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NOSOCOMIAL INFECTION IN SURGICAL HOSPITAL IN ZAGAZIG UNIVERSITY

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Tohamy[1], E.Y.; A.M. Abo-Zeid [2]; A.A. Shaheen[1] and Samah F. El-Awadi[1]

ABSTRACT

Surgical site infection (SSI) remains an important cause of morbidity and mortality among hospitalized patients. A total of 254 bacterial isolates were collected from 303 surgical specimens which were isolated from 92 males (53.2%) and 81 females (46.8%), their mean ages were 39.6±16.05 years (ranged from 1 month to 74 years). These isolates were identified as *Staphylococcus aureus, Escherichia coli, Klebsiella pneumoniae, Proteus vulgaris, Pseudomonas aeruginosa* and commensal Gram+ve and Gram-ve bacteria. The most effective antibiotics were imipenem while ampicillin and penicillin G (First and second generation of β-Lactam) showed much lower activity against all types of bacterial strains. The minimum inhibitory concentrations (MIC) of imipenem determined by E-test were 0.047- 0.064 , 0.125, 0.19, 0.25 and 0.75μg/ml against *Staphylococcus aureus, Escherichia coli, Proteus vulgaris, Klebsiella pneumoniae* and *Pseudomonas aeruginosa* respectively.

Key words*:* Imipenem, Antibiotic susceptibility, Multi-drug resistance, Risk factors, Nosocomial infection

INTRODUCTION

Nosocomial infection (NI) remains an important cause of morbidity and mortality among hospitalized patients. It is an important clinical complication in adult and children patients in different hospital wards. It is associated with prolonged hospital stay and increased health care costs **(Urea *et al* 2004).** It may be endogenous arising from an infection agent present within a patient's body or exogenous transmitted from another source within the hospital **(Aitken and Jeffris, 2001).** The most important risk factors of mortality were observed to be nosocomial infection, older age, high (APACHE) II score (the mean of age, gender, acute, physiology and chronic health evaluation), mechanical ventilation, enteral nutrition, tracheotomy and use of steroids or chemotherapy **(Coplan *et al* 2005).** *Diabetes mellitus*, obesity and prolonged presence of a surgical drain increased the risk of infection **(Vilar-Compte *et al* 2000).** The risk of surgical site infection (SSI) increases also with the duration of surgery **(Nateghian *et al* 2004).** The

1- Department of Botany, Faculty of Science, Zagazig University, Zagazig, Egypt
2- Department of Microbiology, Faculty of Medicine, Zagazig University, Zagazig, Egypt

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emergence of resistant pathogens is an important factor in the morbidity and mortality of hospitalized patients **(Nichols and Raad, 1999).** Surgical site infection (SSI) is the most common in surgical patients accounting for 38% of all such infections **(Malone *et al* 2002). Ibrahim *et al* (1998)** claimed that 31.25% of impatients have acquired surgical wound infections in the General Surgery department, Ain Shams University hospital (Egypt). **Abu-Shady *et al* (1999)** found that the most encountered nosocomial pathogens in Egypt were *E. coli, P. aeruginosa, K. pneumonaie and Staph. aureus.* The results of the study on the efficacy of nosocomial infection control (SENIC) project demonstrated that hospitals with active NI programs had lower rates of NI than those without such programs. A key component of these programs was the inclusion of a systematic method for monitoring NI and reporting these infections to clinicians, the preparation of surgical site infection (SSI) reports including the diagnosis of wound infection and parameters that allow comparison of infection rates to improve their perceptions regarding data accuracy and usefulness, post-discharge surveillance and information regarding pathogens, antibiotic sensitivities and co-morbidities of patients developing SSI are the most important categories for nosocomial infection control measures **(Macbeth *et al* 2005).**

Also, geographic information system is a part of the quality control system **(Le Roux *et al* 2004).**

Aim of the work: To determine the rate of nosocomial infection, identify the associated risk factors; study the antimicrobial resistance of bacterial isolates in order to evaluate the infection control measures in the Department of General Surgery in Zagazig University Hospitals (Egypt).

