Challenge of *Pseudomonas aeruginosa* infection among cancer patients at Khartoum Oncology Hospital- Sudan

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Abstract

Objectives: To investigate the impact of *Pseudomonas aeruginosa* as bacterial infection among cancer patients were attended Khartoum Oncology hospital.

Methods: A descriptive cross sectional study was obtained between 2010 to 2013. Different types of specimens (urine, wound, swabs, bloods) were collected from 593 cancer patients with different age groups. The samples were inoculated in different media followed by isolation, identification and sensitivity and SPSS used for analysis.

Results: Out of 593 clinical samples 51 *pseudomonas aeruginosa* were isolated. Among which 46(90.2%) were from wound swabs, 4(7.8%) from urine and one (2%) isolated from sputum. Five of the isolated strain among children with age group less than 16 years.

Conclusion: It seem that the prevalence of *Pseudomonas aeruginosa* infection among this study had an effect among cancer patients.

Introduction:

Pseudomonas aeruginosa (P. aeruginosa) is a Gram-negative , aerobic rod , typically give a positive result to the oxidase test , the absence of gas formation from glucose.

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P.aeruginosa is belonging to the bacterial family Pseudomonadaceae.

These bacteria are common inhabitants of soil, water, sewages, marshes, and coastal marine habitats, as well as on plant and animal tissues. Unlike many environmental bacteria, *P. aeruginosa* has a remarkable capacity to cause disease in susceptible hosts. It has the ability to adapt to and thrive in many ecological niches. They occur regularly on the surfaces of plants and occasionally on the surfaces of animals (1) .

P. aeruginosa is an opportunistic pathogen that causes urinary tract infections, respiratory system infections, dermatitis, soft tissue infections, bacteremia and a variety of systemic infections, particularly in patients with severe burns, and in cancer and AIDS patients who are immunosuppressed .

Its optimum temperature for growth is 37 degrees, and it is able to grow at temperatures as high as 42 degrees. It can also grow in distilled water utilizing carbon dioxide, residual sulphur, phosphorus, iron, divalent cations, etc. as the source of carbon and essential nutritional substrates . It cannot, however, survive at a pH of 4.5 or lower. In the hospital environment, it is readily accessible to water in sinks and drains , toilets and flowerpots. *P. aeruginosa* is notorious for its innate resistance to chemical disinfectants, a property conferred by its outer membrane. The high Mg^{2+} content of the outer membrane is responsible for strong lipopolysaccharide linkages which do not permit the penetration of the disinfectant molecules. Resistance to the commonly used antiseptics like quaternary ammonium compounds, hexachlorophene, cetrimide etc. has been noted. The

organism is susceptible, however, to acids, gluteraldehyde, silver salts and strong phenolic disinfectants. [1, 2]

The major threat is the infection of patients with *pseudomonas aeruginosa* who are immunocompromised or those in burns, neonatal and cancer wards. Infection of *P. aeruginosa* is one of the main causes of death among the ill and patients with impaired immune systems in spite of the development of antibiotics [3].

Only a few antibiotics are effective against *Pseudomonas*, including fluoroquinolones, gentamicin, amikacin, and certain broad-spectrum Beta-lactam antibiotics like imipenim, and even these antibiotics are not effective against all strains. The futility of treating *Pseudomonas* infections with antibiotics is most dramatically illustrated in cystic fibrosis patients, virtually all of whom eventually become infected with a strain that is so resistant that it cannot be treated.

According to the (CDC), the overall incidence of *P. aeruginosa* infections in US hospitals averages about 0.4 percent (4 per 1000 discharges), and the bacterium is the fourth most commonly-isolated nosocomial pathogen accounting for 10.1 percent of all hospital-acquired infections. [1, 2]

The bacterium is capable of utilizing a wide range of organic compounds as food sources, thus giving it an exceptional ability to colonize ecological niches where nutrients are limited. *P. aeruginosa* can produce a number of toxic proteins, which not only cause extensive tissue damage, but also interfere with the human immune systems defense mechanisms. These proteins range from potent toxins that enter and kill host cells at or near the site of colonization to degradative enzymes that permanently disrupt

the cell membranes and connective tissues in various organs (4).

Materials and Methods

Study design and area

It is descriptive cross sectional hospital based study conducted at Khartoum Oncology Hospital located at Khartoum state, Sudan.

Study population and sample size

Five hundred and ninety-three patients were included in this study, their age were classifying to three groups, children age (3 ≥16 years), adults age (16 ≤40 years) and (> 40 years). the selection criteria include all patients attend to the hospital and developed secondary signs of infection after at least two days of hospitalization. Ethical approval to perform the study was obtained.

Collection of samples

Urine, swabs, blood, sputum and stool was collected from 593 cancer patients. The clinical samples used to investigate and isolate pseudomonas aeruginosa as pathogenic microorganism according to medical protocol.

Isolation and Identification of *Pseudomonas aeruginosa*

Isolation and identification of the isolates were done on the basis of the growth characteristics of an organism on a selective and differential medium. The recognition of bacterial antigen was performed based on biochemical characteristics, antibiotic susceptibility testing.

Urine samples were inoculated onto CLED medium, wound swabs were inoculated onto blood agar and MacConkey agar plates, stool specimens were inoculated on Deoxycholate citrate agar (DCA), sputum specimens were inoculated onto blood agar plates aerobically and in carbon dioxide atmosphere with chocolate blood agar and MacConkey agar plates, all media for

all samples were incubated aerobically at 37 °C for 24 hours. Blood specimens were inoculated onto brain heart infusion broth and incubated at 37 °C for 7-14 days. After incubation the growth bacteria examined by gram stain and biochemical reaction to confirm pseudomonas isolation and then followed by antibiogram.

