Content available at: iponlinejournal.com

IP International Journal of Medical Microbiology and Tropical Diseases

Journal homepage: www.innovativepublication.com

Original Research Article

A study of aerobic bacteriological profile of surgical site infections in a tertiary care hospital

Mythri B.A[1], Mahesh Kumar S[1,*], Asha B Patil[1], Gana Pramod[1], Akshata Uppar[1]

[1] *Dept. of Microbiology, Karnataka Institute of Medical Sciences, Hubballi, Karnataka, India*

ARTICLE INFO

Article history:
Received 06-02-2020
Accepted 23-03-2020
Available online 26-04-2020

Keywords:
Surgical Site Infections
Antibiotic Resistance
MRSA
Nosocomial infection
Post-operative wound infection
ESBL.

ABSTRACT

Introduction: Surgical Site Infection (SSI) is the leading cause of all Healthcare Associated Infections in developing countries. SSIs are a frequent cause of morbidity and mortality among inpatients of hospitals. For proper management of the patients it is very essential to know which pathogen has caused the infection and also its antibiotic susceptibility.

Objectives: 1. To determine the aerobic bacteriological profile, 2. To know the antibiotic susceptibility patterns of the bacterial isolates.

Materials and Methods: This retrospective study was carried out on 320 culture positive swabs, tissue & discharge samples received over a one year period from January 2019 to December 2019 in the department of Microbiology from Surgery, Orthopaedics & Obstetrics and Gynaecology (OBG) departments. Data analysis was done on the microbiological profile of the aerobic isolates and its antibiotic susceptibility pattern.

Results: Among the 320 samples monomicrobial growth was seen in 316 (98.75%) samples whereas polymicrobial growth was seen in 04 samples (1.25%). Out of the 324 isolates Gram negative bacilli constituted 239(73.76%) and Gram positive cocci constituted 26.24%. The predominant isolate in the study was *Escherichia coli* 101(31.17%) followed by *Staphylococcus aureus* 68(20.98%).The other major isolates were Citrobacter spp. 48(14.81%), *Klebsiella spp.* 41(12.65%), *NFGNB* 24(7.41%), *CONS* 17(5.25%) and Pseudomonas aeruginosa 14(4.31%).

Conclusion: This study shows that *Escherichia coli* and *Staphylococcus aureus* are the commonest organisms associated with the surgical site infection. Simple measures like appropriate hand hygiene can go a long way in bringing down the rate of SSI as well as slowing down the further spread of the resistant hospital strains.

1. Introduction

Health care-associated infections (HAI) are acquired by patients during the process of receiving care and represent the most common adverse event affecting patient safety worldwide.[1] The HAIs can be classified into central line-associated bloodstream infections, catheter-associated urinary tract infections, surgical site infections and ventilator-associated pneumonia.[2] The term "surgical wound infection" was replaced by "surgical-site infection" by the Surgical Wound Infection Task Force in the year 1992.[3] Surgical Site Infection(SSI) by definition refers to an infection which occurs within 30 days after the surgery or within 1 year when an an implant is left in place after the surgery and involving the incision or deep tissues at the operated site or infections involving organ or body space other than the incision, which was opened or manipulated during an operation.[4] SSIs are classified by The Centre for Disease Control (CDC), USA into superficial incisional SSI, deep incisional SSI, and organ/space SSI .3 Recent work by the World Health Organization (WHO) shows that SSI affects up to one third of patients who have undergone a surgical procedure is in low- and middle-income countries where the endemic burden of HAI is also significantly

* *Corresponding author*.
E-mail address: maheshshankar1973@gmail.com (M. Kumar S).

https://doi.org/10.18231/j.ijmmtd.2020.009

higher than in high-income nations. 1 SSI is the leading cause of all HAIs in developing countries.[5]

