P. aeruginosa* and other causative agents from wounds and other body sites (hands, groins, axillae, umbilicus and drains) and secondly to investigate the resistance patterns of antimicrobial susceptibility against various antibiotics. **Materials and Methods:** The study was carried out in Departments of General Surgery and Medical Laboratory in Tripoli Central Hospital, Tripoli, Libya over a period of 6 months from March through August 2007. A total of 792 clinical samples were taken during the examination from several sites of 150 patients and transported immediately to the laboratory then inoculated directly into selective on MacConkey agar and standard bacteriological media. The isolates were identified and antimicrobial susceptibility testing was performed by the disc diffusion method according to National Committee for Clinical and Laboratory Standards (NCCLS) guidelines. **Results:** 336 different bacterial isolates were identified in wounds and other body sites. In general, *P. aeruginosa* was the commonest isolate (35.7%) followed by *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae* (29.2%, 9.2%, and 8.9%) respectively. In particular, *P. aeruginosa* was the most common bacteria isolated in samples from diabetic foot disease reaching 80.6% of total isolates. **Conclusion:** *P. aeruginosa* was found to be quite common in our surgical patients and it has emerged as one of the most problematic Gram negative pathogens. Hands of the patients were commonly colonized by different bacteria. Resistance rates to frequently used antibiotics were high. Microbiology sensitivity results should guide the use of proper antibiotic drugs.

Key words: *Pseudomonas aeruginosa*, nosocomial infections, diabetic foot disease

Introduction

Pseudomonas aeruginosa and *Pseudomonas maltophilia* account for approximately 80 per cent of pseudomonads recovered from clinical specimens. *P. aeruginosa* has received the most attention. It is a ubiquitous free-living bacterium and is found in most moist environments. Although it seldom causes disease in healthy individuals, it is a major threat to hospitalized patients, particularly those with serious underlying diseases such as cancer and burns. The high mortality associated with these infections is due to a combination of weakened host defenses, bacterial resistance to antibiotics, and the production of extracellular bacterial enzymes and toxins (1). *P. aeruginosa* is a well-known cause of nosocomial (hospital acquired) infections among surgical patients and infants in neonatal intensive care units.

Pseudomonas aeruginosa has become an important cause of infection, especially in patients with compromised host defense mechanisms. It is the most common pathogen isolated from patients who have been hospitalized longer than 1 week. It is a frequent cause of nosocomial infections such as pneumonia, urinary tract infections (UTIs), and bacteremia. Pseudomonal infections are complicated and can be life threatening. Environmental sources such as sinks and respiratory-therapy equipment are the most commonly described reservoirs of *P. aeruginosa* (2,3) but occasionally health care workers have been the reservoir. Data are available about the frequency and implications of pseudomonas infections in many parts of the world but not from our own region (4-7). Patients with impaired immune defenses were raised and leading to an increase in nosocomial infections especially by Gram-negative organisms such as Pseudomonas (8). These bacteria may be found in the patient's own flora, or in damp environmental sites such sinks or hospital equipments. They are resistance to many antibiotics and antiseptics and they may survive for long periods, and have the ability to colonize traumatized skin (9). In the present study, we wished firstly to identify the prevalence of *P. aeruginosa* and other causative agent from wound and other body sites (hands, groins, axillae, umbilicus and drains) and secondly to investigate the resistance patterns of antimicrobial susceptibility against various antibiotics.

Materials and Methods

792 clinical samples were taken during the examination from several sites of 150 patients and transported immediately to the laboratory then inoculated directly into standard and selective bacteriological media. Using standard diagnostic microbiological laboratory methods for identification include; culturing on MacConkey agar; Gram stain, oxidase test, catalase test, coagulase test, API 20NE and API 20E (BioMérieux, Marcy L'Etoile, France). All *P. aeruginosa* isolates were tested for the formation of large colonies with grapelike odor, a positive reaction to oxidase and production of pyocyanin, a water soluble greenish color pigment on the culture medium. Strains giving positive reactions in these tests were accepted as *P. aeruginosa* and 98% of the *P. aeruginosa* strains isolated produced pyocyanin on agar plate. In fact, the presence of pyocyanin pigment is good characteristic for identification of *P. aeruginosa* as no other non-fermenter synthesizes this pigment (10). The *P. aeruginosa* isolates were tested against different antibiotics agents by disk diffusion method as described by National Committee for Clinical Laboratory Standard (NCCLS) (11).