MATERIAL AND METHODS

1- Collection of samples

Samples were collected from inpatients after 48-72 hours of hospitalization in General Surgery Department of Zagazig University and delivered consecutively to the Microbiology Department. A total of 303 surgical specimens were collected from one hundred and seventy-three patients (91 males and 82 females) whose ages ranged from one month to 74 years. Specimens of pus were collected by swabbing wound with a sterile swab.

2- Media used

Different samples were cultured on C.L.E.D. agar, blood agar, MacConkey agar and Nutrient agar for their isolation and purification according to **Murray *et al* (1999).**

3- Identification of bacterial isolates

Conventional methods for the identification and characterization of isolates were employed according to **Murray *et al* (1999),** including colony morphology, Gram staining and biochemical reactions.

4- Antibiotic susceptibility testing

All isolates were tested for their in-vitro susceptibility to various antibiotics by disc diffusion testing according to **Bauer *et al* (1966).**

5- Determination of minimum inhibitory concentration (MIC) using E-test

Minimum inhibitory concentration (MIC) of imipenem was determined against different multi-drug resistant strains (MRD) using E-test techniques (Epsilometer, AB

Biodisk, Solna, Sweden) following the manufacture's recommendations **(Jacobs *et al* 1992).**

RESULTS

During the study period, a total of 254 bacterial isolates were collected from 303 different clinical specimens, isolated from 92 males (53.2%) and 81 females (46.8%), whose mean ages were 39.6 ± 16.05 years (ranged from 1 month to 74 years).

Data presented in Table (1) show the relation between numbers, percentage of inpatients during the period of June 2001 to July 2002 located in general Department of Zagazig University and the number of surgical specimens isolated from each patient.

The data from Table (2) claim that the highest incidence of bacterial strains isolated from 173 impatients was *Staph. aureus* being 37 %, while the lowest incidence of the strains was commensal gram +ve and gram–ve bacteria being 7.1%. The other isolated bacterial strains ranged between 9.1% and 25.2%.

Concerning the data in Table (3) the data showed that the most important risk factors affecting each patient in General Surgery Department were age, gender, surgical interference and presence of *Diabetes mellitus* (D.M.) since older age patients (55.6%) were highly disposable to have nosocomial infection than younger age (44.4%), also males (54%) were higher than females (46%) in their ability to have nosocomial infection from the hospital. Surgical interference also affected on dispersal of nosocomical infection in the hospital. Presence of D.M. were the most important reason for the ability of patient to have nosocomial infection.

Concerning the risk factors associated with nosocomial infection in General Surgery Department of Zagazig University Hospitals by multi-drug resistant strains (MDR), the obtained data in Table (3) show that the percentage of NI rate among 173 patients (92 males, 81 females) isolated from General Surgery Department of Zagazig University between 2001 and 2002, was 72.2%.

Susceptibility patterns for bacterial strains to various antibacterial agents by disc diffusion method

Susceptibility patterns of bacterial strains to various antibacterial agents by disc diffusion method, showed that the most active antibiotics against all tested strains was imipenem, the susceptibility patterns of imipenem were 95.6%, 93.1%, 90.4%, 84.6%, 78.1% against *P. vulgaris, K. pneumoniae, Staph. aureus, E. coli and P. aeruginosa* respectively. While the lower activity was showed by penicillin and ampicilline, where the susceptibility patterns of penicillin were 21.7%, 17.2%, 3.8%, 2.1 and 0% against *P. vulgaris, K. pneumoniae, E. coli, Staph. aureus and P. aerguinosa* respectively and the susceptibility patterns of ampicillin were 21.7%, 20.2%, 13.7%, 0% and 0% against *Proteus vulgaris, Staph. aureus, K. pneumoniae, E. coli and P.. aeruginosa* respectively.

DISCUSSION

In the present study, a total of 254 bacterial isolates were collected from 303 surgical specimens isolated from 173 inpatients in General Surgery Department in Zagazig University (Egypt).

