Prevalence Rates of Bacterial Isolates Associated with Nosocomial Infection in Sputum and Surgical Wounds

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ABSTRACT- Nosocomial infection (NI) is one of the most important problems facing the world. This work is dedicated to investigating the prevalence rates of NI in sputum and surgical wounds samples in addition to determine the impact of antibiotic disks on isolated bacteria. This study included fifty samples of sputum and thirty four samples of surgical wounds from fifty patients staying for 3 days or more in Gastroenterology Surgical Center, Mansoura University, Mansoura, Egypt. A total of 7 antibiotics selected from three families having different mode of action were used. Our findings demonstrated that the highest prevalence rate of NI was detected in *K. pneumonia*e and MRSA (35%, n=14 for each other) followed by *E. coli* (12.5%, n=5), *Ps. putida* (7.5%, n=3) and finally *P. mirabilis* and *Ps. aeruginosa* (5%, n=2 for each other). In addition, the results showed variable impact of various antibiotics on isolated bacteria associated with NI. Interestingly, our findings showed that K. pneumoniae was the most resistance bacteria against all antibiotic disks except Neomycin.

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

1 INTRODUCTION

Nosocomial contaminations (NIs) are those diseases that patients procure while accepting wellbeing care (1). The term NIs at first alluded to those contaminations connected with admission to an intestinal consideration clinic, yet the term currently incorporated diseases created in different settings where patients get hospitals. NIs are diseases that initially show up 48 hours or increasingly after hospitalization or inside 30 days consequent to having gotten hospitals (2). The danger of creating NI isn't equitably appropriated all through the healing center. Intensive care units are related with an a lot more serious hazard than different offices. The danger of NI in ICUs is ten multiple times more prominent than those gained in general medical and surgical wards (3). In numerous units, 40–50% of patients build up a disease and usually a definitive reason for death (4).

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The yearly expenses for NIs alone in the USA are somewhere in the range of US$28 and US$45 billion, yet with even this measure of burning through, 90,000 lives are as yet lost every year: NIs are among the top five killers in the USA (5). National Healthcare Safety Network with Center for Disease Control (CDC) for observation have arranged NI locales into13 types, with 50 infection destinations, which are explicit based on biological and clinical criteria. The destinations which are basic incorporate (6):

- **Respiratory Tract Infection (RTI)**

The bacterial organisms causing RTI ends up resistant in the nasopharynx which is the biological specialty where advancement towards opposition happens (7). These resistant microorganisms can cause NI in the respiratory failure patients, as the patients with intense respiratory failure are inclined to acquire NIs fundamentally in light of the fact that they may require ventilatory help, normally intrusive mechanical ventilation. The most incessant type of pathogen causing healing center acquired pneumonia has a place with gram negative type (65.9%) (8). The two most imperative clinical issues in pulmonology office are nosocomial and ventilator-related pneumonia with greater mortality and dismalness (9). The patients conceded with intense respiratory failure experiencing mechanical ventilation are inclined to nosocomial infection by two variables. First, is the endotracheal tube which make glitches in safeguard instrument of the respiratory tract and second, the danger of cross transmission of pathogens while taking care of and controlling the ventilator related gadgets (10).

- **Surgical Site Infections (SSIs)**

Surgical site infections are a standout amongst the most well-known type of nosocomial infections in all around the world (11). The definition is basically clinical: purulent release around the injury or the inclusion site of the empty or spreading cellulitis out of the injury (12). Another definition, SSIs are infections happening up to 30 days after surgeries (or up to one year after medical procedure in patients accepting inserts) and influencing either the cut or profound tissue at the activity site (13). Infections of the surgical wound (regardless of whether above or beneath the aponeurosis) and profound infections of organs or organ spaces are distinguished independently (14). The infection is typically obtained during the operation itself; either exogenously (e.g. from the air, medicinal equipment, specialists and other staff), endogenously from the flora on the skin or in the operative site or once in a while, from blood utilized in medical procedure (15). The infecting microorganisms are variable relying upon the type and area of medical procedure and antimicrobials gotten by the patient (16). The primary hazard factor is the degree of infection during the procedure (clean, clean debased, tainted and filthy), which is to a vast part subject to the length of the operation and the patient's general condition (17). Other factors incorporate the nature of careful strategy, the nearness of remote bodies including channels, the destructiveness of the microorganisms, associative infection at different locales, the utilization of preoperative shaving and the experience of the surgical group (18).