Results

Clinical Aspects

Out of the 150 patients examined, 25 patients had diabetic foot disease (DFD) and the remainder 125 patients were described as non-DFD (Table 1). Figure 1 illustrates the percentage results of bacterial growth from (125) non-DFD patients plus the total number of the infected wounds. *P. aeruginosa* was present in 80.5% of isolates in DFD group (Figure 1) and in 22% of non-DFD group (Figure 2). The 125 non-DFD patients were further divided into three categories according to the type of the operation i.e. clean, potentially contaminated and contaminated (Table 1).

Pathogen Frequency

The most common isolates were from potentially contaminated operations. *Staphylococus aureus* was the most common pathogen (10%) followed by *Escherichia coli* (33.3%). The lowest rate of isolation was from clean operations (*P. aeruginosa* 9.7%) (Table 1). Analysis of the data based on the site of isolation revealed that 90 (26.8%) of the isolates were obtained from wounds (diabetic and non-diabetic). The other body sites were mostly colonized by bacteria were hands (79; 23.5%), groins (59; 17.6%), umbilicus (51; 15.2%), axillae (49; 14.6%) and drains (8; 2.4%). The distribution of individual isolates by site are detailed in Table 2.

Antibiotic Resistance

P. aeruginosa was highly resistant to the most commonly used antibiotics such as Imipenem, Ciprofloxacin,

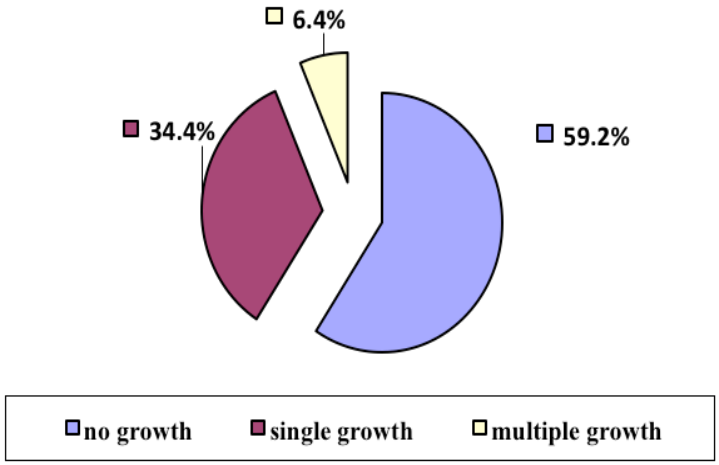

Figure 1. The bacterial growth pattern from 51 infected wounds in 125 patients with non-diabetic foot disease.

Table 1. The percentages of infected operation and the isolates from (125) patients with non-DFD

Isolates	Clean wounds n=31	Potentially contaminated wounds n=70	Contaminated wounds n=24	Total isolates
P. aeruginosa	3 (9.7%)	4 (5.7%)	6 (25%)	13 (22%)
S. aureus	2 (6.5%)	7 (10%)	1 (4%)	10 (16.9%)
E. coli	2 (6.5%)	3 (4.3%)	8 (33.3%)	13 (22%)
K. pneumonia	1 (3.2%)	3 (4.3%)	2 (8.3%)	6 (10.2%)
Entero. cloacae	0	3 (4.3%)	4 (16.7%)	7 (11.9%)
Proteus mirabilis	0	3 (4.3%)	1 (4%)	4 (6.8%)
St. faecalis	0	0	2 (8.3%)	2 (3.4%)
Acinto. baumanni	1 (3.2%)	1 (1.4%)	0	2 (3.4%)
Citro. freundii	0	2 (2.9%)	0	2 (3.4%)
Total isolates	9	26	24	59

