Original Article

Proportion of bacteria causing healthcare associated infection in Khartoum North Teaching Hospital

Fadwa Gafar Abd Ekarim Yousif[1]
Abdullahi Nur Hassan[2]

Abstract

Background: This study was conducted at Khartoum North Teaching Hospital (KNTH) in the period between June 2005 to September 2007 in order to determine the bacteria that causes common healthcare associated infection (HAI.)

Methods: Hundred bacteriological specimens from patients with HAI from different surgical and internal medicine departments (27 from patients in obstetrics and gynecology units, 33 from patients in surgical ward, and 16 from urology units, 12 from the medicine, 8 from the otorhinolaryngyology and 4 from ophthalmology departments) were collected. All samples were cultured on suitable bacterial culture media and processed. Presence of significant growth was further studied to identify type of pathogen and its susceptibility against selected (common used) antibiotics.

Results: Study showed that the most frequent bacteria isolated from patients as a cause of HAI were Pseudomonas aeruginosa (23%) , Proteus mirabilis (17%) , and E. coli (13%) respectively.

Conclusion: The study also revealed that all Gram-negative isolates were highly sensitive to antibiotic such as ceftriaxone, ciprofloxacin and imipenem, while *P aeruginosa* showed resistant to many commonly used antibiotics, but was sensitive to imipenem and pipracillin. All Gram-positive isolates were sensitive to vancomycin.

Further studies are needed to evaluate the common microorganisms causing HAI and their drug susceptibility and proportion of HAI in this setting.

Keywords: Gram-negative, Gram-positive, Nosocomial, microorganisms, antibiotic resistance.

Hospitals and clinics were recognized as sources of infection long before the recognitions of microorganisms as causative agents of diseases1. Nosocomial or healthcare associated infection (HAI) has been a persistent major problem in every institution where patient care is provided. Worldwide, millions of patients develop such infection, resulting in several thousands of deaths and an economic cost of several billions dollars[1-3].

1.Alzaiem Alazhari University, Faculty of Medical Laboratory Sciences
2.Alzaiem Alazhari University, Faculty of Medicine
Correspondent: Abdullahi N Hassan. E-mail: Abdullahi2001@yahoo.com

HAI is a problem which limited neither to developed nor to developing countries . However, the problem is likely to be greater in the latter[1-4].

Bacterial infection is a common cause HAI[5]. Also most bacterial infection can be easily diagnosed and treated with few exceptions. But nowadays the emergence and spread of resistance bacteria (especially Enterobacteriaceae) are complicating the treatment of serious HAI and threatening to create species resistant to all currently available agents[3-6].

The aim of this study was to identify the common bacterial agent causing HAI in Khartoum North Teaching Hospital (KNTH) and their antibiotic susceptibility.

Methods and materials

Hospital based descriptive case study was conducted during June 2005 to September 2007 in KNTH in order to identify the common bacterial agent causing HAI and their antibiotic susceptibility. Hundred bacteriological samples (43 urine, 33 wound swab, 12 sputum, 6 ear swab, 4 eye swab and 2 throat swab) were collected from patients who fulfilled the designed case definition of HAI and who were admitted to the different departments of KNTH (27 from patients in obstetrics and gynecology units, 33 from patients in surgical ward, and 16 from urology units, 12 from the medicine , 8 from the otorhinolaryngology and 4 from ophthalmology departments) and subjected to laboratory studies. The age of the patients ranged between 3-78 years old.

All samples were cultured on suitable bacterial culture media and processed. Presence of significant growth was further studied to identify type of pathogen by using appropriate biochemical tests and its susceptibility against selected (common used) antibiotics according to the National Committee for Clinical Laboratory Standards (NCCLS). The data were analyzed by using Statistical Package for Social Studies (SPSS)

Ethical consideration

All patients enrolled in this study were informed about study and consented. Results were reported to the patients and their doctors.

Results

Hundred bacteriological samples from the patients were collected and processed. Bacterial growth was seen in 74 of collected samples, with different bacteria isolates as shown in Table 1.

Pseudomonas aeruginos (23%), *Proteus mirabilis* (17%), *E coli* (13%), *and Staphylococcus aureus,* (9%) were most commonly isolated pathogens, followed by others such as *Klebsiella pneumoniae* (8%), *Staphylococcus saprophytic* (3%) and *Enterococci* (1%).

E coli 10 (23.2%), *P aeruginosa* 8 (18.6%), *P mirabilis* 6 (14%), *S aureus* 3 (7%) and *K pneumonia* 3 (7%), were the most common causative agents isolated from urine, while *K pneumonia* 3 (25%), *P aeruginosa* 2 (16,7%) with *Staphylococcus aureus* 2 (16.7%) were isolates from sputum. The most common bacteria isolated from wound swab were *Proteus mirabilis* 11 (33.3), *Pseudomonas aeruginosa* 7 (21.2%), followed by *Staphylococcus aureus* 4 (12.1%) and *E. coli* 3 (9.1%). While *P aeruginosa* were most common bacteria isolated from ear and eye swabs, as shown Table 1.