SSIs are a frequent cause of morbidity and mortality among inpatients of hospitals.[6] SSIs lead to an increased economic burden on the healthcare systems, including additional postoperative hospital stay and costs.[7] According to the WHO and the CDC, SSIs are considered as one of the most preventable HAIs.[8] Despite usage of prophylactic antibiotics both pre- and postoperatively along with various other preventive measures such as sterilization methods, use of barriers, improved operating room ventilation, improved surgical techniques SSIs are still a serious problem among postoperative patients.[5] This has been mainly attributed to the increasing emergence of antibiotic resistance due to irrational use of antibiotics, this inappropriate choice of antibiotics increases selection pressure favouring emergence of pathogenic drug resistant bacteria.[5] The incidence of postoperative SSI is seen to vary widely between patients, procedures, surgeons, hospitals and geographical locations.[9] In developing countries the problem is more complicated due to overcrowded hospitals, poor infection control practices, and inappropriate use of antibiotics.[10] Due to lack of standardized diagnosis, absence of surveillance and notification system in many developing countries there is lack of data on the global epidemiology of SSI.[5]

Usually these infections are caused either by exogenous and/or endogenous micro organisms which enter the operative wound either during the surgery causing primary infection or after the surgery leading to secondary infection.[11] The risk of SSIs are also significantly influenced by a number of patient related factors, procedure related factors , another important factor is the virulence and the invasiveness of the organism involved.[11] Numerous bacteriological studies reveal that gram-positive and gram-negative bacteria both play a role in the infection of surgical wounds.[3] The most common among these bacteria is *Staphylococcus aureus* (31.58%) followed by *Klebsiella pneumoniae* (26.31%), *Pseudomonas aeruginosa* (15.79%), *Escherichia coli* (10.53%), *Acinetobacter* (10.53%) and *Proteus mirabilis* (5.26%). 3 Most of these bacteria are multi-drug resistant posing a major problem for surgeons. 3 For proper management of the patients it is very essential to know which pathogen has caused the infection and also its antibiotic susceptibility.[12] Especially in the situation where empirical treatment has to be started without the benefit of the Gram-stain or culture and sensitivity results, knowledge regarding the most likely organisms and their prevailing antibiotic sensitivity pattern will be helpful.[13]

Therefore the information regarding the common organisms causing SSI and their antibiotic susceptibility pattern will be helpful in choosing the most effective antibiotics early on and thereby help in preventing further life-threatening infections. Given this scenario where the vital knowledge of the most probable microorganism and also their existing antibiotic susceptibility pattern will be helpful in preventing SSI. The present study was undertaken to know about the aerobic bacteriological profile and antibiotic susceptibility pattern of surgical site infections in our hospital.

2. Materials and Methods

This retrospective study was carried out on 320 culture positive samples received over a one year period from January 2019 to December 2019 in the department of Microbiology from Surgery, Orthopaedics & Obstetrics and Gynaecology (OBG) departments of KIMS Hospital. Tissue, Discharge and swabs received from the surgical wounds of patients were analysed. Microbiological profile of the aerobic isolates and its antibiotic susceptibility pattern was collected from the maintained records in the department of microbiology and analysis was done. The samples were processed as per standard microbiological methods. Two swabs were collected. One swab used for smear preparation and Gram stain. The second swab was used for aerobic bacterial culture by inoculation on various culture media like blood agar, chocolate agar, MacConkey agar, thioglycollate broth etc. The isolates were identified by relevant biochemical tests.[14] The isolates were subjected to antibiotic susceptibility testing on Mueller-Hinton agar plates by Kirby-Bauer disc diffusion method, as per CLSI guidelines. Screening for *Methicillin Resistant Staphylococcus Aureus (MRSA)* was done using cefoxitin (30 μg) disc. Resistance to ceftazidime (30 μg) disk was used as a screening method for detection of Extended Spectrum Beta Lactamase (ESBL) confirmed by double disk synergy test.[15]

3. Results

From January 2019 to December 2019 combined from departments of General Surgery, Orthopaedics & OBG samples from 320 patients with SSIs were processed to yield a total of 324 aerobic bacterial isolates. Among the 320 patients with SSIs 171(53.44%) were females & 149(46.56%) were males. Out of the 320 samples monomicrobial growth was seen in 316 (98.75%) samples whereas polymicrobial growth was seen in 04 samples (1.25%). Out of the 324 isolates Gram negative bacilli constituted 239(73.77%) of the isolates with Escherichia coli predominating. The Gram positive cocci constituted 26.23% with *Staphylococcus aureus* 68(20.98%) predominating followed by *Coagulase Negative Staphylococcus* (CONS) which accounted for 17(5.25%). Organisms isolated are seen inTable 1.