Ceftriaxone (24.2%, 33.4% and 42.5%) respectively. Whereas the most effective antibiotics with low resistance were Piperacillin, Ticarcillin and Gentamicin (14.2%, 17.5% and 23.4%) respectively. Methicillin-resistance *S. aureus* (MRSA) was very common in the patients of the surgical department with 75.6% and all were sensitive to Vancomycin.

Discussion

In this study, 120 isolates (35.7%) of *P. aeruginosa* were isolated from all clinical samples received from the surgical department including various types of surgical wounds and other body sites. Nearly similar results showed that the prevalence of *P. aeruginosa* isolates from wounds in this study was (42.2%) compared to the prevalence of *P. aeruginosa* isolates from wound infections obtained from the study carried out in Ahmadu Bello University Teaching

Table 2. The number and percentage of isolated bacteria from wounds other body sites

isolates	wounds DFD and non DFD	Hands	Groins	Umbilicus	Axillae	Drains	Total isolates
P. aeruginosa	38 (42.2%)	34 (43%)	13 (22%)	15 (29.4%)	17 (34.7%)	3 (37.5%)	120 (35.7%)
S. aureus	13 (14.4%)	18 (22.8%)	28 (47.5%)	19 (37.3%)	19 (38.8%)	1 (12.5%)	98 (29.2%)
E. coli	13 (14.4%)	7 (8.9%)	3 (5.1%)	4 (7.8%)	4 (8.2%)	0	31 (9.2%)
K. pneumonia	9 (10%)	6 (7.6%)	5 (8.5%)	6 (11.8%)	3 (6.1%)	1 (12.5%)	30 (8.9%)
Entero. Cloacae	7 (7.8%)	2 (2.5%)	5 (8.5%)	3 (5.9%)	2 (4.1%)	2 (25%)	21 6.3%)
Proteus mirabilis	4 (4.4%)	4 (5.1%)	2 (3.4%)	3 (5.9%)	4 (8.2%)	0	17 (5.1%)
St. faecalis	2 (2.2%)	3 (3.8%)	0	1 (2%)	0	1 (12.5%)	7 (2.1%)
Acint. Baumanni	2 (2.2%)	3 (3.8%)	1 (1.7%)	0	0	0	6 (1.8%)
Citro. Freundii	2 (2.2%)	2 (2.5%)	2 (3.4%)	0	0	0	6 (1.8%)
Total	90 (26.8%)	79 (23.5%)	59 (17.6%)	51 (15.2%)	49 (14.6%)	8 (2.4%)	336

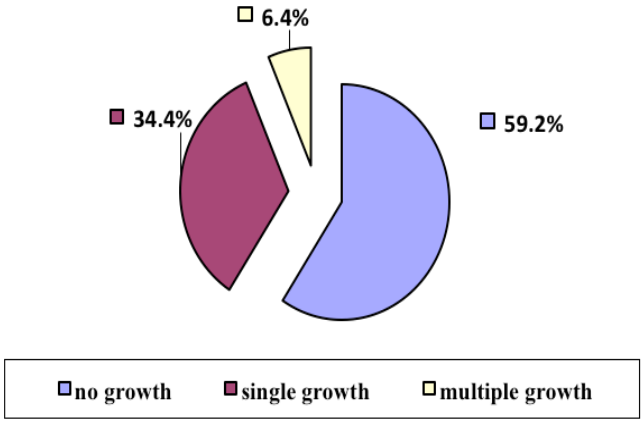

Figure 2. The distribution of the main pathogens isolates from 25 patients with diabetic foot disease.

