ORIGINAL ARTICLE

Assessment of Surgical Site Infections; bacterial isolates, prevalence and their antibiogram pattern at Cairo University Hospitals, Cairo, Egypt

[1]Essraa Hegazy*, [2]Ibrahim Elsebaie, [3]Nouran Allaboudy

[1]Lecturer of Medical Microbiology and Immunology Department, Faculty of Medicine, Cairo University
[2]Lecturer of Orthopedic Department, Faculty of Medicine, Alazhar University
[3]Lecturer of Pharmaceutical Microbiology Department, Faculty of Pharmacy, Ain shams University

Key words:
Antibiogram, Surgical site infection, antibiotic resistance

Corresponding Author:
Essraa Hegazy
Lecturer of Medical Microbiology and Immunology Department, Faculty of Medicine, Cairo University
Essraa.hegazy@gmail.com
Tel:01006554539

ABSTRACT

Background: *Surgical site infections (SSI) are a common type of healthcare-associated infection and a complication of hospitalization, responsible for the prolongation of hospital stay, and increasing costs (1300–5000 USD per SSI)1-3. Most SSIs are caused by Gram-positive bacteria such as CoNS, Enterococcus spp. and Staphylococcus, also Gram-negative bacteria like Escherichia coli (E. coli), Klebsiella spp., Pseudomonas aeruginosa, and Acinetobacter spp. 3.* ***Objectives:*** *It is crucial to monitor emerging trends in resistance at the local level to support clinical decision-making, infection-control interventions, and antimicrobial-resistance containment strategies. Also guiding clinical laboratories in Cairo university hospitals in the preparation of a cumulative antibiogram, explain the rationale for some of the recommendations, discuss limitations of its use, and propose new directions for future revisions.* ***Methodology:*** *A retrospective analysis of culture results of surgical site infection was performed at Cairo University's Central Laboratory. The sex and age of patients, the organism isolated, and the antimicrobial susceptibility profiles were collected from the registration records using a standard data collection method. From positive cultures, pathogens were identified according to the standard operating procedures as per the standard microbiological methods.* ***Results:*** *This study showed that the prevalence of SSI was high in all age groups. The most frequently isolated bacterium was sensitive to Linezolid and the other isolates were sensitive to clindamycin and ciprofloxacin are considered as appropriate antimicrobials for empirical treatment of SSI in the area. Periodic monitoring of etiology and drug susceptibility is recommended.* ***Conclusion:*** *We recommend using Linezolid, clindamycin, and ciprofloxacin for empirical treatment of SSI if needed with a continuous urge to periodic monitoring of etiology and drug susceptibility for proper orientation of the bacterial antimicrobial changeable pattern*

INTRODUCTION

Based upon the latest CDC report, more than 10 million patients are subjected to surgical procedures as inpatients each year, surgical operations account for over one-fourth of all hospital stays [1].

Cesarean section, orthopedic, neurosurgical, and intraabdominal procedures (cholecystectomy and colorectal resections) are the most commonly encountered types of surgery that require prolonged hospital stay [1,2].

Surgical site infection (SSI) is defined as infection occurring post any operative approach insitu or near the surgical incision site in duration from a month up to 3 months after surgery [3].

Although the majority of infections could be managed by antimicrobial treatment, SSIs remain an eminent cause of morbidity and mortality after surgery[4,5].

Age, smoking, chronic diseases such as diabetes, malnutrition, and procedure-specific risk factors including blood loss and sterilization procedures are considered major risk factors for developing post-operative SSIs[6,7].

Although some of these risk factors could not be modified, most of them could be prevented by close monitoring and application of proper infection control measures [8].

Our study aims to close monitoring of emerging drug resistant strains and to guide clinical laboratories in Cairo University Hospitals in the preparation of a cumulative antibiogram to propose new directions for empiric antimicrobial use if needed and limit the use of others, based upon data collected from SSIs culture and sensitivity results.

METHODOLOGY

Study design

A retrospective analysis of surgical site infection results of cultures was performed at Cairo University's Central Laboratory.

From the registration records patients' data including gender, age, and organism antimicrobial results were collected and entered into Excel form for analysis.

Ethical considerations

Ethical approval was obtained from both the Ethics Committee and Research Laboratory of Cairo University territory number FMCU 2497/2019 dated February 2019

Culture and identification

According to standard operating procedures, the specimens were collected using sterile swabs.

Samples were cultured on Nutrient agar, Blood agar, MacConkey agar, and Orsap (Oxoid, Basingstoke, UK) followed by their incubation aerobically at 37°C overnight.

Positive culture plates were identified according to the microbiological methods 9.

Antimicrobial susceptibility tests

Using the Kirby-Bauer disk diffusion method, antimicrobial susceptibility tests were done on Mueller-Hinton agar (Oxoid, Hampshire, England) 10.

Each isolate was tested for its sensitivity for 44 antibiotics which were commonly used in thetreatment of surgical site infections in Cairo University Hospitals according to CLSI guidelines 2019/2020, as shown below table (1).