Department wise the number of cases 101(31.17%) were 138(42.6%) from General Surgery department, 113(34.8%) were from OBG department & 73(22.6%) were from Orthopaedics department. Among the 138 isolates from Surgery department the predominant isolate was *Escherichia coli* with 67(48.6%) & this accounts for 66.3% of the total *Escherichia coli* isolates in the entire study. Out of the 113 isolates from OBG department the predominant isolate was *Staphylococcus aureus* with 38(33.6%) & accounting for 55.9% of the total *Staphylococcus aureus* isolates across all 3 departments. Out of the 73 isolates from Orthopaedics department the predominant isolate was *Staphylococcus aureus* with 19(26%) & accounting for 27.9% of the total *Staphylococcus aureus* isolates. Department wise distributions of isolates are seen in Table 2.

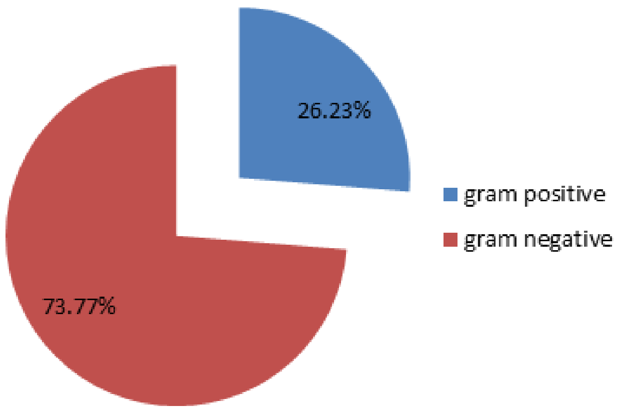

Fig. 1: Distribution of gram positive and gram negative organisms isolated in the study

Antibiotic susceptibility pattern- In this study 14(20.6%) of the *Staphylococcus aureus* were found to be methicillin resistant. Of the *Staphylococcus aureus* isolates 32% were resistant to ampicillin, 28% were resistant to amoxy-clavulanic acid, 35.3% were resistant to erythromycin, 60.3% were resistant to ciprofloxacin, , and 81% were sensitive to cefepime, 94% were sensitive to vancomycin, 97% were sensitive to amikacin, 99% were sensitive to linezolid & 100% were sensitive to gentamicin. Four (24%) isolates of *CONS* were found to be methicillin resistant. The resistance rates for *CONS* were 76% were resistant to ampicillin, 35% were resistant to ciprofloxacin, 53% were resistant to cefepime and, 82% were sensitive to erythromycin, 94% were sensitive to amikacin, 100 % were sensitive to vancomycin & linezolid.

Of the *Escherichia coli* isolates 88% were resistant to ampicillin,53% were resistant to amoxy-clavulanic acid, 88% were resistant to ciprofloxacin, 84% were resistant to cephazolin,68% were resistant to cephaperazone, 57% were resistant to cefepime, 57% were sensitive to gentamicin, 80% were sensitive to amikacin, 95% were sensitive to piperacillin & 100% were sensitive to imipenem. Out of 101 *Escherichia isolates* 82(81.2%) were found to be ESBL (Extended Spectrum Beta Lactamase) producers. Among the *Citrobacter species* 96% were resistant to ampicillin, 71% were resistant to amoxy-clavulanic acid, 48% were resistant to ciprofloxacin, 90% were resistant to cephazolin,75% were resistant to amikacin, 50% were resistant to cefepime, 75% were sensitive to gentamicin, 63% were sensitive to cephaperazone, 54% were sensitive to piperacillin. Out of 48 *Citrobacter* isolates 37(77.1%) were found to be ESBL producers. Among *Klebsiella species* 85% were resistant to amoxy-clavulanic acid, 66% were resistant to ciprofloxacin,76% were resistant to cephazolin, 68% were resistant to cephaperazone, 44% were resistant to cefepime, 93% sensitive to ampicillin 66% were sensitive to gentamicin, 71% were sensitive to amikacin, 59% were sensitive to piperacillin & 100% were sensitive to imipenem. Out of 41 *Klebsiella* isolates 29(70.7%) were found to be ESBL producers.

