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Nosocomial Infection of *Pseudomonasn Aeruginosa* in the Tri-Service General Hospital

Pseudomonas Aeruginosa is one of the important pathogenic bacteria of nosocomial infection. The role of *Pseudomonas Aeruginosa* in nosocomial infection was increased importance, world-wide, particularly in hospital wards where seriously ill patients are vulnerable to its opportunistic infection. Data from US CDC show that nosocomial infection caused by *Pseudomonas Aeruginosa* has increased yearly from 6.3% of all nosocomial infections in 1975 to 11.4% in 1984, whereas nosocomial infections caused by *Escherichia coli* and *Klebsiella pneumoniae* have remained stable. *Pseudomonas Aeruginosa* is sapnophytic, and exists generally in soil, sewage and humid environment, and will attack any sites on the human body given the opportunity. In hospitals, *Pseudomonas Aeriginosa* often contaminates respirators and humidifiers and is resistant to some bactericidal disinfectants. Isolation of *Pseudomonas Aeruginosa* from Zephiran has been reported. A recent study suspects the inflammation of the abdominal cavity, bacteremia and pseudobacteremia caused by *Pseudomonas Aeruginosa* to be related to contamination of Povindone/Iodine. The fatality rate of hospital-acquired *Pseudomonas Aeruginosa* infection is high. When aleukia patients are infected and develop bacteremia, the fatality rate is varied from 67 to 90% and is much higher than the fatality rate of bacteremia caused by other bacteria. Therefore, hospital infection control personnel must review current control measures to come up with more effective ways to reduce the threat of infection.

The present survey began in 1985. Data relevant to hospital-acquired infections of ward-patients was collected by the hospital infection control teams in the following ways: from reports of doctors and nurses of various departments; from medical records and patient x-rays of from laboratory reports and from searches of computer data. The data were entered in full detail on a "Case Record of Nosocomial Infection", and reviewed each week by members of the hopital infection control teams to decide whether or not they were nosocomial infection cases. Criteria and definition of nosocomial infection developed by the US CDC were applied. Information of nosocomial infection cases was computerized by the infection control nurses, and analyzed by them regularly.

A survey of all hospitalized patients of the Tri-Service General Hospital in the last six years shows that of all clinical isolates, the proportion of *Pseudomonas Aeruginosa* increased from 12.5% in 1985 to 17.7% in 1990, an increase of 41.6% of all pathogenic

bacteria for nosocomial infection, the proportion of *Pseudomonas Aeruginosa* increased from 8.6% to 12.7% in the same period, an increase of 47.7%. Over the last four years, *Pseudomonas Aeruginosa* has been the first of either isolates or pathogenic bacteria for nosocomial infection. (see Table 1).

Of all *Pseudomonas Aeruginosa* infections in hospitals, the urinary tract is the most common site of infection (28.5%), followed by the respiratory tract (21.4%) and blood stream (20.3%). As can be noted from Table 2, respiratory tract, skin and from the blood stream infections, particularly the respiratory tract infections, have been increasing; whereas urinary tract infections are decreasing. As can be noted from Table 3, of all respiratory tract infections acquired in hospitals, 21.6% have been caused by *Pseudomonas Aeruginosa.* The rate was around 18% between 1987 and 1989, but rose sharply to 26.6% in 1990, a rate comparable to the rate of 26.5% of 1986. 12.0% and 11.6% were urinary tract and surgical wound infections respectively. More infections were found in the ICUs, general surgery, neurosurgery, neurology and thoracic medicine departments. Data for the last two years show that there have been increases in the number of cases in the ICUs, general surgery and thoracic medicine departments.

In terms of antibiotic-resistance, data from the last two years show an average of 70% resistance to the following antibiotics: carbenicillin (71.3%), ceftriaxone (89.8%), moxalactam (97.2%), ceftazoxime (97.7%), cefotaxime (98.3%). A lower than 50% resistance is found against: aztreonam (49.8%), cefaperazone (48.1%), tobremycin (44.9%), piperacillin (38.3%), arnikacin (33.4%), cefatazidine (16.2%), and imipenem (7.9%) (see Table 4). *Pseudomonas Aeruginosa* strains in hospitals are more resistant to antibiotics than strains outside hospitals. When both in- and out-hospital sstrains of 1989 are compared, resistance to seven antibiotics, particularly to tobramycin and cefaperazone, shows statistically significant differences.

Editorial Note: Infection by *Pseudomonas Aeruginosa,* paraticularly in hospitals, has increased in number and become more serious. In the last four years, it has been the leading cause of infection among either all isolates or pathogenic bacteria of hospital infections, and the number of infections has increased at a surprisingly rapid rate. This fact deserves concern. After all, nosocomial infections prolong hospital stay, require more money and manpower, and are a major cause of death.

Many hospitals have set up hospital infection control committees to monitor hospital infection and to analyze data epidemiologically to understand the type of bacteria, the department and the site of infection that are most common in their hospitals and also the antibiotic-resistance of these bactria. In this way, an unusal infection can be detected early on and necessary measures are be taken. However, nosocomial infection caused by *Pseudomonas Aeruginosa* is rarely collective, that is, rarely develops an outbreak. Because of its special biological characteristics, infection often is opportunistic. It can infect any site on the body such as burn wounds, cornea, urinary tract and the lungs, and can develop into bacterial endocarditis and gastroenteritis. It grows anywhere under adequate humidity.