Table 1: The antimicrobial agents tested in surgical site infection cultures.

penicillin G	**ampicillin**	**amoxicillin**	**oxacillin**
piperacillin	amoxicillin-clavulanic acid	ampicillin-sulbactam	piperacillin- tazobactem
cefuroxime	cefoperazone	cefotaxime	ceftazidime
cefoxitin	ceftriaxone	cephalexin	cefoperazone-sulbactam
ofloxacin	ciprofloxacin	nitrofurantoin	gentamycin
vancomycin	clindamycin	erythromycin	amikacin
kanamycin	lincomycin	polymixin b	doxycycline
tetracycline	azithromycin	fusidic a.	cotrimoxazole
impinem	meropenem	chloramphenicol	metronidazole
cefoperazone30	tazobactam	sulphamethoxazole	trimethoprim
augmentin	sulbactam	linezolid	TGC

Guided by CLSI guidelines antimicrobial resistance patterns were interpreted using reference strains of gram-negative (*E coli* ATCC 25922) and positive bacteria *(*MRSA ATCC 33591) for ensuring quality control for antimicrobial susceptibility tests16.

Data analysis:

A Chi-square test was used to hold a comparison and relate sex, age, and type of isolated bacteria with its antimicrobial pattern.

A P-value of less than 0.05 was considered to indicate a statistically significant difference.

RESULTS

A total of eight bacterial strains were isolated including MRSA, *Pseudomonas* spp., *Klebsiella* spp., *E coli* spp., *Acinetobacter* spp., *CoNS*, *Providencia* spp., and *Stenotrophomonas maltophilia* spp.

From2019 to 2020, a total of 23040 samples from suspected SSIs were analyzed for isolation and identification of bacteria and antimicrobial susceptibility testing.

Mean age of 32.26 (SD=14.45) years was recorded from1year to 85 years. The mean ages of male and female patients were 35.1 (SD=15.8) and 30.78 (SD=12.4) years, respectively. A total of (62.2%) samples were from females and (33.8%) were from male patients with males to females ratio of 1:1.96.

The ratio of females to males ratio was 2:1, where the age group between 26 to 44 years showed the highest isolation rate.

MRSA was the most predominant isolated pathogen from wound samples with a prevalence of 27% counting 7600 strains out of 20737 followed by CoNS accounting for 16%, *Pseudomonas* spp., *Stenotrophomonas maltophilia* spp. resembles 12% and the least prevalence to *Providencia* spp., *Acinetobacter* spp., *Ecoli* spp. , *and Klebsiella* spp. respectively.

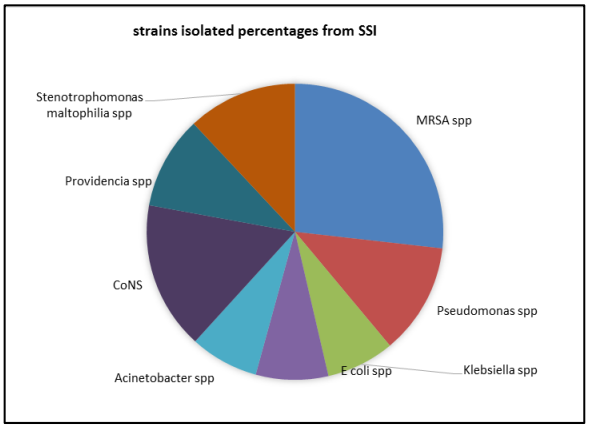

Fig. 1: Percentages of different strains isolated from SSI

Upon testing all bacteria isolates antimicrobial susceptibility profiles from SSIs patients, Penicillin G had the highest overall resistance with a count of 18726 out of 20373, followed by gentamycin 16710, tazobactam 13533, linezolid 12562, cefoperazone 12402, and cotrimoxazole 1116 as shown tab (2).
Each organism was tested against various antimicrobials and its antibiogram was recorded.

Table 2: Antimicrobial susceptibility profile of bacterial isolates from SSIs.