Table 1. Demographic data:

No. of surgical specimens	No. of patients	(%)	Total No. of surgical specimens
1	90	(52.0)	90
2	47	(27.0)	94
3	27	(15.6)	81
4	8	(4.6)	32
6	1	(0.6)	6
Total	173	100	303

Table 2. The percentage incidence of bacterial strains in different clinical Specimens

Bacterial strains	Isolates	
	Total No.	%
Staphylococcus aureus	94	37
Escherichia coli	26	10.2
Klebsiella pneumoniae	29	11.4
Proteus vulgaris	23	9.1
Pseudomonas aeruginosa	64	25.2
Commensal G+ve & G-ve bacteria	18	7.1
Total	254	100

Table 3. Risk factors associated with nosocomical infection in General Surgery Department of Zagazig University by different multidrug resistant strains (MDR)

Items	No. n=173	+ve Cultures n=126		R.R. (CI=95%)	P. Value
		No	%		
1- Age (years)					
≤40	93	70	55.6	1.08	0.43
>40	80	56	44.4	(0.89-1.29	NS
2- Gender					
Male	92	68	54	1.03	0.73
Female	81	58	46	(0.86-1.24)	NS
3- Surgical interference					
Yes	113	79	62.7	0.89	0.23
No	60	47	37.3	(0.75-1.07)	NS
4- Presence of D.M.					
Yes	37	32	25.4	1.25	*
No	136	94	74.6	(1.06-1.48)	0.3

D.M. = Diabetes mellitus R.R= Relative risk P= Probability
CI = Confidence interval NS= Non significance P> 0.05
* = Significance P< 0.05

The results showed that *Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella pneumoniae, Escherichia coli and Proteus vulgaris* were the most commonly isolated pathogens from the different clinical specimens. These results are in agreement with those reported by **Smith *et al* (2000),** who found that the most frequent organisms were *P. aeruginosa, P. mirabilis, E. Coli, K. pneumoniae, Staph. aureus and Entercocci*. Also, **Rangel-Frausto *et al* (1999)** found that the microorganisms most commonly isolated were *E. coli* (28%), Staph. aureus (11.11%) and *P. aeruginosa* (8.6%). **Gransden (1997)** also reported that the most frequent organisms isolated from a teaching hospital in U.K. were *E. coli, P. aeurginara and K. species*. The current susceptibility pattern of the isolated strains to different antibiotics was investigated.

The results showed that imipenem proved to have aboard spectrum and high activity against all the tested Gram-positive and Gram-negative bacterial isolates.

The susceptibility rates of imipenem were 95.6%, 93.1%, 90.4%, 84.6% and 78.1% for *P. vulgaris, K. pneumoniae, Staph. aureus, E. coli and P. aeruginosa* respectively. These results are in accordance with data reported in other studies of **Gowan *et al* (1989); Amyes & Gemmell (1997).** While pencillin G and ampicillin showed the lowest activity against

Table 5. Determination of minimum inhibitory Concentrations (MIC) of imipenem (IPM) against different multi-drug resistant strains using E-test

Multi-drug resistant strains (MRD)	E-test	
	MIC (μg/ml)	Interpretation
Methicilline resistant *Staph. aureus (MRSA)*	0.064 - 0.047	S
Escherichia coli	0.125	S
Proteus vulgaris	0.19	S
Klebsiella pneumoniae	0.25	S
Pseudomonas aeruginose	0.75	S

Fig. (1)
Staph. aureus

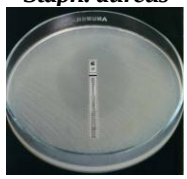

Fig. (2)
P. aeruginosa

Fig. (3)
E. coli

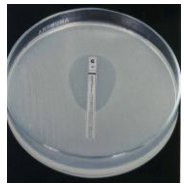

Fig. (4)
P. vulgaris

Fig. (5)
K. pneumoniae

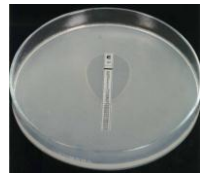

Fig. (1, 2, 3, 4 & 5). Determination of minimum inhibitory concentrations (MIC) of imipenem (IPM) against different multidrug resistant strains using E-test

