Microbiological Studies for Investigating Nosocomial Infections in Urine and Stool Samples

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ABSTRACT- Nosocomial infections (NIs) are a noteworthy contributer of expanded diseases, mortality and emergency clinic costs, in spite of the fact they are regularly preventable. Most NIs are related with an obtrusive gadget amid hospitalization and excessively happen in older emergency unit patients. This study is concerned with determining the percentage of nosocomial infections and identifying the bacteria involved and then estimating the impact of different antibiotic disks on isolated bacteria in urine and stool samples. This study included 100 urine and stool samples obtained from 50 patients staying for 3 days or more in Gastroenterology Surgical Center, Mansoura University, Mansoura, Egypt. Different antibiotic disks selected from five families having different mode of action were used. Our findings demonstrated that the highest prevalence rate of NI was detected in *K. pneumonia*e was found to have the highest detection rate of 40.6% (n=13) followed by *E. coli* (31.25%, n=10), *P. mirabilis* (12.5%, n=4), MRSA (6.25%, n=2), *Ps. aeruginosa* (6.25%, n=2) and finally *Ps. putida* (3.15%, n=1). The results showed variable effects of various antibiotics on isolated bacteria.

Keywords: Nosocomial infections, Antibiotics, *K. pneumoniae*, *E. coli*, *P. mirabilis*

1 INTRODUCTION

Nosocomial infection (NI) is among the most troublesome issues standing up to clinicians who manage severally sick patients. They are winding up all the more disturbing in 21th century as antibiotic obstruction spreads. By drawing out the healing facility remain of patients, NI adds essentially to the financial weight. The occurrence of NI is assessed at 5-10% in tertiary consideration doctor's facilities coming to up to 28% in emergency unit). 90% of the NIs are caused by microscopic organisms, while mycobacterial, viral, parasitic or protozoal operators are less regularly included (1). Nosocomial disease can be characterized as: A contamination obtained in healing center by a patient who was conceded for a reason other than that disease (2). Disease happening in a patient in a hospitals or other healing facility in whom the contamination was absent or brooding at the season of confirmation. This incorporates contaminations procured in the healing facility yet showing up after release and furthermore word related diseases among staff of the office (3).

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Nosocomial infection can be spread in the healing center environment, nursing home environment, restoration office, facility or other clinical settings. Infection is spread to the vulnerable patient in the clinical setting by various methods. Human services staff can spread disease, notwithstanding debased gear, bed materials or air beads(4). The infection can start from the outside condition, another tainted patient, staff that might be contaminated or at times, the wellspring of the disease can't be resolved. Now and again the microorganism starts from the patient's own skin flora, getting to be entrepreneurial after medical procedure or different systems that trade off the defensive skin boundary(5). Notwithstanding the way that the patient may have gotten the disease from their own skin, the sullying is so far idea to be nosocomial since it makes in the medical services setting. Find a wide range of kinds of microorganisms like *Escherichia coli (E. coli), Pseudomonas aeruginosa (Ps. aeruginosa), Acinetobacter baumannii, Staphylococcus aureus* (*S. aureus*) and Methicillin resistant *S. aureus* (MRSA)(6). This study is concerned with determining the percentage of nosocomial infections and identifying the bacteria involved and then estimating the impact of different antibiotic disks on isolated bacteria.

2 MATERIALS AND METHODS

Urine and stool samples were obtained from fifty consecutive patients staying three days or more were randomly recruited from the Gastroenterology Surgical Center (GEC), Mansoura University, Mansoura, Egypt. Informed consents were obtained from all participants and they were fully informed concerning the diagnostic

procedures involved and disease nature. The study protocol conformed to ethical guide-lines of 1975 Helsinki Declaration. Urine and stool samples were prepared for microbiological studies in order to identify nosocomial infection. Nutrient and MacCkonkey agar were used for culturing urine and stool samples. Finally, the isolated bacteria were morphologically and biochemically identified and kept for subsequent analysis for assessing the influence of different antibiotics disks (OXOID, England) on them according to agar disk-diffusion method(7).

3 STATISTICAL ANALYSES

Every single measurable investigation were performed by Statistical Package for the Social Sciences (SPSS) programming adaptation 15.0 (SPSS Inc., Chicago, IL) and GraphPad Prism bundle; V. 5.0 (GraphPad Software, San Diego, CA).