Antimicrobial agent	Antimicrobial susceptibility patterns				No of tested samples Total no. 23040
	Susceptible		Resistant		
	No.	%	No.	%	
Penicillin G	2011	7.091267	18726	92.90873	20737
Ampicillin	866	8.76	9015	91.24	9881
Amoxicillin	1333	4.7	1589	95.3	6814
Oxacillin	911	8.99	10133	91.75	11044
Piperacillin	273	9.48	2606	90.52	2879
Amoxicillin-clavulanic acid	156	5.73	2723	94.27	2879
Ampicillin-sulbactam	289	14.78	1956	85.22	2245
Piperacillin- tazobactem	234	5.40	4335	94.60	4569
Cefuroxime	464	4.713052	9381	95.28695	9845
Cefoperazone	735	5.59	12402	94.41	13137
Cefotaxime	2110	27.47	5570.00	72.53	7680
Ceftazidime	412	6.96	5511	93.04	5923
Cefoxitin	1000	23.61	3236	76.39	4236
Ceftriaxone	298	8.65	3146	91.35	3444
Cephalexin	634	5.3	11336	94.7	11970
Cefoperazone-sulbactam	243	5.32	4326	94.68	4569
Ofloxacin	244	8.48	2635	91.52	2879
Ciprofloxacin	118	5.59	1993	94.41023	2111
Nitrofurantoin	167	0.59	28206	99.41	3400
Gentamycin	815	4.65	16710	95.35	17525
vancomycin	245	11.53	1880	88.47	2125
Clindamycin	488	6.42	7115	93.58	7603
Erythromycin	234	6.79	3210	93.21	2359
Amikacin	993	22.80	3363	77.20	4356
Kanamycin	256	5.60	4313	94.40	4569
Lincomycin	454	7.18	5869	92.82	6323
Polymixin b	145	1.91	7455	98.09	7600
Doxycycline	1118	11.31	8763	88.69	9881
Tetracycline	512	11.21	4057	88.79	4569
Azithromycin	650	18.87	2794	81.13	3444
Fusidic a.	117	4.06	2762	95.94	2879
Cotrimoxazole	840	7.03	11116	92.97	11956
Impinem	666	15.72	3570	84.28	4236
Meropenem	570	4.3836	12433	95.6164	13003
Chloramphenicol	210	9.88	1915	90.12	2125
Metronidazole	177	5.21	3223	94.79	3400
Cefoperazone30	540	5.49	9305	94.51	9845
Tazobactam	759	5.31	13533	94.69	14292
Sulphamethoxazole	1019	13.26823	6661	86.73177	7680
Trimethoprim	929	8.70	9750	91.30	10679
Augmentin	984	17.71	4571	82.29	5555
Sulbactam	433	20.51	1678	79.49	2111
Linezolid	593	4.51	12562	95.50	13155
TGC	833	19.12	3523	80.88	4356
P-value		0.0001		0.0001	

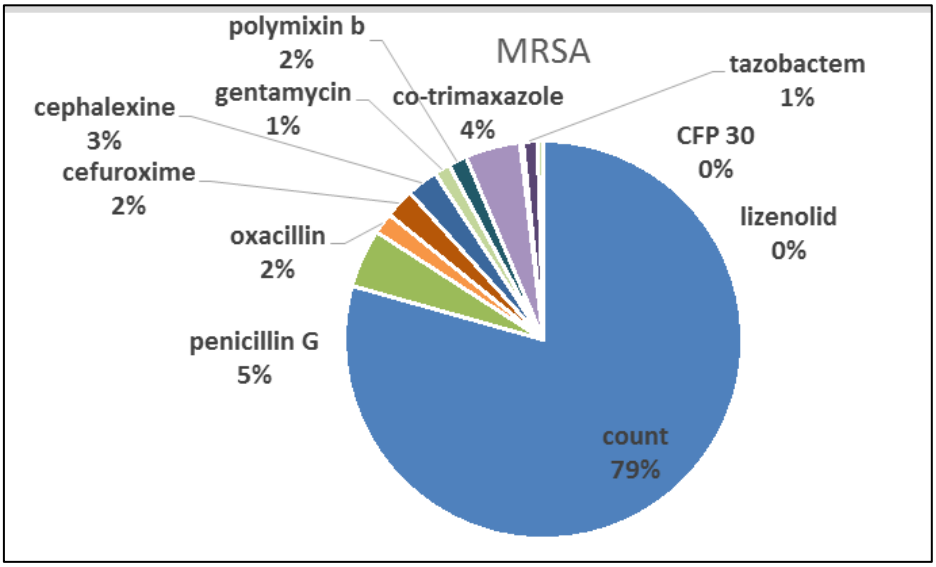

Fig. 2: Antibiotic sensitivity testing of MRSA against selected antibiotics.

MRSA was the most frequently isolated bacterium, where 21 % found resistant to various antibiotics with the highest resistance to penicillin G and no resistance to linezolid or cefepime (30%)

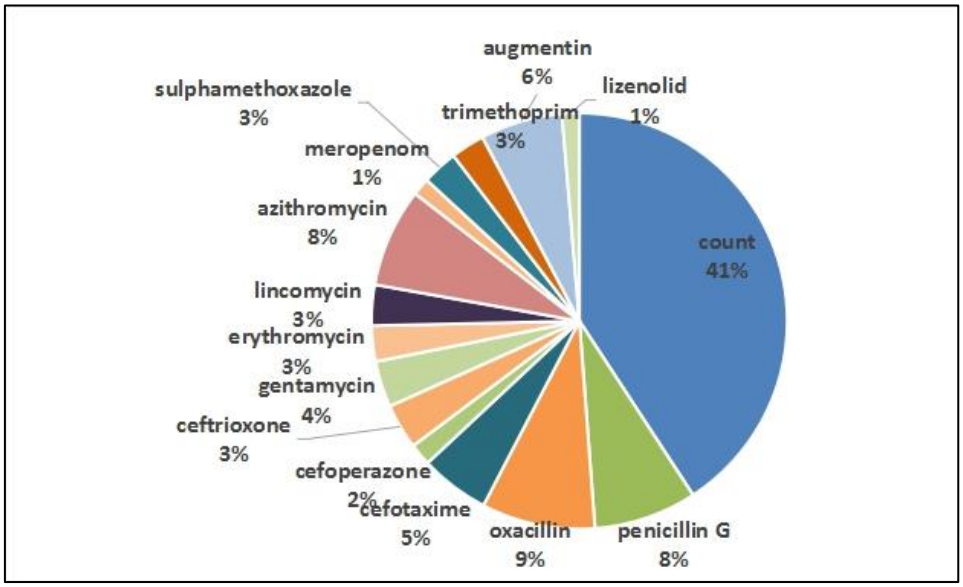

Fig. 3: Sensitivity testing of *Pseudomonas* spp. against selected antibiotics.

