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Nosocomial Infection due to Instrumentations in Critical Care Center

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Abstract

Clinical samples were collected from 120 patients admitted in the critical care center of Kasr El Eini hospital, Cairo University. All patients under study were subjected to different types of invasive procedures. Nosocomial infection in CCC developed in 15.8% patients. Respiratory tract infections developed in 40% of the patients after the use of ventilators. Catheter associated urinary tract infection developed in 30% of the patients. Ten per cent of patients developed infections after cardiac catheterization. Central venous line catheterization was followed by infection in 4% of the patients. The predominant organisms isolated were *Staphylococcus pyogenes* and *epidermidis* followed by Gram negative bacilli mainly *Klebsiella* and Pseudomonas. The duration of subjection to different procedures was found to influence the incidence of infection. Sex and age factors did not play any role in changing the incidence of nosocomial infections.

Introduction

DESPITE advances in medicine, techniques used to alleviate the illness carry frequently a very high risk of infection. Patients in critical care centers are severely compromised and frequently subjected to equipment that increase their susceptibility to infection [1].

Hospital acquired urinary tract infections account for 25-50% of nosocomial infection [2]. Infections occur predominantly by catheterization. Lower respiratory tract infections form about 10-40% of hospital acquired infections [3]. According to Maki [4] hospital acquired bacteremia occurred in 1 in 200 patients admitted to hospitals in USA [4]. The incidence of

infection after pacemaker implantation has been reported to be 1-12.6% [5].

The aim of this work is to study the incidence of infection among patients subjected to various procedures in critical care units, the relation between the infection and the duration of instrumentation, the different types of the pathogenic microorganism and age of the patients.

Material and Methods

Samples were collected from 120 patients admitted in the critical care center of Kasr El Eini Hospital, Cairo university. 67 male patients and 53 female patients were included in this study. The age ranged from 22-88 years and patients were subjected to different types of invasive procedures. Six groups of patients were included in the study, these are:

Group 1: 20 patients under artificial ventilation.

Group 2: 20 patients with inserted urinary catheters.

Group 3: 20 patients with pacemaker implantations.

Group 4: 20 patients undergone cardiac catheterization.

Group 5: 20 patients with central venous line cannulations.

Group 6: 50 patients with peripheral intravenous cannulations.

In 35 patients subjected to more than one type of devices, samples were taken from more than one site (table 1).

Table (1): Distribution of Studied Patients Under Various Invasive Procedures.

No. of Patients	Type of procedure					
	artifcial ventilation	urinary catheter	cardiac catheter	Pacemaker implantation	Central venous catheter	peripheral I.V. catheter
15	+					+
5	+				+	
15						+
5						
20		+				
20		+				
20			+		+	
20				+		+
total 120	20	20	20	20	25	50

N.B. + = subjection of patient to such type of proce-

Samples obtained were: endotracheal aspirations, urine, skin swabs from local septic areas and blood. Samples were taken 76-96 hours after being subjected to the procedure used.

Follow up was done for 29 patients; five to seven days later; a second sample was obtained.

All samples were cultured at 37c under aerobic conditions for 24 hours. Samples collected on thioglycollate broth were incubated for 3-4 days at 37c then subcultured under anaerobic conditions using gas pack system.

Results

Nineteen out of one hundred and twenty patients (15.7%) under instrumentation acquired nosocomial infections . 16.7% were males and 15% were females (table 2). 13% of the patients were of age group 22-44 years, 13.9% were of age group 44-66 years and 18.5% were of age group 66-88 years (table 3).

Out of twenty patients under artificial ventilation, eight developed respiratory infections (40%) (table 4). One of these patients developed respiratory infections within 3 days, two patients developed infections after 4 days, two after 5 days and 3 patients developed respiratory infections after 6 days (table 4). The predominant microorganisms isolated were coagulase positive *Staphylococcus pyogenes* (six isolates), Gram negative bacilli, mainly *Klebsiella* species (four isolates) and *Pseudomonas* species (two isolates) and *Candida* species (one isolate) (table 5).

Out of twenty patients having inserted urinary catheter, six patients developed nosocomial urinary tract infections (30%) table 4). Three patients acquired infections after

Table (2) : Incidence of Nosocomial Infection among Patients of both Sexes.