Hospital, Zaria, Nigeria (41.3%) (7). However the incidence of wound infections varies from hospital to hospital, from one surgical procedure to another and most importantly from one patient to another (12). Furthermore, hospitalized patients receiving broad-spectrum antibiotics prophylaxis are frequently colonized by *P. aeruginosa* in their small and large intestinal tracts (13). On the other hand infected diabetic foot, which is a major complication of uncontrolled diabetes mellitus can lead to development of foot gangrene and eventually limb amputation. This study investigated the most predominant bacterial isolates responsible for diabetic foot infections, the result showed that the prevalence of *P. aeruginosa* isolates in diabetic foot disease (DFD) was (80.6%) which is a very high prevalence compared with the results found in Malaysia where the most frequently isolated pathogens were Gram-negative bacteria (52%) of which the isolates of *P. aeruginosa* was (25%) (14). *P. aeruginosa* was found to be the most common pathogen associated with cross nosocomial infections transmission between patients admitted into tertiary intensive care units, the serotype of the clinical isolates and surveillance sample isolates from nurses' hands showed the same serotype

(15). In addition, hand carriage of aerobic gram-negative rods by health care personnel; transient colonization of the hands with *P. aeruginosa* has been described in 31% of these health care workers (16). Another report showed an outbreak of *P. aeruginosa* in a surgical intensive care linked to hand carriage by a single staff member, which is the same clone of *P. aeruginosa* was isolated from nine patients (17). These studies showed that hospital acquired cross transmission with *P. aeroginosa* between surgeons, nurses or health care workers play a major role in nosocomial infections and correlates well with our study in that the prevalence of *P. aeruginosa* isolated from patient's hands was (23.5%) which is more than isolates from any other body sites. Furthermore, the rate of nosocomial methicillin-resistant *staphylococcus aureus* (MRSA) in our study in surgical department was very high with (75.6%) compared with other studies which showed a rate of (59 %) in adult patients with acute purulent skin and soft-tissue infections, also these reports showed that the most effective treatment in these patients were incision and drainage of the infected sites (18).

Antibiotics treatment of *p. aeruginosa* in various worldwide studies showed that the prevalence of Imipenem resistance *P. aeruginosa* (IRPA) isolates in Cali, Colombia, increased from (2%) in 1996 to (28%) in 1997 and over (40%) in 2003 (19), also, another study in Turkey showed the IRPA was (44.1%) (20), these results were high compared with our investigation in which IRPA was (24.2%). On the other hand, concerning ciprofloxacin resistant *p. aeruginosa* the resistance rate in our study was (33.4%), which is slightly higher than the results obtained from Italy (26.4%) (21) and from Gaza Strip, Palestine (20.0%) (22). The resistance rate to ceftriaxone was (86.1%) of *P aeruginosa* isolated from wound swab and pus samples in Dhaka, Bangladesh (23), and was 67% in Pakistan (24). These results were very similar to our results of (42.5%). The mechanisms of intrinsic resistant of *P. aeruginosa* to many antimicrobial agents increased because of the low permeability of its outer membrane (1 in 100 of the permeability of *E. coli* outer membrane) (25) and the naturally occurring chromosomal Amp β-lactamase (26).

The prevalence of antimicrobial resistance often varies dramatically between countries and regions and between hospitals in the same region and even among different patient populations in the same hospital. In light of these variations, physicians in clinical practice must make a clinical judgment about the likely pathogen(s) involved in the infectious process (27). Therefore empirical antibiotics therapy for suspected pseudomonad infections is not recommended as indicated by the result of this study.

In conclusion, the frequency of *P. aeruginosa* was found to be high in patients admitted to surgical department and it has emerged as one of the most problematic Gram negative rods, followed by the Gram positive cocci *Staphylococcus aureus*. Hands of the patients were the most common sites colonized by different species of bacteria and to determine the mode of transmission of *P. aeruginosa*, another study should be carried out on the epidemiological and molecular analysis of *P. aeruginosa*. The resistance rates to commonly used antibiotics were high; and it should be used according to sensitivity results.

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