Out of 3444 *Pseudomonas* isolates 59 % were found resistant to various antibiotics with the highest resistance to oxacillin (9 %) and least resistance to linezolid and meropenem (1%).

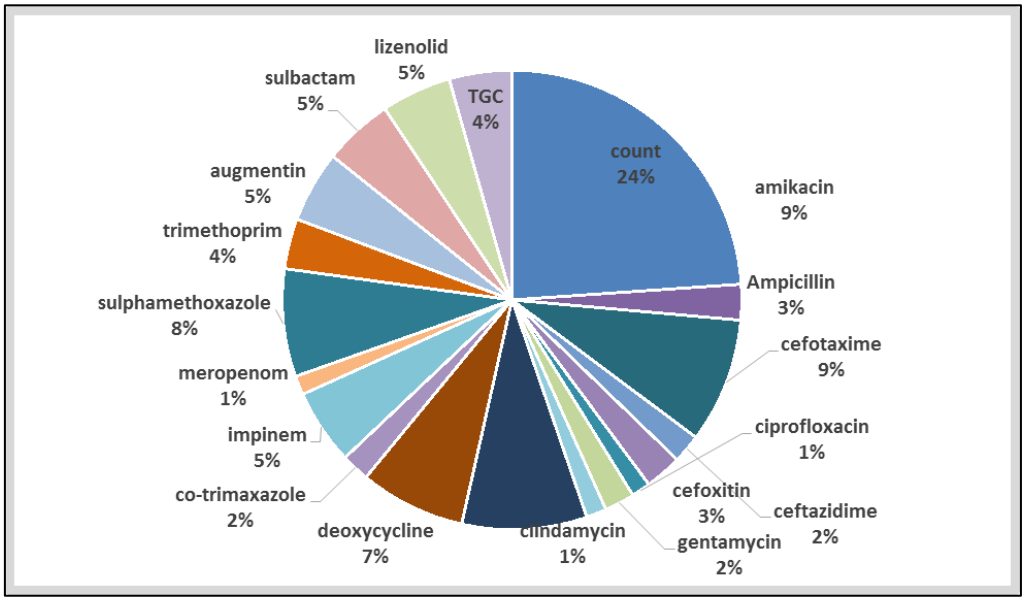

Fig. 4: Sensitivity testing of *Klebsiella* spp. against selected antibiotics.

As for *Klebsiella* spp. out of 2111 isolates 76 % were found multidrug-resistant with the highest resistance to amikacin (9 %) and least sensitive to clindamycin and ciprofloxacin (1%)

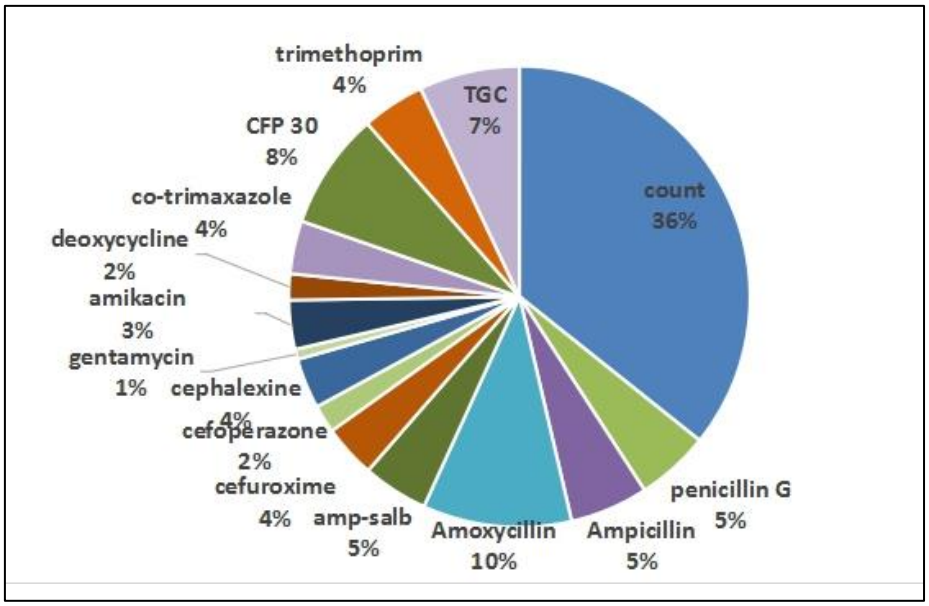

Fig. 5: Sensitivity testing of *E coli* against selected antibiotics.