Among the *NFGNB*(Non Fermenting Gram Negative Bacilli) 63% were sensitive to ampicillin, 96% were sensitive to amoxy-clavulanic acid, 71% were sensitive to ciprofloxacin, 42% were resistant to cephazolin, 50% were resistant to cephaperazone, 42% were resistant to cefepime, 87% were sensitive to gentamicin, 67% were sensitive to amikacin, & 63% were sensitive to imipenem.

Among *Pseudomonas aeruginosa* 43% were resistant to piperacillin, 29% were resistant to ciprofloxacin, 28% were resistant to ceftazidime, 79% were sensitive to ofloxacin, and 93% were sensitive to levofloxacin. 57% were sensitive to gentamicin, 86% were sensitive to aztreonam & amikacin, 95% were sensitive to piperacillin & 100% were sensitive to piperacillin-tazobactum & imipenem.

Among *Enterobacter species* 100% were sensitive to ampicillin, amoxy-clavulanic acid, cefotaxime, ceftazidime, cephaperazone & ciprofloxacin, 71% were sensitive to ceftriaxone, 71% were resistant to piperacillin, & 86% were resistant to amikacin. *Proteus species* 100% were sensitive to ampicillin & amoxy-clavulanic acid, 67% were sensitive to ciprofloxacin & ceftriaxone, 100% were resistant to cephaperazone. Among *Providencia species* 100% were sensitive to piperacillin with tazobactum. 100% were resistant to ceftriaxone, ceftazidime, amikacin, ciprofloxacin & cephazolin.

4. Discussion

The results of this study provide an overview of the current microbiology, both the aerobic bacteriological profile and also the present antibiotic susceptibility pattern in SSIs in our setup. From the 320 patients in our study we obtained 324 bacterial isolates.

In this study majority of the infections were monomicrobial infections (98.75%) as in other studies. Polymicrobial infections (1.25%) were of a small proportion only which corresponds to various other studies where monomicrobial infections were dominant.[11,12,16,17]

Table 1: List of organisms isolated in the study

No.	Organism	Number(n)	Percentage (%)
1.	*Escherichia coli*	101	31.17
2.	*Staphylococcus aureus*	68	20.98
3	*Citrobacter species*	48	14.81
4	*Klebsiella species*	41	12.65
5	*NFGNB*	24	7.41
6	*CONS*	17	5.25
7	*Pseudomonas aeruginosa*	14	4.31
8	*Enterobacter species*	7	2.16
9	*Proteus species*	3	0.92
10	*Providencia species*	1	0.3
	Total	324	100

NFGNB- Non Fermenting Gram Negative Bacilli CONS- Coagulase Negative Staphylococci

Table 2: Department wise distribution of isolation of the bacteria

Organism	Surgery	OBG	Orthopaedics	Total
Escherichia coli	67(48.6%)	25(22.1%)	9(12.3%)	101
Staphylococcus aureus	11(8%)	38(33.6%)	19(26%)	68
Citrobacter species	25(18%)	13(11.5%)	10(13.7%)	48
Klebsiella species	20(14.5%)	8(7.1%)	13(17.8%)	41
NFGNB	6(4.3%)	10(8.9%)	8(11%)	24
CONS	3(2.2%)	13(11.5%)	1(1.4%)	17
Pseudomonas aeruginosa	4(2.9%)	4(3.5%)	6(8.2%)	14
Enterobacter species	1(0.7%)	0(0%)	6(8.2%)	7
Proteus species	1(0.7%)	1(0.9%)	1(1.4%)	3
Providencia species	0(0%)	1(0.9%)	0(0%)	1
Total	138(100%)	113(100%)	73(100%)	324