Respiratory taract, skin and blood stream infections acused by *Pseudomonas Aeruginosa* have been increasing. These infections are thought to be related to the increasing use of

invasive testings and treatment, high-power anti-carcinoma chemotherapy and other immunosuppressants. The patients are either hosts of resistance or are potentially ill and are more vulnerable to the opportunistic infection of *Pseudomonas Aeruginosa*. For effective control, treatment of patients should be continued to improve their resistance, effective and adequate antibiotics should be carefully chosen to treat the infection, and appropriate infection control measures applied to the patients, medical care personnel and the environment. In respiratory tract infections most patients are found to be under invasive treatment or testings such as tracheo catheterization, tracheotomy, or the use of respirator. In the process of treatment, patients should be told to wash there hands before and after, and all sterilization procedures should be strictly followed to prevent the patients from inhaling the bacteria and to avoid the colonization of bacteria. Instruments used by the patients for treatment, such as catheters, sprayers and humidifiers should be completely sterilized.

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Table 1. Pseudomonas aeruginosa as Percent of All Hospital Isolates and All Hospital Pathogenic Bacteria, 1985-1990, TSGH

Year	No. of Hospital Isolates	No. and % P.aeruginosa	Order	No. of Hospital Pathogenic Bacteria	No. and % P.aeruginosa	Order
1985	7,993	999(12.5%)	3	1,255	108(8.6%)	4
1986	11,441	1,670(14.6%)	1	1,417	163(10.8%)	3
1987	15,431	1,959(12.7%)	1	1,820	190(10.4%)	1
1988	10,426	1,344(12.9%)	1	1,435	162(11.3%)	1
1989	11,029	1,621(14.7%)	1	1,447	180(12.4%)	1
1990	11,091	1,965(17.7%)	1	1,353	172(12.7%)	1

Table 2. Pseudomonas aeruginosa Infections by Site, 1985-1990, TSGH

Site	1985	1986	1987	1988	1989	1990	Total (%)
Surgical wound	24(22)*	28(17)	25(13)	24(15)	11(6)	17(10)	129(13.2)
Urinary tract	31(29)	54(33)	64(34)	42(26)	53(29)	34(20)	278(28.5)
Respiratory tract	24(22)	40(25)	28(15)	33(20)	38(21)	46(27)	209(21.4)
Skin	12(11)	16(10)	24(13)	19(12)	28(16)	29(17)	128(13.1)
Blood stream	12(11)	20(12)	42(22)	39(24)	41(23)	44(25)	198(20.3)
Others	5(5)	5(3)	7(4)	5(3)	9(5)	2(1)	33(3.4)
Total	108	163	190	162	180	172	975(100.0)

*No. of nosocomial infections due to P. aeruginosa and its percentage.

Table 3. Pseudomonas aeruginosa Infections by Site, 1986-1990, TSGH

Site	1986	1987	1988	1989	1990	Average (%)
Surgical wound	28(15.6)*	25(9.8)	24(12.4)	11(8.0)	17(12.4)	21(11.6)
Urinary tract	54(9.9)	64(11.9)	42(12.5)	53(14.7)	34(11.0)	49(12.0)
Respiratory tract	40(26.5)	28(18.1)	33(18.5)	38(18.5)	46(26.6)	37(21.6)
Skin	16(9.0)	24(8.2)	19(8.5)	28(10.9)	29(10.8)	23(9.5)
Blood stream	20(6.5)	42(8.2)	39(9.3)	41(9.3)	44(10.7)	37(8.8)
Others	5(8.5)	7(10.6)	5(7.0)	9(19.1)	2(3.5)	6(9.7)
Total	163(10.8)	190(10.4)	162(11.3)	180(12.4)	172(12.7)	173(11.5)

*No. and percentage of nosocomial infections due to P.aeruginosa. Percentage based on total number of bacteria strans for each site.

Table 4. Percentage of Resistance to Various Antibiotics by In- and Out-Hospital Infections of P.aeruginosa

Antibiotics	1989		1990	
	In-hospital (R/S)	Out-hospital (R/S)	In-hospital (R/S)	Out-hospital (R/S)
Gentamicin	60.6(109/71)	44.5(640/798)***	47.9(82/89)	42.6(764/1030)
Carbenicillin	77.2(139/41)	69.4(997/440)*	65.3(94/50)	57.4(1046/775)
Amikacin	41.7(75/105)	25.8(371/1066)***	25.0(43/128)	23.6(424/1370)
Tobramycin	53.1(95/84)	30.6(440/996)***	36.6(63/109)	31.8(570/1220)
Moxalactam	97.2(174/5)	96.2(1383/54)	97.1(164/5)	93.7(1672/120)
Cefotaxime	98.7(150/2)	96.6(1239/43)	97.9(142/3)	96.4(1447/54)
Cefaperazone	55.5(66/53)	32.7(939/67)***	40.7(48/70)	31.2(389/857)*
Netilmicin	58.7(81/61)	44.4(500/626)**	48.5(79/84)	40.8(731/1061)
Ceftriaxone	90.0(63/7)	93.9(579/39)	89.5(153/18)	83.6(1470/322)***
Pipercillin	40.8(73/106)	23.1(331/1107)***	35.7(61/110)	27.3(489/1304)*
Cefatazidime	14.8(20/150)	11.5(159/1218)	21.4(30/140)	21.4(316/1479)
Ceftazoxime	97.8(175/4)	97.1(1395/43)	97.6(168/4)	95.9(1720/73)
Aztreonam	50.9(28/27)	47.7(227/249)	48.8(83/87)	44.0(789/1005)
Imipenem	5.4(3/53)	10.3(49/427)	10.5(18/153)	14.5(260/1530)

*p 0.05; **p 0.01; ***p 0.001 all by X^2-test
R=resistant strain; S=susceptible strain