Out of 2245, *E coli* strains 64 % were found resistant to various antibiotics with the highest resistance to amoxicillin (10%) and least resistance to gentamycin (1%)and cefoperazone (2%)

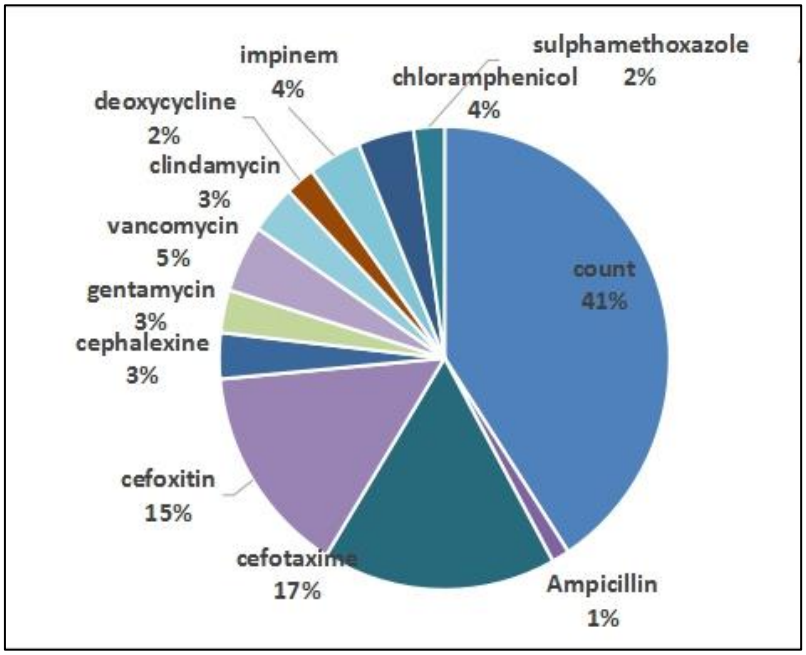

Fig. 6: Sensitivity testing of *Acinetobacter* spp. against selected antibiotics.

On testing *Acinetobacter* out of 2125 isolates, 59% were resistant to various antibiotics with the highest resistance to cefotaxime (17%) and least resistant to ampicillin (1%) and sulphamethoxazole (2%)

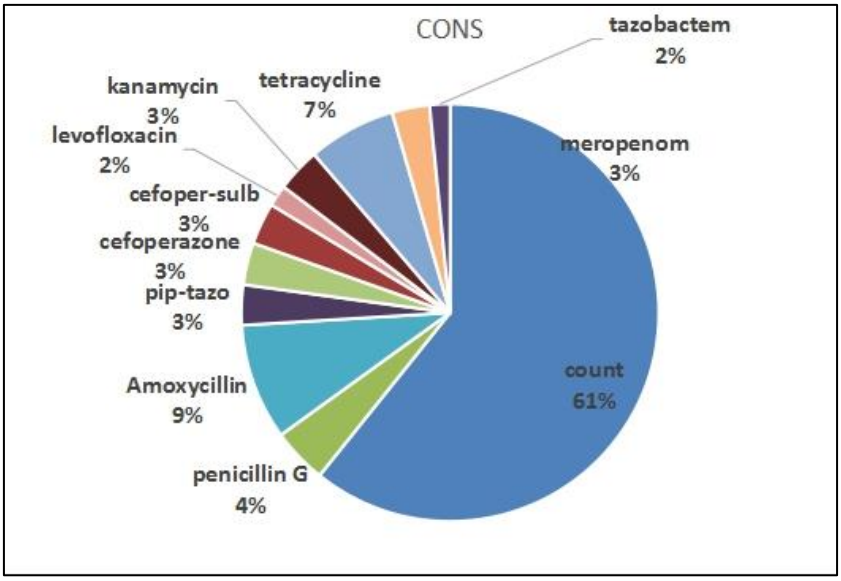

Fig. 7: Sensitivity testing of CoNS against selected antibiotics

As for CoNS out of 4569 isolates, 39% were resistant to various antibiotics with the highest resistance to cefotaxime (17%) and least resistance to ampicillin (1%) and sulphamethoxazole (2%)

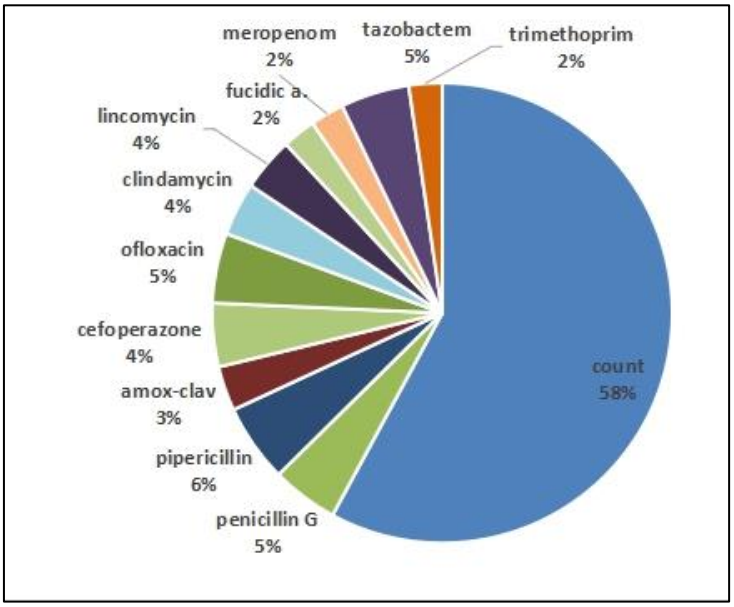

Fig. 8: Sensitivity testing of *Providencia* against selected antibiotics.