4 RESULTS

First of all, this work aimed to identify different bacterial isolates related to nosocomial infections and estimating their prevalence rates in urine and stool samples. These samples were further classified based on nosocomial infections into positive and negative groups as shown in Figure 1.

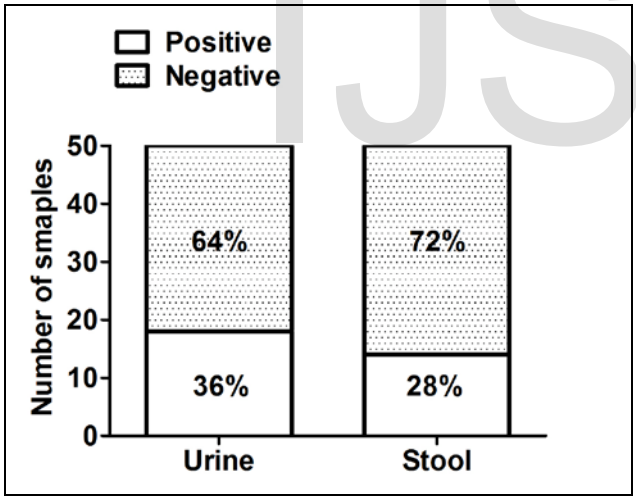

Figure 1. Detection rate of bacterial isolates associated with nosocomial infections in urine and stool samples.

Our results showed that 18 out of 50 urine samples were tested positive whereas 32 out of those were tested negative for the presence of bacteria associated with nosocomial infections. In addition, 14 out of 50 of stool samples were tested positive whereas 36 out of those were tested negative for the presence of bacteria associated with nosocomial infections. Overall, 32 out of 100 samples (32.0%) samples were tested positive for the presence of nosocomial infections bacteria. Interestingly, it was estimated that urine samples were associated with a 1.29-fold increase (i.e. 29% increase) over stool samples for the presence of bacteria associated with nosocomial infections as depicted in Figure 2.

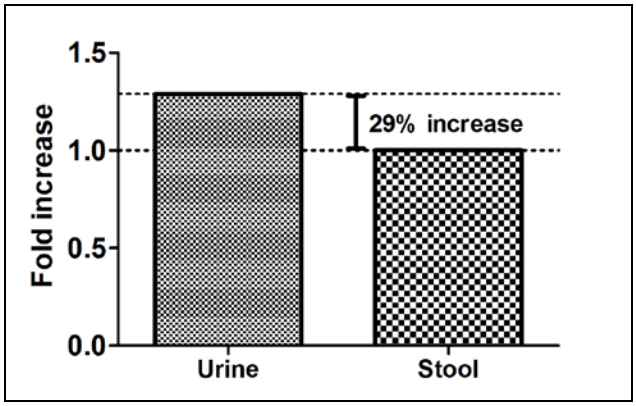

Figure 2. Distribution of the observed fold changes for the presence of bacteria associated with nosocomial infections in different samples.

The positive urine and stool samples were identified by VITEK 2 compact 15 (Biomerieux, France). As a consequence, different pathogenic bacteria were appeared with variable prevalence rates in different urine and stool samples as presented in Figure 3.

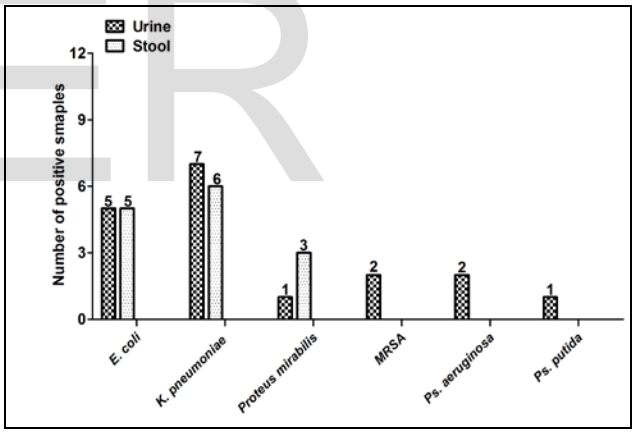

Figure 3. Prevalence of different types of pathogenic isolated bacteria associated with nosocomial infections in urine and stool samples.