Table 1: demonstrates relation between samples and results of isolations.

	Result of isolation								
Sample	*E c*	*Ec*	*K P*	*P m*	*Pa*	*S S*	*S a*	No growth	Total
Ear swab					4			2	6
Eye swab					2			2	4
Sputum			3		2		2	5	12
Wound swab	3		2	11	7	3	4	3	33
Urine	10	1	3	6	8		3	12	43
Throat swab								2	2
Total	13	1	8	17	23	3	9	26	100

Ec=E coli, Ec=Enterococci, K P= Klebsiella Pnemoniae, P m =Proteus mirabilis, Pa = Pseudomonas aeruginosa, Ss= Staphylococcus Saprophytic,Sa= Staphylococcus aureus

All Gram-negative isolates were highly sensitive to antibiotic such as ceftriaxone, ciprofloxacin and imipenem, while *P aeruginosa* showed resistant to many commonly used antibiotics, but was highly sensitive to imipenem and pipracillin as shown Table 2.

All Gram-positive isolates were sensitive to vancomycin, while all isolated enterococci were resistant to gentamicin. Table3.

Table 2: Susceptibility test for Gram-negative bacteria

Isolates	Antimicrobial Agents								
	GN	CU	CF	CI	NA	NX	I	CP	PC
E coli	76%	84%	100%	100%	76%	61%	92%	23%	-
K pneumoniae	62%	87%	75%	87%	37%	75%	100%	50%	-
P aeruginosa	0%	-	91%	-	52%	73%	93%	-	86%
P mirabilis	52%	58%	88%	70%	58%	94%	100%	49%	-

GN= Gentamicin, CU= Cefuroxime, CF= Ciprofloxacin, CI= Ceftriaxone, PC= Pipracillin, NA= Nalidixic Acid, NX= Norofloxacin, I= Imipenem, CP= Cephalexin, VA= Vancomycin

Table 3: Susceptibility test for Gram-positive bacteria

Isolates	Antimicrobial Agents					
	GN	CU	CF	NX	VA	CP
Enterocooci	0%	-	100%	100%	100%	-
S aureus	77%	77%	66%	66%	100%	88%
S saprophyticus	66%	100%	66%	66%	100%	66%

GN= Gentamicin, CU= Cefuroxime, CF= Ciprofloxacin, CI= Ceftriaxone, PC= Pipracillin, NA= Nalidixic Acid, NX= Norofloxacin, I= Imipenem, CP= Cephalexin, VA= Vancomycin

Discussion

In this study it was observed that *Pseudomonas aeruginos* (23%), *Proteus mirabilis* (17%), *E coli* (13%), *and Staphylococcus aureus,* (9%) were most common bacteria causing HAI in this setting. Gram-negative bacteria accounted for more than two third of isolates. Similar results were reported from different studies done in developed and undeveloped countries[5-7].

Gram-negatives such as *E coli, P aeruginosa*, *P mirabilis*, *K pneumonia* and *S aureus* were most common causative agents in patients with nosocomial UTI in this study. Different results were obtained from studies done in European countries which showed low proportion of the microorganism in urine than this study, except *P aeruginosa* which showed higher proportion than our study [7-8].

The most common bacteria causing nosocomial wound infections in this study

were *P mirabilis*, *P aeruginosa* followed by *S aureus* and other Gram-negative bacteria. Studies done in India showed that *Pseudomonas aeruginosa* (51. 5%) was the commonest pathogen followed by *Staphylococcus aureus* (11.15%), *Klebsiella Pneumonia* (9.23%) and *Proteus mirabilis* (2.3%) [9].

K pneumonia, *P aeruginosa* and *S aureus* were isolated from lower respiratory tract infection in this study. Similar results were obtained from study done by Kofteridis et.al[10].

Studies from Southern Taiwan showed that the most frequently bacteria isolated from ear

were *Streptococcus pneumonia* (21.8%), followed by *Haemophilus Influenzae* (10.2%), *Staphylococcus aureus* (7%) and *Pseudomonas aeruginosa* (1.8 %)[11] , while Marton et al showed that *Streptococcus pneumonia* was the most common bacteria causing ear infection[12].

Antibiotic resistance is serious and growing health problem, gaining international and national attention as resistance increases at an alarming rate in both hospital and physician practice setting[13-15]. In this study, most of Gram-negative bacteria were sensitive to the imipenem and ciprofloxacin. However, gentamicin resistance was seen among *Pseudomonas aeruginosa. E.coli* resistant to ciprofloxacin were isolated from the urine elsewhere[13].

Gadapalli et.al in their study showed pipracillin resistance among *Pseudomonas aeruginosa* isolated from diabetic wound[9]. In this study *Pseudomonas aeruginosa* (86%) was sensitive to the pipracillin.