On testing *Providencia* sensitivity out of 3065 isolates, 42% were found resistant to various antibiotics with the highest resistance to piperacillin (6%) and least resistance to meropenem, fusidic acid, and trimethoprim (2%) against various antibiotics

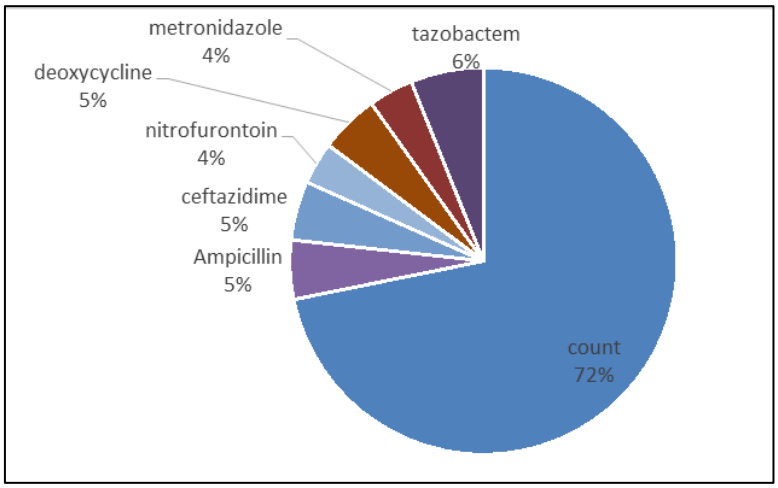

Fig. 9: Sensitivity testing of *Stenotrophomonas maltophilia* against selected antibiotics.

And finally *Stenotrophomonas maltophilia* out of 3400 isolates, 28% were found resistant to various antibiotics with the highest resistance to tazobactam (6%) and the lowest resistance to metronidazole (4%)

DISCUSSION

Surgical site infection has been a major problem facing humanity a long time ago that urges the need for medicine development to reduce that problem.

Also, surgical site infections are one of the main causes of the high and prolonged cost of hospital stay which draws attention to finding a solution to that everyday health problem to minimize the possible complications for the long hospitalization 11,12.

Our research aims to introduce current views on the possible pathogenic cause of surgical site infection and to provide the antibiotic resistance pattern for those pathogens aiming to avoid recurrent bacterial resistance health problems that face the surgery sector upon the management of cases.

Our study was carried on 23040 samples from suspected SSIs that were analyzed for isolation and

identification of bacteria and antimicrobial susceptibility testing.

Mean age of 32.26 (SD=14.45) years was recorded from 1 year to 85 years. The mean ages of male and female patients were 35.1 (SD=15.8) and 30.78 (SD=12.4) years, respectively. A total of (62.2%) samples were from females and (33.8%) were from male patients with a male to female ratio of 1:1.96.

The ratio of female to male ratio was recorded as 2:1, where the age group between 26 to 44 years showed the highest isolation rate.

MRSA was the most predominant pathogen isolated from wound samples with a prevalence of 27% counting 7600 strains out of 20737 strains followed by CoNS accounting for 16%, *Pseudomonas, Stenotrophomonas maltophilia* resembles 12% and the least prevalence to *Providencia, Acinetobacter, Ecoli, and Klebsiella* respectively.

The wound pathogens isolation rate in this study was 23.7% which is relatively lower than the rates reported from Egypt11,12. However, the rate was higher than in other studies13,14.

MRSA was the most common pathogen isolated from wound samples with a prevalence rate of 27% counting 7600 strains out of 20737 strains followed by CoNS accounting for 16%, *Pseudomonas, Stenotrophomonas maltophilia* resembles 12% and the least prevalence to *Providencia, Acinetobacter, Ecoli, and Klebsiella* respectively. The rates of isolated pathogens in this study were comparable to the rates documented previously. However, the rates were lower than other reports that stated a rate of 56% of MRSA prevalence in 250 cases

as well as the prevalence of *E coli* in 23% of the same sample as a post-surgical infection cause in one of the Indian hospitals11-13.

Gram-positive bacteria were predominantly causative agents for SSI than Gram-negative bacteria and this finding is in agreement with the findings of previous studies14-16.

Statistically, a significant difference was observed as the majority of the pathogens were isolated from females (P<0.001).