NFGNB- Non Fermenting Gram Negative Bacilli
CONS- Coagulase Negative Staphylococci

In this study overall predominance of gram negative bacilli was seen with 73.77%, correlating with another study where gram negative bacilli predominated with 73.1%.[17] This could be attributed to diverse habitat of Gram negative bacteria including inanimate surfaces in hospitals, multidrug resistant patterns portrayed and possible contamination from intestinal tract during surgery.[5] This is also in concordance with various other studies where gram negative bacteria were dominant.[9,10,16] A systematic review also concluded that surgical site infections are caused predominantly by gram negative bacilli and found *Escherichia coli* as the common predominant isolate.[18]

In the present study, out of 320 culture positive samples, 149(46.56%) specimens were from male patients and 171 (53.44%) were from female patients. The infection was found to be higher in female patients as in another study which concluded that it was statistically insignificant.[19]

In our study Escherichia coli was the predominant isolate being isolated from 101 patients constituting 31.2% of the isolates. Among the gram negative bacilli *Escherichia coli* was followed by *Citrobacter species* n=48(14.8%), *Klebsiella species* n=41 (12.7%) and *NFGNB* n=24 (7.4%). *Escherichia coli* was the predominant isolate in studies by several authors with isolation rates of 23.1%17, 33.33%7, 42.3%20 & 58%21.

In the present study the second most common isolate was *Staphylococcus aureus* n=68(21%). This correlates with other studies where the isolation rates for *Staphylococcus aureus* were as follows…21.51%5, 26.2%19, 27.7%10, 29%12, 29.16%13. Among these studies few have *Staphylococcus aureus* as their predominant isolate.[10,12,13,19]

CONS was isolated from n=17 (5.3%) which correlates with other studies where the isolation rates for *CONS* were as follows…3.8%17, 7.53%5 & 8.64%16. Few other studies have shown higher rates of isolation of *CONS*. 19.8 % 22, 21.4 %.[19]

The other dominant organisms in our study were *Klebsiella species, Citrobacter species, NFGNB* and P*seudomonas aeruginosa. Klebsiella species* was isolated from n=41(12.65%). This correlates with other studies where the isolation rates for *Klebsiella species* were as follows...12.5%17 & 11.7%12. The various rates in other studies are 8.5%23, 20.4%24, 27.8%.6 Few studies have shown *Klebsiella* to be predominant isolate with 29.03 %5 & 55 %25. *Citrobacter species* was isolated from n=48(14.81%) corresponding to another study with an isolation rate of 16 %.6 *NFGNB* was isolated from n=24(7.41%). It is one of the lesser common isolates in our study.

Pseudomonas aeruginosa was isolated from n=14(4.81%) corresponding to various other studies with isolation rates of 5.1 % 9, 5.8 %.[17] In one particular study *Pseudomonas* was a predominant isolate with 29.31%.[20] *Enterobacter species* was isolated from n=7(2.16%). Proteus species was isolated from n=3(0.92%), Providencia species was isolated from n=1(0.3%) Department wise as in the overall study, *Escherichia coli* was the predominant isolate in General Surgery department, whereas in Orthopaedics & OBG departments *Staphylococcus aureus* was the predominant isolate. This may be due to the variation in nature of surgeries. In General Surgery due to intra-abdominal & rectal surgeries endogenous flora may be the main contaminant due to which *Escherichia coli* could be predominant. In Orthopaedics department based on the nature of surgeries accompanied with the usage of implants, skin contaminants are more common due to which Staphylococcus aureus may predominate. In a study done on implant surgeries in Orthopaedics department *Staphylococcus aureus* was the predominant isolate with 44.4%.27 In OBG department, in our study *Staphylococcus aureus* was the predominant isolate with 33.6% & accounted for 55.9% of total isolated Staphylococci corresponding with a study where *Staphylococcus aureus* was the predominant isolate with 36.6% & accounted for 57.7% of total isolated *Staphylococci*.[21]