2 MATERIALS AND METHODS

Fifty consecutive patients staying three days or more were randomly recruited from the Gastroenterology Surgical Center (GEC), Mansoura University, 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. Different samples of sputum and surgical wound swabs were collected from patients for microbiological studies in order to identify nosocomial infection. Next, the obtained samples were cultured using nutrient in addition to MacCkonkey agar. 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 (19).

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

Above all else, this work expected to distinguish diverse bacterial segregates identified with nosocomial contaminations and evaluating their pervasiveness rates in pee and feces tests. These examples were additionally characterized dependent on nosocomial diseases into positive and negative gatherings as appeared in Figure 1.

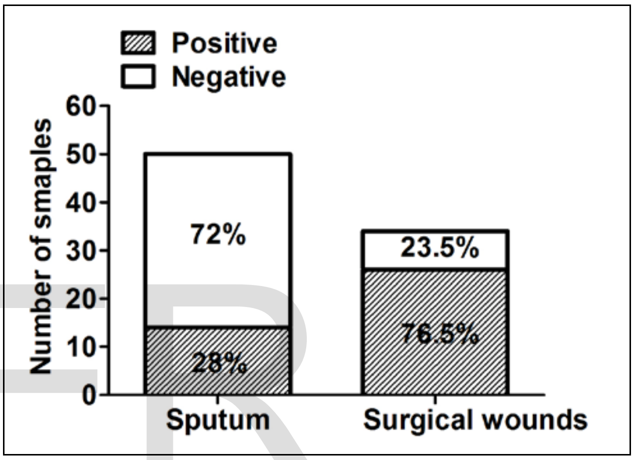

Figure 1. percentage of bacterial isolates associated with nosocomial infections in urine and stool samples.

Our outcomes demonstrated that 14 out of 50 sputum samples were positive though 36 out of those were negative for the nearness of bacteria related with nosocomial infections. Also, 26 out of 34 of surgical wounds samples were tested positive though 8 out of those were tested negative for the nearness of bacteria related with nosocomial infections. By and large, 40 out of 84 (47.62%) samples were tested positive for the nearness of nosocomial infections bacteria. Strikingly, it was assessed that surgical wounds samples were related with a 1.63-overlay increment (for example 163% expansion) over sputum samples for the nearness of bacteria related with nosocomial contaminations as portrayed in Figure 2.

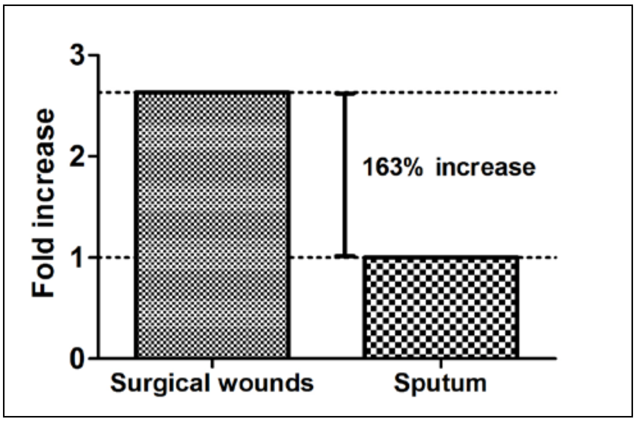

Figure 2. Distribution of the observed fold changes for the presence of bacteria associated with nosocomial infections in different samples.

The positive sputum and surgical wounds samples were distinguished by VITEK 2 minimized 15 (Biomerieux, France). As a result, distinctive pathogenic bacteria were showed up with variable pervasiveness rates in various sputum and surgical wounds samples as exhibited in Figure 3.

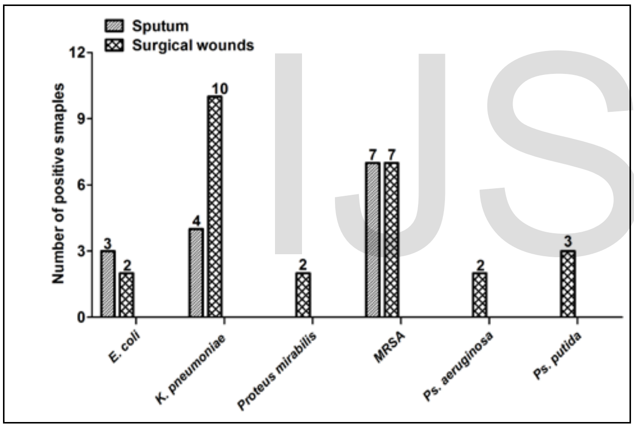

Figure 3. Prevalence of different types of pathogenic isolated bacteria associated with nosocomial infections in urine and stool samples.