Type of patient	No. of patients	No. of infected patients	%
Both sexes	120	120	15.7
Males	67	67	16.4
Females	53	53	15

Table (3): Incidence of Nosocomial Infection According to Age

Age in years	No. of patients			No. of infected patients			%		
		M	F		M	F		M	F
22-44	23	15	8	3	1	2	13	6.6	25
44-66	43	23	20	6	4	2	13.9	17.4	10
66-88	54	29	25	10	6	4	18.5	20.6	16

Table (4): Number of Infected Patients after Certain Duration of Exposure to Different Types of Procedures.

Type of procedure	Diagnosis at admission	Number of patients	3 days	4 days	5 days	6 days	Total	%
Artificial ventilation	Congestive theart failure and pulmonary oedema	10	-	-	2	2	4	
	Upper respiratory distress syndrome	8	1	1	-	1	3	
	Chronic obstructive pulmonary disease	2	-	1	-	-	1	
Total		20	1	2	2	3	8	40
Urlnary Catheterization	Congestive heart fallure and pulmonary oedema	9	-	-	2	2	4	
	Urinary failure	3	-	-	1	-	1	
	Hypertensive crises	8	-	-	-	1	1	
Total		20	-	-	3	3	6	30
Cardiac catheterization	Arrytmia	20	-	1	1	-	2	10
Total		20	-	1	1	-	2	10
Pacemaker implation	Heart block	20	1	1	-	-	2	10
Total		20	1	1	-	-	2	10
Central venous cannulation	Congestive heart failure	12	-	1	-	-		
	Arrythmia	8	-	-	-	-	-	
	Pulmonary oedema	5	-	-	-	-	-	
Total		25	-	1	-	-	1	4
Peripheral intravenous catheterization	Diabetic crises	20	-	-	-	-	-	
	Pulmonary oedema	15	-	-	-	-	-	
	Congestive heart failure	-		-	-	-	-	
Total		50		-	-	-	-	-

Table (5): Types and Percentage of Isolated Pathogenic Microorganisms Acquired Due to Exposure to Different Types of Invasive procedures

Type of procedure	Total number of cases	Staph.aureus coagulases +ve		Staph. aureus coagulases - ve		E.coli		Kelbsiella		Pseudomon.		Candida		Total number of isolates		No growth
		no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	no.	%	
Artificial ventilation	20	6	30	-	-	-	-	2	10	2	10	1	5	11	55	12
Urinary catheterization	20	-	-	-	-	2	10	2	10	1	5	1	5	6	30	14
Pacemaker implantation	20	-	-	2	10	-	-	-	-	-	-	-	-	2	10	18
Cardlac catheterization	20	2	10	-	-	-	-	-	-	-	-	-	-	2	10	18
Central venous cannultion	25	-	-	1	4	-	-	-	-	-	-	-	-	1	4	24
Peripheral intravenous Catheterization	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
Total		8	5.1	3	1.9	2	1.2	4	2.5	3	1.9	2	1.2	22	14.1	136

N.B: The difference in number between infected cases and isolated organisms in cases of respiratory infections was due to mixed infections.

5 days and three after 6 days (table 4). The most common organisms isolated were Gram negative bacilli mainly *Klebsiella* species (four isolates) and *Pseudomonas* species (two isolates), and *Candida* species was detected in only one case of urinary tract infection (table 5).

Out of twenty patients with pacemaker implantations, two developed local sepsis (10%). One of the patients developed infection after 3 days, and the other after 4 days (table 4). The microorganisms isolated were coagulase negative *Staphylococcus epidermidis* (table 5).

Out of twenty patients who undergone cardiac catheterization, two patients developed local sepsis and bacteremia (10%). One patient developed infection within 4 days and the other after 5 days (table 4). The microorganisms isolated locally and systemically were coagulase positive *Staphylococcus pyogenes* (table 5).

Out of twenty five patients who had central venous line catheterization, only one patient developed local sepsis (4%) (table 4). Infection was developed within 4 days after catheterization. The causative microorganism was coagulase negative *Staphylococcus epidermidis* (table 5).

None of the fifty patients who had peripheral intravenous cannulations developed local or systemic infection.

Discussion

In this study the frequency of nosocomial infection in critical care center was found to be 15.8%. The frequencies of nosocomial infections in other critical care centers were found to be 11.7% [6], 18% [7], 20% [8] and 28% [9].

In the present study respiratory tract infections developed in 40% of the patients after the use of ventilators and endotracheal intubation. This represents the highest frequency of nosocomial infections developing after instrumentation. Cross and Roupe reported that the incidence of nosocomial pneumonia for intubated patients appears to be 4 times higher than that for non intubated patients [10]. Klinisk et al stated that ventilator - associated pneumonia was diagnosed in 21% of the patients under artificial ventilation [11]. Apart from the obvious fact that such patients are often the most critically ill, the mucociliary clearance system of the airways, are largely by-passed during intubation. Furthermore, the mechanical irritation and injury of the respiratory mucosa may predispose to local colonization of airways with potential bacterial pathogens [12].