Interestingly, *K. pneumonia*e was found to have the highest detection rate of 40.6% (n=13) followed by *E. coli* (31.25%, n=10), *P. mirabilis* (12.5%, n=4), MRSA (6.25%, n=2), *Ps. aeruginosa* (6.25%, n=2) and finally *Ps. putida* (3.15%, n=1) as depicted in Figure 4.

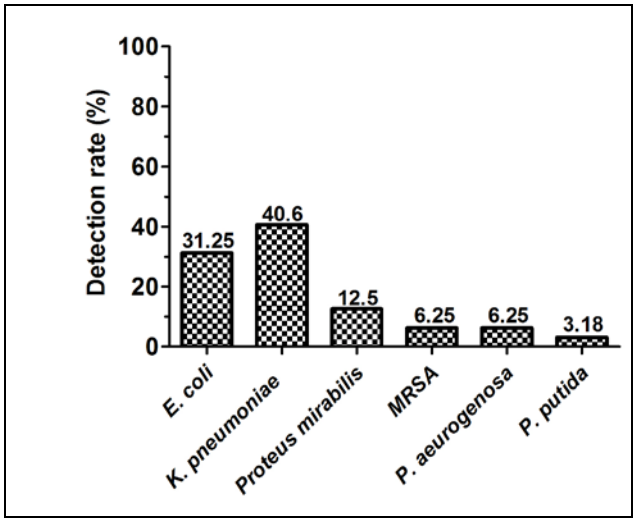

Figure 4. Overall infection rates of pathogenic bacteria isolated from patient samples associated with nosocomial infections.

The second part of this work was dedicated to investigating the influence of different families of antibiotic disks on nosocomial infections. Generally, antibiotics were selected from five groups having different mode of action. They are quinolones, β-lactams, aminoglycosides, macrolides and cephalosporines. Thus, the efficiency of different families of antibiotic disks were measured against the aforementioned bacteria associated with nosocomial infections and the results were shown in Table 1.

Table 1. Impact of antibiotics against isolated bacteria according to agar disk diffusion.

Name of Antibiotics	Clear zone (mm)					
	E. coli	*K. pneumoniae*	*P. mirabilis*	MRSA	*Ps. aeruginosa*	*Ps. putida*
Ciprofloxacin (CIP)	27	R	33	31	29	14
Norfloxacin (NOR)	28	R	38	31	25	R
Imipenem (IPM)	29	R	23	40	25	24
Cefotaxime (CTX)	30	R	15	R	R	R
Amikacin (Ak)	22	9	21	27	24	20
Erythromycin (E)	R	R	R	R	R	R
Ceftriaxone (CRO)	27	R	14	R	R	R

(R) Resistant

5 DISCUSION

Nosocomial infection influences immense number of patients universally, raising death rate and money related misfortunes fundamentally. As indicated by gauge revealed of WHO, around 15% of all hospitalized patients experience the ill effects of these diseases(8).These infections are in charge of 4-56% of all demise causes in neonates, with frequency rate of 75% in South-East Asia and Sub-Saharan Africa(9). The frequency is sufficiently high in high income nations i.e. somewhere in the range of 3.5% and 12% while it changes somewhere in the range of 5.7% and 19.1% in center and low salary nations(10). The recurrence of in general diseases in low income nations is multiple times higher than in high pay nations though this frequency is twenty multiple times higher in neonates(11).