Curiously, *K. pneumoniae* and MRSA were found to have the most noteworthy location rate of 35% (n=14 for each other) trailed by *E. coli* (12.5%, n=10), *Ps. Putida* (7.5%, n=3), lastly *P. mirabilis* and *Ps. aeruginosa* (5%, n=2 for each other) as portrayed in Figure 4.

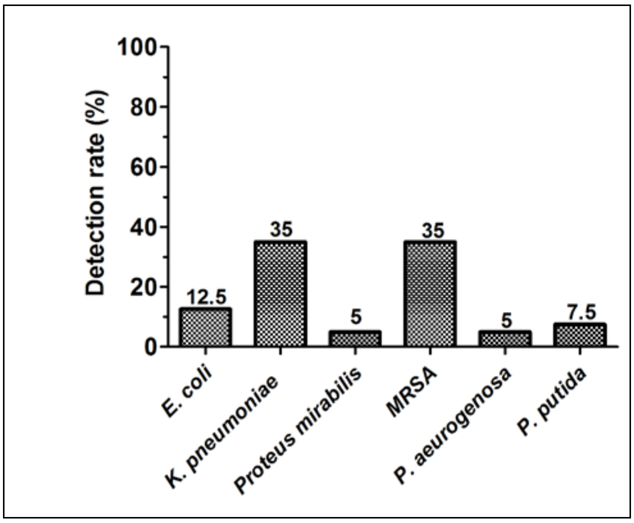

Figure 4. Overall infection rates of pathogenic bacteria isolated from patient samples associated with nosocomial infections.

The second part of this work was devoted to examining the impact of various groups of antibiotics disks on nosocomial infections. By and large, antibiotics were chosen from three families having diverse method of activity. They are quinolones, β-lactams and macrolides. In this way, the effectiveness of various groups of antibiotics disks were estimated against the previously mentioned bacteria related with nosocomial infections and the outcomes were appeared 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*
Ofloxacin (OFX)	32	R	31	40	30	13
Levofloxacin (LEV)	32	R	30	40	32	16
Nitrofurantoin (F)	23	R	10	38	R	12
Meropenem (MEM)	32	R	29	15	35	31
Ampicillin+Sulbactam (SAM)	R	R	R	R	R	R
Amoxicillin (AX)	16	R	R	R	R	R
Neomycin (N)	19	11	20	20	19	R

(R) Resistant.

5 DISCUSION

Nosocomial infections are a noteworthy wellbeing worry for both healthcare also, patients. They keep on raising at a disturbing rate, particularly in rising economies, with contamination rates 3 to 20 times higher than in high-salary countries (2). HCAIs increment morbidity, mortality, length of medical clinic stays, and costs (20).