Antibacterial susceptibility testing

Antibacterial susceptibility testing was performed by using Kirby-Bauer disc diffusion methods on Mueller Hinton agar. The isolates were tested against different types of antibiotics according to Laboratory standard guidelines.

The antimicrobial agents were included: cirprofloxacin (5 mcg), amikacin (30 mcg), gentamicin (10 mcg), ceftriaxone(30 mcg) , cefotaxime (30 mcg), ceftazidime (30 mcg), meropenem (10 mcg), ampicillin (10 mcg), vancomycin (30 mcg) , oxacillin (1 mcg) , penicillin (30 mcg) , erythromycin (15 mcg) , clindamycin (2 mcg) , tetracycline 30 mcg) , and tobramycin (10 mcg)

Statistical analysis

The data was analyzed using SPSS version 16.0.

Results:

Out of 593 cancer patients attended to Khartoum Oncology hospital there were 74 children their age (3 ≥16 years), 188 adults with age (16 ≤40 years) and 331adult with age group more than 40 years.

Table (1) shows the samples collected among different age groups.

Among all age group more than 50% of samples was urine. Neither blood nor sputum samples were collected from children.

(Table 1): Types of specimens collected from cancer patients according to age groups.

Specimen	**(3 ≥16) years**	**(16 ≤40) years**	**40 years**	Total
Urines	50 (67.6%)	94 (50.0%)	181 (54.7%)	325(54.8%)
Stools	12 (16.2%)	19 (10.1%)	57 (17.2%)	88(14.8%)
Wound swabs	12 (16.2%)	44 (23.4%)	74 (22.4%)	130(21.9%)
Blood	0 (0.0%)	12 (6.4%)	8 (2.4%)	20(3.4%)
Sputum	0 (0.0%)	19 (10.1%)	11 (3.3%)	30(5.1%)
Total	74 (12.5%)	188 (31.7%)	331 (55.8%)	593(100%)

Out of the 593 samples collected from cancer patients. Pseudomonas aeruginosa was isolated in 51(8.6%), of these 46 were adults and five children.

Pseudomonas aeruginosa isolated in 29 patients more than forty years of age while only 17 patients with age group (16≤40 years) (Table2).

(Table 2): Distribution of isolated pseudomonas aeruginosa among cancer patients according to age groups.

Culture	**(3 ≥16)**	**(16 ≤40)**	**40 years**	Total
Pseudomonas aeruginosa	5 (6.8%)	17 (9.1%)	29 (8.8%)	51(8.6%)
No Isolation	69(93.2%)	171(90.9%)	302(91.2%)	542(91.4%)
Total	74 (100%)	188 (100%)	331 (100%)	593(100%)

The resistance pattern for the isolated Pseudomonas aeruginosa was as following: 97.3% were resistant to cefotaxime, followed by ceftazidime 82.7%, ceftriaxone 82.2%, ampicillin 82.2%, ciprofloxacin 46.8%, meropenem 34.1%, gentamicin 29.7%, amikacin 24.9%, pipracillin-tazobactam 68.6%, pipracillin 66.7%, and imipenem 60.8%.

Discussion

Nosocomial infections are an important cause of morbidity and mortality; and constitute a significant socioeconomic cost. Surveillance of nosocomial infection is an essential part of the infection control programme. National prevalence surveys of nosocomial infection have been performed in many European and developing countries (7)

In this study it seems that the prevalence of *Pseudomonas aeruginosa* infection had an effect among cancer patients (8.6%) this result is similar to other results published worldwide due to the colonization of the *P. aeruginosa* in hospitals and cancer patients (3).

the isolated pseudomonas aeruginosa from children is similar to isolated strain from adults this result is correlated to results done by Reem And other (7)

The group of patients that is perhaps unique to our study is the population of patients who have had solid tumors or Leukemia. Our study suggests that removal of the focus of infection is currently the most effective means of improving survival among patients with cancer (6).

The majority of patients came to RICK for getting their dosages of radiotherapy and chemotherapy. Most of cancer patients' age ranged between 17 and40 years. Arzu*et al*[1] reported that the median age for their study was 41 years. This is in agreement with that of National Nosocomial Infections Surveillance (NNIS)[2] reported the median age of 26 years (interquartile range 16 to 39).

In the present study, (21.9%) of cancer patients developed surgical infection. This is consistent with other studies which

reported significant surgical infection rates in cancer treatment centers.

The isolation of *Pseudomonas aeruginosa* which is well known as multi antibiotics resistant organism, and the role of these bacteria as nosocomial organism is well documented. It was the common isolated organisms from wounds of cancer patients [5]

Resistance of microorganisms to antimicrobials is a well-known and growing problem physicians often face worldwide. It is even more difficult to deal with this problem in medical centers , given the severity of patients conditions. Both Gram-negative bacilli and Gram-positive bacteria have developed several mechanisms of resistance. The phenomenon of multi-drug resistant pathogens had emerged in Egypt and worldwide in recent years due to excessive antibiotics misuse. Thus , pathogens resistant to cephalosporins (specially third generation) , carbapenems , aminoglycosides , and fluoroquinolone had emerged.

Conclusion

It seems that the prevalence of *Pseudomonas aeruginosa* infection among this study had an effect among cancer patients.

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