Many studies revealed increasing multi drug resistant (MDR) Gram-negative and Gram-positive bacteria in most of the hospitals settings[14-18]. Studies also showed increasing number of patients infected with vancomycin resistance *Enterococcus* and vancomycin intermediate sensitive *Staphylococcus aureus*[18-19]. But no vancomycin resistance was observed among all Gram-positive isolates. Also some microorganisms showed resistance to many commonly used drugs.

Conclusion:

This study concluded that the high percentage of bacteria causing HAI have more or less similar drug sensitivity to other countries. However, highly resistant Gram-negative bacteria such as *P aeruginosa* were also seen.

Acknowledgment

We are greatly indebted to the volunteers in Khartoum North Teaching Hospital from whom samples were taken for this study and their doctors. We also thank Mr Mohamed Ahmed Ibrahim Holi for his kind help.

References

1. T G Emori and R P Gaynes. An overview of nosocomial infections, including the role of the microbiology laboratory. *Clin Microbiol Rev* 1993; 6(4): 428-442

2. Wenzel RP. The economics of nosocomial infection. *J Hosp infect* 1995; 31:79-87

3. Kirkland KB, Briggs JP, Trivette SL et al. The Impact of Surgical-Site Infections in the 1990s: Attributable Mortality, Excess Length of Hospitalization, and Extra Costs. *Infect Control Hosp Epidemiol* 1999; 20:725–730

4. Al Ghamdi, Gedebon M, Bilal NE. Nosocomial infection and misuses of antibiotics in a provincial community hospital Saudi Arabia. *Journal of Hospital Infection* 2002:115-121.

5. Jarvis WR and Martone WJ. Predominant pathogens in hospital infections. *J Antimicrob Chemother.* 1992;29 Suppl A:19-24

6. Pena C, Pujol M, Ardanuy C, et al. Epidemiology and successful control of a large outbreak due to *Klebsiella pneumonia* producing extended-spectrum beta-lactamases. *Antimicrob Agents Chemother* 1998; 42: 53-58.

7. Golsing R, Mbatia R, Savage A et al. Prevalence of hospital-acquired infection in a tertiary referred hospital in Northern Tanzania. *Ann Trop Med Parasitol* 2003; 79 (1):69-73.

8. Bouza E, San juan R, Munoz P et al. A European perspective on nosocomial urinary tract infections I. Report on the microbiology workload, etiology and antimicrobial susceptibility (ESGNI-003 study). *Clinical Microbiology & infection* 2001; 7 (10): 523-531

9. Gadepalli R, Dhawan B, Sreenivas V et al. A Clinio-Microbiological study of diabetic foot ulcers in an Indian tertiary care hospital. *Diabetes Care* 2006; 29 (8): 1727-32

10. Kofteridis DP, Papadakis JA, Bouros D et al Nosocomial lower Respiratory tract infection. *Eur J Clin Microbiol Infect Dis* 2004; 23: 888-891.

11. Li WC, Chiu NC, Hsu CH et al. Pathogens in the middle ear effusion of children with persistent otitis media: implications of drug resistance and complications. *J Microbiol Immunol Infect* 2001; 34:190-194.

12. Marton A, Nagy A, Katona G A et al. Nosocomial *Streptococcus pneumoniae* infection causing children's acute otitis media. *International journal of antimicrobial agents* 1997; 8: 29-35

13. Ena J, Lopez - Perezagua MM, Martinez – Peinado C et al. Emergence of Ciprofloxacin resistance in *Escherichia coli* isolates after widespread use of Fluoroquinolones. *Diagnostic microbiology and infectious disease* 1998; 30 (2): 103-107

14. Rice L.B. Emergence of Vancomycin - resistant Enterococci. *Emerg Infect Dis* 2001; 7: 183-7

15. Albrecht SJ, Fishman NO, Kitchen J et al. Reemergence of gram-negative health care-associated bloodstream infections. *Arch Intern Med* 2006;166:1289-94

16. Gunseren F, Mamikoglu L, Ozturk S et al. A surveillance study of antimicrobial resistance of gram-negative bacteria isolated from intensive care units in eight hospitals in Turkey. *J Antimicrob Chemother* 1999; 43: 373-8.

17. Hassan AN, Dya MS and Mahgoub M. Uropathogens and their antibiotic resistance patterns. *Sudan Medical Monitor*. 2007; 2:51-54

18. Bonten MJ, Slaughter S, Hayden MK et al. External sources of vancomycin-resistant Enterococci for intensive care units. (1998); 26:2001-2004.

19. Cui L, Iwamoto, A, Lian JQ et al. Novel Mechanism of Antibiotic Resistance originating in Vancomycin intermediate. *Staphylococcus.aureus. Antimicrob Agents chemother*. 2006; 50: 428-438.