all the tested *Gram-positive* and *Gram-negative* bacterial isolates. These results are not matched with the study of **Matsukawa *et al* (2001),** who found that penicillin's and first to second-generation cephalosporins (older antibacterial agents) can prevent bacterial infection except those caused by resistant microorganisms. In general, a high level of resistance among *Staph. arueus, P. vulgaris, P. aeruginosa, E. coli* and *K. pneumoniae* isolates to most cephalosporins tested was found in the present study. Contrasting to our results, **Sammour *et al* (1995)** in Egypt, **Thornsberry & Yee (1996)** in USA and **Gransden (1997)** in U.K. obtained much lower percentage of resistance among the above organisms to cephalosporins. This confirm the finding of **Tillotson *et al* (1997)** and **Davidson (1999)** that the rates of antibiotic resistance vary markedly in different geographic regions, states, within the hospitals in the same geographic location and even among the various centers in the same hospital.

Susceptibility pattern of microorganisms to different antibiotics was affected mainly by the duration, dose, and interval of antibiotic administration. **Kresken *et al* (1994)** reported that the resistant levels of *P. aeruginosa* to cioprofloxacin was 43.3% in Italy and 19% in Greece, whilst in all other countries the incidence was < 10%. These authors concluded that different use of antibiotics clearly affected the degree of resistance development. **Bonfiglio *et al* (1998)** concluded that the different levels of resistance found are in accordance with the low or high use of the drug in different centers. The Epsitometer-test (E-test) is a simple and reliable method for determining the susceptibility of bacterial isolates to many antibiotics. The results are comparable to those obtained with reference methods **Mthwalo *et al* (1998); Freburg *et al* (1998) and Ho *et al* (1998),** who found that disc diffusion tests perform satisfactory, but they yield categorized qualitative only and not MIC. The opinion of species-related breakpoints of the Swedish reference group for antibiotics **(SRGA)** is that the E-test is an important complement to recommend that disk diffusion screening methods for certain resistant mechanisms should be followed by E-test MIC- determination rather than by further disk testing. In present study, the susceptibility results of *Staph. aureus, E. coli, K. pneumonaie, P. vulgaris* and *P. aeruginosa* obtained with disc diffusion reference method were compared to those obtained with E-test. The data obtained indicate that there was a good correlation between disc diffusion test and E-test against different multidrug resistant isolates. The minimum inhibitory concentrations MIC of imipenem by E-test were 0.047 - 0.064, 0.125, 0.19, 0.25, 0.75 µg/ml against *MRSA, E. coli, P. vulgaris, K. pneumoniae* and *P. aeruginosa*. These results are in agreement with the results of **Hanberger *et al* (1999)** who found that MIC of imipenem against *E.coli, K. spp., Enterobacter spp., P. spp.* and *P. aeruginosa* were 100/100/98, 100/100/100, 100, 100, 95, 92/92/69 and 84/84/84 respectively according to the MIC breakpoints of the British Society for Antimicrobial Chemotherapy **(BASC)** ,the National Committee for Clinical Laboratory Standards **(NCCLS)** and the new species-related breakpoints of the Swedish Reference Group for Antibiotics ***(SRGA)*** and comparable to the results of **Tallis *et al* (1999)** who found that MIC of imipenem against *MSSA, P. aeruginosa* and *Entero-*

bacteriacae, was slightly superior to cefepime with only seven isolates resistant (3%). In the present study, the overall nosocomial infection rate of 173 inpatients admitted to General Surgery Department in Zagazig university during the period from 2001 to 2002 was 72.8%. These results are matched with the results of **Atiken & Jeffries (2001),** who found that the incidence of NI is still higher than to be accepted. Although a complete elimination of NI is still far to be achieved, reduction of the incidence of these infection to a minimum level could be accomplished. The main risk factors associated with surgical wound infections were age, gender, presence of D.M. and surgical interference. The results showed that males (53.2%) had higher NI rate than females (46.8%), the post operative wound infections (65.3%) were higher than that of preoperative wound infections (34.7%) and the mean of age had higher NI was 39.6±16.05 years (older age had a risk factors of NI than young age); also D.M. cases (21.4%) had higher NI rate than other cases. These results are in agreement with **Coplan *et al* (2005)** who found that the most important risk factors of mortality were observed as nosocomial infection, older age and high **(APACHE)** score, and **Nateghian *et al* (2004)** who found also that the risk of surgical site infection (SSI) increase with the duration of surgery and **Vazquez-Aragon *et al* (2003)** who stated that the most frequent NI was surgical infection.