In the present study, our results showed that the overall percentage of bacterial isolates associated with nosocomial infections has been demonstrated in 32% of urine and stool samples. Interestingly, our findings showed that 28% of stool and 36% of urine samples were tested positive for the presence of nosocomial infections higher than that produced previously by Custovic et al.,(12) who demonstrated that nosocomial infections were found in only 9% and 16% of stool and urine samples, respectively. It is noteworthy that nosocomial infections are caused by many microbes. However, bacteria are responsible for approximately 90% of nosocomial infections(13). In this study, the agents that have been isolated from the included samples were *K. pneumonia*e, *E. coli, P. mirabilis,* MRSA, *Ps. aeruginosa* in addition to *Ps. putida.* Out of these bacteria, *K. pneumoniae* and *E. coli* were found to have the highest detection rates. The results showed that *K. pneumoniae* had a prevalence rate in urine and stool samples accounting for 38.9% and 42.9%, respectively. On the other hand, Shaikh et al.,(14) reported *E. coli* as the most frequent pathogen (26.3%) while *Klebsiella* spp. was responsible for only 5.2% of all urinary tract infections. Overall, the present study showed that *K. pneumonia*e was found to have the highest detection rate of 40.6% followed by *E. coli* (31.25%), *P. mirabilis* (12.5%), MRSA (6.25%), *Ps. aeruginosa* (6.25%) and finally *Ps. putida* (3.15%). However, Borg et al.(15) reported that the highest levels of MRSA were observed in Jordan, Egypt and Malta, which were all above 50% higher than that provided in this study. Custovic et al.,(12) reported that *K. pneumoniae* was the most frequently isolated gram negative pathogen (51% of all positive samples), followed by *Ps. aeruginosa* (10%), *P. mirabilis* (7%) and *E. coli* (4%), respectively; while MRSA was the most common among gram positive bacteria (15%).

On the other hand, this work was also concerned with estimating the impact of five families of antibiotics on the isolated bacteria associated with nosocomial infection. Interestingly, several studies have been performed for investigating the impact of different families of antibiotic on nosocomial bacteria. Among these, the study that was reported by Lombardi et al.,(16) who showed that *Ps. putida* was resistant to quinolones but it was susceptible to aminoglycocides except for amikacin. As well, Kim et al.,(17) reported that *Ps. putida* was susceptible to ciprofloxacin, levofloxacin, amikacin and meropenem. Another study

was reported by Ayub et al.(18) showed that *S. aureus* and *P. mirabilis* were resistant to amoxicillin but susceptible to tetracycline. In addition, Mustafa et al.,(19) reported that MRSA was resistant only to β-lactams while *S. aureus* was resistant to penicillin and susceptible to nitrofurantoin, vancomycin, levofloxacin, tetracycline, and erythromycin. Mustafa et al.,(19) also reported that the most potent antimicrobials on *E. coli* were meropenem, levofloxacin and amikacin. It was also reported that *K. pneumoniae* was susceptible to amikacin and moderately sensitive to ceftriaxone, ciprofloxacin and tetracycline. Additionally, Mustafa et al.,(19) reported that the most potent antimicrobials on *Ps. aeruginosa* were meropenem and levofloxacin while *Ps. aeruginosa* was resistant to tetracycline, erythromycin and vancomycin. This is comparable with the rates reported by various authors Maehara et al.,(20); Aga et al.,(21) and Baker et al.,(22). In this work, all included antibiotic families have showed variable activities when used. In case of *E. coli*, cefotaxime antibiotic was found to have the maximum activity followed by imipenem and norfloxacin whereas, on the contrary, erythromycin showed no activity against *E. coli*. With regard to *K. pneumoniae*, our results provided that neomycin followed by amikacin were the most efficient antibiotic that performed well. With respect to *P. mirabilis*, norfloxacin was found to have the maximum activity followed by ciprofloxacin. As well, imipenem was found to have the maximum activity against MRSA and *Ps. putida*. with regard to *Ps. aeruginosa*, ciprofloxacin was found to have the maximum activity followed by norfloxacin and imipenem.

6 Conclusion:

In conclusion, the highest prevalence rate of NI was detected in *K. pneumonia*e was found to have the highest detection rate of 40.6%. In additionally, urine samples were associated with a 1.29-fold increase (i.e. 29% increase) over stool samples for the presence of bacteria associated with nosocomial infections.