In our study 21% of the *Staphylococcus aureus* were methicillin resistant similar to another study which reported that 25% of Staphylococcus aureus isolated from cases of surgical site infection were methicillin resistant.[20] The various findings about *MRSA* isolation rates by other authors are 10.5%17, 15.7%11, 39.7%12. A few others have very high rates of *MRSA* like 54.4%28 & 86.4%.[9]

In our study the rate of methicillin resistance among *CONS* was 24% corresponding to another study where the rate of methicillin resistance among *CONS* was 21.05% 16.

The overall rate of methicillin resistance among the S*taphylococci* was found to be 21.2%.

Among *Escherichia coli* 81.1% were found to be ESBL producers & among *Klebsiella species* 70.7% were found to be ESBL producers. Overall among *Escherichia coli* & *Klebsiella* ESBL producers were found to be 71.1%, corresponding to another study with an ESBL rate of 64 %.[22]

For *Staphylococcus aureus* amikacin, gentamicin, cefepime, linezolid & vancomycin were found to be highly effective antibiotics; a pattern of high resistance was observed against the penicillins & fluoroquinolones. The degree of resistance was comparably higher among the gram negative bacilli showing high resistance against the penicillins, cephalosporins & fluoroquinolones but demonstrated good sensitivity to amikacin, gentamicin & carbapenems. Amikacin, piperacillin-tazobactum, aztreonam & carbapenems were found to be the most effective antibiotics for *Pseudomonas* species.

5. Conclusion

This study shows that *Escherichia coli* and *Staphylococcus aureus* are the predominant organisms associated with surgical site infections. A very high rate of ESBL producers was observed. Overall the gram negative bacilli showed a high rate of drug resistance against the commonly used antibiotics. Several measures can be taken to decrease the antibiotic resistance like infection control measures, restricting the use of the broad spectrum antibiotics, rational use of antibiotics, prescribing only specific antibiotic therapy after evaluating the sensitivity pattern of isolates and cycling of antibiotics. Simple measures like appropriate hand hygiene can go a long way in bringing down the rate of SSI as well as slowing down the further spread of the resistant hospital strains.

6. Acknowledgements

Authors acknowledge the immense help received from the scholars whose articles are cited and included in references of this manuscript. The authors are also grateful to authors / editors / publishers of all those articles, journals and books from where the literature for this article has been reviewed and discussed.

7. Conflicts of interest

None

8. Source of funding

None.

References

1. World Health Organisation. Global guidelines for the prevention of surgical site infection. Geneva,Switzerland; 2016.
2. Centers for disease control and prevention; 2020. Available from: https://www.cdc.gov/hai/infectiontypes.html.
3. Sattar F, Sattar Z, Zaman M, Akbar S. Frequency of Post-operative Surgical Site Infections in a Tertiary Care Hospital in Abbottabad, Pakistan. *Cureus*. 2019;12(3).
4. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Hospital Infection Control Practices Advisory Committee. Guideline for prevention of surgical site infection. *Infect Control Hosp Epidemiol*. 1999;20(4):247–280.
5. Hope D, Ampaire L, Oyet C, Muwanguzi E, Twizerimana H, Apecu RO. Antimicrobial resistance in pathogenic aerobic bacteria causing surgical site infections in Mbarara regional referral hospital, Southwestern Uganda. . *Sci Rep*. 2019;9(1):1–1.
6. Setty NH, Nagaraja MS, Nagappa DH, Giriyaiah CS, Gowda NR. Laxmipathy Naik RD. A study on Surgical Site Infections (SSI) and associated factors in a government tertiary care teaching hospital in Mysore, Karnataka. *Int J Med Public Health*. 2014;4(2):171–175.
7. Kochhal N, Mudey GD, Choudhari SZ. A study of clinico-microbiological profile of surgical site infections in a tertiary care hospital. *Int J Adv Med*. 2019;6(2):324–329.
8. Albishi W, Albeshri MA, Mortada HH, Alzahrani K, Alharbi R, et al. Awareness and Level of Knowledge About Surgical Site Infections and Risks of Wound Infection Among Medical Physicians in King

Abdulaziz University Hospital: Cross-Sectional Study. *Int J Med Res*. 2019;8(1):e12769.