The high incidence of respiratory tract infections as obtained in this study is attributed to the fact that parts of ventilators were left unchanged for more than six days. It was found that the major risk of infection was associated with main stream reservoir nebulizer [13]. The contamination of nebulizer is caused by reflux of contaminated condensate in the ventilator circuit. To decrease the rate of respiratory associated

pneumonia, nebulizers should be disinfected after each use. Moreover, the use of cascade humidifiers allow gas to bubble through water prior to delivery and do not generate microaerosols which may be contaminated [13].

The most predominant microorganisms isolated in patients with respiratory infections were *Staphylococcus pyogenes* (six isolates) and Gram negative bacilli (four isolates). Mixed infections with *Staphylococcus pyogenes* and Gram negative bacilli were detected in three patients. In other studies Gram negative bacilli have been reported to be the predominant organisms in ventilator-associated infections [14, 15]. It has been documented that mucosal cell surface fibronectin prevents adherence of *Pseudomonas aeruginosa* to buccal cells. Increased levels of salivary protease were found in seriously ill hospitalized Patients hence the increase colonization of airway mucosa with Gram neagtive bacilli [16].

In this study catheter-associated urinary tract infection (UTI) developed in 30% of the patients. Other studies reported an incidence of 46% [9], 57% [17] and 34% [18]. The variations in incidences are multifactorial. It includes changes in population of catheterized patients, changes in antibiotic prophylaxis, management and duration of urinary catheterization.

The two major factors that predispose to catheter associated (UTI) are the presence of potential bacteria in the periurethral area and an indwelling urethral catheter that allow the retrograde migration of bacteria into the urinary bladder.

In this study UTI occurs on day 5 and 6. Garibaldi found that early removal of catheters prevent as many as 40% of catheter associated UTI [19]. Other methods of urinary drainage have been proposed mainly, suprapubic catheterization and condom drainage.

The predominant causative microorganisms found in this study were Gram negative bacilli mainly *E. coli, Klebsiella and Pseudomonas.* Similar results were obtained by Casewell et al [20], Ohkawa et al [17] and Harding et al [18]. Infections in catheterized patients are frequently caused by gastro-intestinal flora such as Enterobacteriacae or enterococci which are often antibiotic resistant in hospitalized patients [21].

In this study, the incidence of infection associated with pace maker implantation was found to be 10%. Other studies reported an incidence that varied between 1-12% [22, 23].

Infections were detected in 10% of the patients after cardiac catheterization. The recorded incidence in literature varied between 7-44% [24. 25]. Al Sibaii found that the use of intravenous antibiotics prophylaxis significantly reduces exit site infection [25].

Central venous line catheterization in

the critical center of Kasr El Eini was followed by infection in 4% of the patients. Results reported by other workers ranged from 2-5% [26, 27, 28]. Catheter related sepsis could be prevented by topical application of povidone - iodine solution, daily dressing and the use of jugular vein rather than infra-clavicular location [29] and shortening the duration of catheterization.

Peripheral intravenous cannulation was not associated with infection. The recorded incidence of infection varied from 0.7%-3.4% [27, 30, 31].

Staphylococci were the only microorganisms associated with cannula-related infections and pacemaker implantation. The organisms could migrate from the surface of the skin which colonize in the fibrin sheath around the cannula or pacemaker inserted [4].

The duration of subjection to different procedures was found to influence the incidence of infection. An increase of the duration was associated with increased incidence of nosocomial infection. Similar findings were obtained by other workers [32, 33, 10].

It was also found that the sex factor did not play a role in changing the incidence of nosocomial infection. No observable changes in the incidence of nosocomial infection were found among ages. This could be attributed to the limited number of patients under study. Hardy stated that the very young infants and old aged patients appear to have frequent infections [34], Harding et al found that nosocomial infection among urinary catheterized patients was more frequent in patients above 65ys than those between 65ys [18].

In conclusion, the most important procedures that carry the hazards of nosocomial infections among critically ill patients were found to be artificial ventilation (40%) and urinary catheterization (30%). The frequent change of breathing circuits every 48 hours is recommended. Moreover, initiation of urinary catheterization (30%). The frequent change breathing circuits every 48 hours is recommended. Moreover Initiation of urinary catheterization should be limited.

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