RECOMMENDATIONS

1- Early diagnosis and treatment is of critical importance to make infection control.
2- Even suspicion of infective postoperative complication should be sufficient cause to search for responsible microorganisms and begin antibiotic therapy.
3- Antimicrobial resistance should be seriously considered during surgical therapy and prophylaxis with antimicrobial agents.
4- Preparation of surgical site infection **(SSI)** reports including information, regarding pathogens, antibiotic sensitivities and co-morbidities of patients developing SSI.

CONCLUSION

From the previous data it is concluded that the most predominant organisms causing nosocomial infection was (37%) *Staphylococcus aureus* and the most resistant organisms were Methicillin resistant *Staphylococcus aureus* (MRSA) and *Pseudomonas aeruginosa.* Also, the results showed that imipenem is the most effective antibiotics that could be used for treatment of multidrug resiatnt strains (which are important risk factors causing nosocomial infection).

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العدوى المرتبطة بأقسام الجراحة بمستشفيات جامعة الزقازيق

[٩]

إيمان يوسف تهامى[١] – عزه عبد العزيز مهنى أبو زيد[١] – احمد أنور شاهين[٢] – سماح فوزى محمد[١]

١- قسم النبات – كلية العلوم – جامعة الزقازيق – مصر

٢- قسم الميكروبيولوجي – كلية الطب – جامعة الزقازيق – مصر

تعتبر المستشفيات من الأماكن الهامة لانتشار العدوى التى تؤدى إلى حالات مرضية وقد تؤدى فى النهايه إلى الوفاة بين المرضى المتواجدين في المستشفى. ويهدف هذا البحث إلى تحديد نسبة العدوى في المستشفيات، وتعريف العوامل المرتبطة بالعدوى ، ودراسة البكتريا المقاومة للمضادات الحيوية، وتقييم عملية مكافحة العدوى في أقسام الجراحة بمستشفيات جامعة الزقازيق (ج.م.ع). وقد تم الحصول على ٣٠٣ عينة جراحية من ١٧٣ مريض في أقسام الجراحة بمستشفيات جامعة الزقازيق في المدة من ٢٠٠١ إلى ٢٠٠٢ ومن هذه العينات الجراحيه تم عزل وتعريف ٢٥٤ عزله بكتيريه، وقد لوحظ ان العزلات السائده هى ستافيلوكوكس أوريس (٣٧%) سيودومونس إيريجينوزا (٢٥,٢%)، كليبسيلا نيومونى (١١,٤%)، إيشريشيا كولاى (١٠,٢%) ، بروتيس فالجارس (٩,١%) . كما تمت دراسة تأثير المضادات

الحيوية لمعرفة مدى استجابة تلك العزلات البكتيرية للأنواع المختلفة من المضادات الحيويـة ، وكانت اكثر المضادات الحيويه فاعليه ضد هذه العزلات هو الإمبينام ، بينما كان البنسلين والأمبيسلين أقل نشاطا بالنسبة لنفس العزلات. كما اوضحت النتائج ان قيم أقل تركيز مثبط من الإمبينام ضد العزلات السابقة كان يتراوح بين ٠,٠٤٧إلى ٠,٧٥ميكروجرام/مللى. من النتائج السابقة نستنتج أن أكثر الكائنات المسببة للعدوى في المستشفيات هــى ستافيلوكوكس أوريس ، وأكثر البكتريا المقاومة للمضادات الحيوية هــي استافيلوكــوكس اوريس المقاومه للميثيسلين وسيدومونس إيريجينوزا.

تحكيم: أ.د راويـة فتحى جمـال
أ.د محمد يسرى الدخاخنى