Gender differences in SSI exist and are procedure-specific. The underlying mechanisms need to be further elucidated so that targeted measures for the prevention of SSI can be developed.

One of the explanations stated that hormones may play a role in defining proper immune response where females have eminent cell-mediated immune responses compared with males owing to their low testosterone levels 17.

Risk factors such as age, diabetes, and smoking status are commonly accounted for in the literature, but few studies address gender differences 17.

Regarding classification according to the operation site, in abdominal surgery women had a lower rate of SSI (SSI/100 procedures) than men (1.92 vs. 3.37; $p < 0.001$).

In contrast to orthopedic and vascular surgery, gender-specific differences were not found, while women had a higher risk for SSI in cardiac surgery (4.50 vs. 2.02; $p < 0.001$).

Isolated pathogens showed differences for sensitive MRSA and *Pseudomonas aeruginosa*, which were more frequent in women (both $p = 0.007$), while CoNS occurred more often in men (17.8 vs. 13.0%; $p < 0.001$).

Wound pathogens were more prevalent in reproductive age groups than others with statically significant association (P=0.011). This finding was in agreement with the results of a study done in Switzerland which was carried on 76 patients where they found 70% of surgical site infection cases age range between 19 to 45 years old 20.

MRSA was the most frequently isolated bacterial isolates, found to be highly resistant to penicillin G . This result is similar to the result documented in Egypt 18-19 and has no resistance to linezolid and cefepime 30 17.

Pseudomonas isolates 59 % were found resistant to various antibiotics with the highest resistance to oxacillin. These rates are higher than those reported from Egypt12-13 where a study was carried on female patients post cesarian section and reported 23% *Pseudomona*s cases out of 68 patients, while another study in Norway reported 11% only out of 140 cases in one of the hospitals 23.

As for *Klebsiella*, 76 % were found resistant to various antibiotics. This rate is lower than reported in other researchers who documented 89% of their sample size had *Klebsiella* MDR strains 16,17.

Increasing drug resistance to these and other antimicrobials has been documented in previous studies11, 22.

Linezolid was found to be effective against MRSA and *Pseudomona*s. High rates of sensitivity to cpf-30ug24, Tazobactem21,24 and have been documented from earlier studies.

In this study, antimicrobial resistance with a percentage of 74.9%. was recorded to more than one antimicrobial agent. A previous study in Italy has demonstrated a comparable result 22 with the prevalence of 65% of their sample size had shown resistance to more than one antimicrobial agent.

Conclusion and recommendations

Our results showed SSI high prevalence in all age groups with the most sensitivity recorded was to Linezolid, clindamycin, and ciprofloxacin.

In the majority of SSI cases, the main source is the native flora of the patient's skin.

Diabetes, cigarette smoking, obesity, and gender have shown a significant, independent correlation for SSI prediction.

This result recommends using the formal antimicrobials for empirical treatment of SSI if needed with a continuous urge to periodic monitoring of etiology and drug susceptibility for proper orientation of the bacterial antimicrobial changeable pattern.

This manuscript has not been previously published and is not under consideration in the same or substantially similar form in any other reviewed media. I have contributed sufficiently to the project to be included as author. To the best of my knowledge, no conflict of interest, financial or others exist. All authors have participated in the concept and design, analysis, and interpretation of data, drafting and revising of the manuscript, and that they have approved the manuscript as submitted.