In the present study, our results showed that the percentage of bacterial isolates associated with NIs samples has been demonstrated in 28% and 76.5% in sputum and surgical wound samples, respectively. Overall, the aforementioned results indicate that 35% and 65% of total positive samples of NIs was found in sputum and surgical wounds samples, respectively. The aforementioned results could indicate the overall percentage of NIs was 47.61%. Nadova *et al.,* (21) reported that of the all out number of diseases detected by surveillance, surgical wound infections were the second most common nosocomial infection (18.5%). Behnke *et al*., (22) showed that surgical wound infections (24.3%), urinary tract infections (23.2%) and lower respiratory tract (21.7%) of the total positive sample were the most widely recognized nosocomial infections. Nadova *et al.,* (21) found that the nosocomial infections distinguished accounted (38.2%) of the quantity of anticipated infections. Our results disagreed with that reported by Amer *et al.,* (23), who indicated that the most frequent site of infection was the respiratory tract (60%), GIT (9%) and surgical wounds infection (7%). In this study, the agents that have been detached from the included examples were *K. pneumoniae*, *E. coli*, *P. mirabilis*, MRSA, *Ps. aeruginosa* notwithstanding *Ps. putida*. Out of these microorganisms, *K. pneumonia*e and MRSA were found to have the most noteworthy location rates. The outcomes demonstrated that *K. pneumoniae* and MRSA have a pervasiveness rates in sputum and surgical wound samples representing 35%. Kallen *et al*., (24) found that up to 60% of nosocomial gram negative infections are caused by bacteria that are resistant to 3 antibiotic classes. According to Amer *et al.,* (23), most of MRSA infections occurred in the respiratory tract, while MRSA accounted for 18.4% of all respiratory tract isolates. And also found that, *K. pneumoniae* was the most common, associated with more than half of surgical wound infections. Additionally, Denys *et al*., (25) indicated that, more than 60% of nosocomial pneumonia infection caused by gram negative bacteria; however, 20% to 40% are now caused by MRSA. According to Yoshino *et al*., (26) showed that *Ps. putida* has been recognized as a rare pathogen of bacteremia in adult patients. Our results disagreed with that reported by Gallego *et al.,* (27) who found that *Ps. aeruginosa* represents one of the more common pathogenic microorganisms associated with respiratory disease. In general, *K. pneumoniae* and MRSA were found to have the highest prevalence rate with overall percentage of (35%) followed by *E. coli* (12.5%), *Ps. putida* (7.5%), *P. mirabilis* and *Ps. aeruginosa* (5%). However, Borg *et al.,* (28) indicated 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.

According to Amer et al., (23) *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%). However, Behnke *et al.,* (22) showed that *E. coli* was the most common gram negative causing nosocomial infection (18%), follow by MRSA (13.1%). Our results disagreed with that reported by Montero *et al.,* (29) who found that *E. coli* was the most frequently isolated bacteria in nosocomial infection (49.9%). However, *Ps. aeruginosa* was the third most prevalent Gram negative bacillus (9 to 13%). As well, Hennequin & Forestier, (30) who reported that *K. Pneumoniae* was causes about 10% of bacterial nosocomial infections. On the other hand, this work was also concerned with estimating the impact of different families of antibiotic disks on the isolated bacteria associated with nosocomial infection. Several studies have been done for evaluating the influence of various families of antibiotics on nosocomial bacteria. Among these, Kim et al.(32) reported that *Ps. putida* was susceptible to ciprofloxacin, levofloxacin, amikacin and meropenem. Ayub et al.(33) showed that *S. aureus* and *P. mirabilis* were resistant to amoxicillin but susceptible to tetracycline. As well, Mustafa et al.(13) reported that MRSA and *S. aureus* were resistant to β-lactams and penicillin, respectively. On contrary, *S. aureus* was found to be susceptible to nitrofurantoin, vancomycin, levofloxacin and tetracycline, in addition to erythromycin. With respect to *E. coli,* it was reported to be susceptible to meropenem, levofloxacin as well as amikacin (13). With regard to *K. Pneumoniae*, it was found to be susceptible to amikacin and moderately sensitive to ceftriaxone, ciprofloxacin and tetracycline. Additionally, *Ps. aeruginosa* was susceptible to meropenem and levofloxacin while, in contrast, resistant to tetracycline, erythromycin and vancomycin (13). In this work, all included antibiotic families have showed variable activities when used. In case of *E. coli*, Ofloxacin, Levofloxacin and Meropenem antibiotics were found to have the maximum activity followed by Nitrofurantoin and Neomycin whereas, on the contrary, Ampicillin+Sulbactam showed no activity against *E. coli*. With regard to *K. pneumoniae*, our results provided that neomycin was the most efficient antibiotic that performed well. With respect to *P. mirabilis*, Ofloxacin followed by Levofloxacin were found to have the maximum activity. As well, both Ofloxacin and Levofloxacin were found to have the maximum activity against MRSA and *Ps. putida*. With regard to *Ps. aeruginosa*, Meropenem was found to have the maximum activity followed by Levofloxacin and Ofloxacin.

6 Conclusion:

In conclusion, the highest prevalence rate of NI was detected in *K. pneumonia*e and MRSA were found to have the highest detection rate of 35%. Additionally, surgical wounds samples were associated with a 1.63-fold increase (i.e. 163% increase) over sputum samples for the presence of bacteria associated with nosocomial infections.

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