7 REFERENCES

1. Jain A, Singh K. Recent advances in the management of nosocomial infections. JK Science. 2007;9(1):3-8.
2. Ducel G, Fabry J, Nicolle L, Organization WH. Prevention of hospital-acquired infections: a practical guide. 2002.
3. Struelens MJ. The epidemiology of antimicrobial resistance in hospital acquired infections: problems and possible solutions. Bmj. 1998;317(7159):652-4.
4. Siegel JD, Rhinehart E, Jackson M, Chiarello L. Management of multidrug-resistant organisms in health care settings, 2006. American journal of infection control. 2007;35(10):S165-S93.
5. Dancer SJ. Importance of the environment in meticillin-resistant Staphylococcus aureus acquisition: the case for hospital cleaning. The Lancet infectious diseases. 2008;8(2):101-13.
6. Akbari F, Kjellerup B. Elimination of bloodstream infections associated with Candida albicans biofilm in intravascular catheters. Pathogens. 2015;4(3):457-69.
7. Valgas C, Souza SMd, Smânia EF, Smânia Jr A. Screening methods to determine antibacterial activity of natural products. Brazilian journal of microbiology. 2007;38(2):369-80.
8. Sydnor ER, Perl TM. Hospital epidemiology and infection control in acute-care settings. Clinical microbiology reviews. 2011;24(1):141-73.
9. Organization WH. The burden of health care-associated infection worldwide: A summary. 2010.
10. Khan HA, Baig FK, Mehboob R. Nosocomial infections: Epidemiology, prevention, control and surveillance. Asian Pacific Journal of Tropical Biomedicine. 2017;5(7):478-82.
11. Nejad SB, Allegranzi B, Syed SB, Ellis B, Pittet D. Health-care-associated infection in Africa: a systematic review. Bulletin of the World Health Organization. 2011;89:757-65.
12. Custovic A, Smajlovic J, Hadzic S, Ahmetagic S, Tihic N, Hadzagic H. Epidemiological surveillance of bacterial nosocomial infections in the surgical intensive care unit. Materia socio-medica. 2014;26(1):7.
13. Khan HA, Ahmad A, Mehboob R. Nosocomial infections and their control strategies. Asian pacific journal of tropical biomedicine. 2015;5(7):509-14.
14. Shaikh JM, Devrajani BR, Shah S, Akhund T, Bibi I. Frequency, pattern and etiology of nosocomial infection in intensive care unit: an experience at a tertiary care hospital. J Ayub Med Coll Abbottabad. 2008;20(4):37-40.
15. Borg MA, De Kraker M, Scicluna E, van de Sande-Bruinsma N, Tiemersma E, Monen J, et al. Prevalence of methicillin-resistant Staphylococcus aureus (MRSA) in invasive isolates from southern and eastern Mediterranean countries. Journal of Antimicrobial Chemotherapy. 2007;60(6):1310-5.
16. Lombardi G, Luzzaro F, Docquier J-D, Riccio ML, Perilli M, Colì A, et al. Nosocomial infections caused by multidrug-resistant isolates of Pseudomonas putida producing VIM-1 metallo-β-lactamase. Journal of clinical microbiology. 2002;40(11):4051-5.
17. Kim SE, Park S-H, Park HB, Park K-H, Kim S-H, Jung S-I, et al. Nosocomial Pseudomonas putida bacteremia: high rates of carbapenem resistance and mortality. Chonnam medical journal. 2012;48(2):91-5.
18. AYUB S, FATIMA B, BAQIR S, NAQVI S, SHEIKH D, ALI SM, et al. AMOXICILLIN AND TETRACYCLINE ACTIVITY AGAINST STAPHYLOCOCCUS AUREUS AND PROTEUS MIRABILIS. Int J Curr Pharm Res. 2015;7(4):49-52.
19. Mustafa M-H, Khandekar S, Tunney MM, Elborn JS, Kahl BC, Denis O, et al. Acquired resistance to macrolides in Pseudomonas aeruginosa from cystic fibrosis patients. European Respiratory Journal. 2017;49(5):1601847.

20. Maehara Y, Shirabe K, Kohnoe S, Emi Y, Oki E, Kakeji Y, et al. Impact of intra-abdominal absorbable sutures on surgical site infection in gastrointestinal and hepato-biliary-pancreatic surgery: results of a multicenter, randomized, prospective, phase II clinical trial. Surgery today. 2017;47(9):1060-71.
21. Aga E, Keinan-Boker L, Eithan A, Mais T, Rabinovich A, Nassar F. Surgical site infections after abdominal surgery: incidence and risk factors. A prospective cohort study. Infectious Diseases. 2015;47(11):761-7.
22. Baker AW, Dicks KV, Durkin MJ, Weber DJ, Lewis SS, Moehring RW, et al. Epidemiology of surgical site infection in a community hospital network. infection control & hospital epidemiology. 2016;37(5):519-26.