REFERENCES

1. Hassan E, Matthew A, Peter A, Vanessa C, Jeffrey E . Decreasing Surgical Site Infections in Plastic Surgery: A Systematic Review and Meta-analysis of Level1 evidence. Aesthet Surg J. 2021 Jun 14;41(7): NP948-NP958. DOI: 10.1093/asj/sjab119.
2. Kirkland KB, Briggs JP, Trivette SL, Wilkinson WE, Sexton DJ. The impact of surgical-site infections in the 2019s: attributable mortality, excess length of hospitalization, and extra costs. Infect Control Hosp Epidemiol. 2019;20(11):725–30
3. De Lissovoy G, Fraeman K, Hutchins V, Murphy D, Song D, Vaughn BB.Surgical site infection: incidence and impact on hospital utilization and treatment costs.Am J Infect Control 2019;37(5):387-397. DOI: https://doi.org/10.1016/j.ajic.2018.12.010. Epub 2019 Apr 23.
4. Ze Li, Hui Li, Pin Lv, Xingang Peng, Changliang Wu,.Prospective multicenter study on the incidence of surgical site infection after emergency abdominal surgery in China. Scientific Reports volume 11, Article number: 7794 (2021)
5. Bratzler DW, Dellinger EP, Olsen KM, et al. Clinical practice guidelines for antimicrobial prophylaxis in surgery. Am J Health Syst Pharm. 2017;70:195e283.
6. Mangram AJ, Horan TC, Pearson ML, et al. Guideline for prevention of surgical site infection, 2019. Infect Control Hosp Epidemiol. 2019;20:247e278.
7. Pauline A, Thanh-L, Patrick D, Gregor J, and JonA. Surgical Site Infections Are Associated With Higher Blood Loss and Open Access in General Thoracic Practice. Front. Surg., 25 June 2021 | https://doi.org/10.3389/fsurg.2021.656249
8. Murray BW, et al. The impact of surgical site infection on the development of incisional hernia and small bowel obstruction in colorectal surgery. Am J Surg. 2016;202(5):558–60.
9. Cheesbourgh M. Medical laboratory manual for tropical countries. 2nd ed. England: Butterworth-Heineman Ltd; 2016.
10. Bauer AW, Kirby WMM, Sherris JC, Turck M. Antibiotic susceptibility testing by standard single disc method. Am J Clin Pathol. 1966;45:493–496.
11. Mu Y, Edwards JR, Horan TC, Berrios-Torres SI, Fridkin SK. Improving risk-adjusted measures of surgical site infection for the National Healthcare Safety Network.InfectControlHospEpidemiol. 2011;32(10):970–986. https://www.cdc.gov/nhsn/pdfs/datastat/ssi_modelpaper.pdf
12. Medhat M A, Alice ER, AneesaMK, ImanE, MarwaKH. An Assessment Scale for Patients with Postoperative Superficial Incisional Surgical Site Infection: a Cross-Sectional Study. Indian J Surg. 2018 Jun; 80(3): 259–268. Published online 20168Nov 12. DOI: 10.1007/s12262-016-1566-y
13. Diah RH, Mohammad H, Detty SN, Katharina L, Erika O, Cochrane Pregnancy and Childbirth Group, Skin preparation for preventing infection following cesarean section Cochrane Database Syst Rev. 2018 Oct; 2018(10): CD007462. Published online 2018 Oct 22. DOI: 10.1002/14651858.CD007462.pub4
14. Bruke B. Billoro, Mengistu H. Nunemo, Seid E. Gelan. Evaluation of antimicrobial prophylaxis use and rate of surgical site infection in the surgical ward of Wachemo University Nigist Eleni Mohammed Memorial Hospital, Southern Ethiopia: prospective cohort study. BMC Infect Dis. 2019; 19: 298. Published online 2019 Apr 2. DOI: 10.1186/s12879-019-3895-5
15. Ahmed RA, Khaled G, Emad MI, Mo'men MM, Eissa MK, Ayman MY. Intra-abdominal infection (IAI) following cesarean section: a retrospective study in a tertiary referral hospital in Egypt. BMC Pregnancy Childbirth. 2019; 19: 234. Published online 2019 Jul 8. DOI: 10.1186/s12884-019-2394-4
16. Mihretu M, Kiber T, Tewodros S, Mengstu M. Surgical site infection and associated factors among women who underwent cesarean delivery in Debretabor General Hospital, Northwest Ethiopia: a hospital-based cross-sectional study. BMC Pregnancy Childbirth. 2019; 19: 317. Published online 2019 Aug 29. DOI: 10.1186/s12884-019-2442-0

17. Corinna LA,* Carolin MR, Stoil T,Beate R, Alexander K,. Gender-Specific Differences in Surgical Site Infections: An Analysis of 438,050 Surgical Procedures from the German National Nosocomial Infections Surveillance System
18. Harshila P, Hanane K, Douglas Gi, Sharon W, Holly Yu. The burden of Surgical Site Infections Associated with Select Spine Operations and Involvement of ***Staphylococcus aureus.*** Surg Infect (Larchmt) 2017 May 1; 18(4): 461–473. Published online 2017 May 1. DOI: 10.1089/sur.2016.186
19. Mark M, Susan J, Thomas P, Peter B, Dion G,. Surgical site infection and costs in low- and middle-income countries: A systematic review of the economic burden 2021
20. Abstracts from the 5th International Conference on Prevention & Infection Control (ICPIC 2019): Geneva, Switzerland. 10-13 September 2019. Antimicrob Resist Infect Control. 2019; 8(Suppl 1): 148. Published online 2019 Sep 9. DOI: 10.1186/s13756-019-0567-6
21. Boonchan T, Wilasrusmee C, McEvoy M, Attia J, Thakkinstian A. Network meta-analysis of antibiotic prophylaxis for prevention of surgical-site infection after groin hernia surgery. Br J Surg. 2017 Jan; 104(2): e106–e117. Published online 2017 Jan 25. DOI: 10.1002/bjs.10441
22. Gomes AEB, Cavalcante RS, Pavan ECP, Freitas ES, Fortaleza CMCB. Predictive factors of post-discharge surgical site infections among patients from a teaching hospital. Rev Soc Bras Med Trop. 2016;47(2):235–238.
23. Anderson DJ, Podgorny K, Berríos-Torres SI, Bratzler DW, Dellinger EP, Greene L, et al. Strategies to prevent surgical site infections in acute care hospitals. Infect Control Hosp Epidemiol. 2016;35(s2):s66–s88.
24. W. Alfouzan, M. Al Fadhli, N. Abdo, W. Alali, R. Dhar. Surgical site infection following cesarean section in a general hospital in Kuwait: trends and risk factors. Epidemiol Infect. 2019; 147: e287. Published online 2019 Oct 10. DOI: 10.1017/S0950268819001675