9. Njoku CO, Njoku AN. Microbiological Pattern of Surgical Site Infection Following Caesarean Section at the University of Calabar Teaching Hospital. Open Access Maced. *J Med Sci*. 2019;7(9):1430–1435.
10. Modugula S, Kumari RP, Kumari LR. Aerobic bacteriological profile of surgical site infections with antibiogram. *Int J Adv Res*. 2019;7(2):408–412.
11. Negi V, Pal S, Juyal D, Sharma MK, Sharma N. Bacteriological Profile of Surgical Site Infections and Their Antibiogram: A Study From Resource Constrained Rural Setting of Uttarakhand State, India. *J Clin Diagn Res*. 2015;9(10):17–20.
12. Sudhaharan S, Kanne P, Chavali P, Vemu L. Aerobic bacteriological profile and antimicrobial susceptibility pattern of pus isolates from tertiary care hospital in India. *J Inf Devel Countr*. 2018;12(10):842–848.
13. Mundhada A, Tenpe S. A study of organisms causing surgical site infections and their antimicrobial susceptibility in a tertiary care Government Hospital. *Indian J Pathol Microbiol*. 2015;58(2):195–200.
14. Forbes BA, Sahm DF, Weissfeld AS. Study guide for Bailey & Scott's Diagnostic Microbiology. USA: Mosby; 2007.
15. Wayne PA. Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing; Twenty-seventh Informational Supplement. In: and others, editor. CLSI document ; 2018. p. M100–S23.
16. Kaur K, Oberoi L, Devi P. Bacteriological profile of surgical site infections. *IAIM*. 2017;4(12):77–83.
17. Dessie W, Mulugeta G, Fentaw S, Mihret A, Hassen M, Abebe E. Pattern of Bacterial Pathogens and Their Susceptibility Isolated from Surgical Site Infections at Selected Referral Hospitals, Addis Ababa, Ethiopia. *Int J Microbiol*. 2016;2016:1–8.
18. Purba AKR, Setiawan D, Bathoorn E, Postma MJ, Dik JWH, et al. Prevention of Surgical Site Infections: A Systematic Review of Cost Analyses in the Use of Prophylactic Antibiotics. *FrontiPharmacol*. 2018;9:776.
19. Mulu W, Kibru G, Beyene G, Damtie M. Postoperative nosocomial infections and antimicrobial resistance pattern of bacteria isolates among patients admitted at Felege Hiwot referral hospital, Bahirdar, Ethiopia. *Ethiop J Health Sci*. 2012;22(1):7–18.
20. Kokate SB, Rahangdale V, Katkar VJ. Study of bacteriological profile of post operative wound infections in surgical wards in a tertiary care hospital. *Int J Contemporary Med Res*. 2017;4(1):232–235.
21. Amare B, Abdurrahman Z, Moges B, Ali J. Postoperative Surgical Site Bacterial Infections and Drug Susceptibility Patterns at Gondar University Teaching Hospital, Northwest Ethiopia. *J Bacteriol Parasitol*. 2011;02(08):126.
22. Shah S, Singhal T, Naik R. A 4-year prospective study to determine the incidence and microbial etiology of surgical site infections at a private tertiary care hospital in Mumbai, India. *Am J Infecti Control*. 2015;43(1):59–62.

Author biography

Mythri B.A Associate Professor

Mahesh Kumar S Professor

Asha B Patil Professor and Head

Gana Pramod Post Graduate

Akshata Uppar Senior Resident

Cite this article: Mythri B.A , Kumar S M, Patil AB, Pramod G, Uppar A. **A study of aerobic bacteriological profile of surgical site infections in a tertiary care hospital**. *IP Int J Med Microbiol Trop Dis* 2020;6(1):42-47.