Bacteriological profile and antibiotic sensitivity patterns of aerobic pus isolates: A study conducted in tertiary care hospital of North India

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Abstract
Background: Wound infection is an important cause of morbidity and mortality among hospitalised patients. Therefore knowledge of pathogens causing wound infection is necessary and can be helpful in selection of appropriate antimicrobial therapy. This study was undertaken to identify the bacterial pathogens recovered from infected wounds and characterise their antimicrobial resistance profile.
Materials and Methods: It was a cross-sectional study, carried out for a period of two years, from January 2017 to December 2018, in the Microbiology department of a tertiary care hospital in North India. During this time period all pus/wound swab samples received were analysed for the identification of microorganisms and for the determination of their antibiotic susceptibility. For data analysis SPSS version 17.0 software and MS excel 2007 were used.
Results: Out of total 2516 pus/wound swab samples, 1672(66.45%) were positive for bacterial growth and of these 1672 positive culture, 1312(78.46%) were pure isolates and 360(21.53%) cultures had grown more than one organism (poly-microbial). So a total number of isolates under study was 2032. Of these 2032 aerobic culture isolates, 594(29.23%) were Gram positive cocci and 1438(70.76%) were Gram negative bacilli. The most common pathogen isolated was Escherichia coli (29.23%) followed by Staphylococcus aureus (20.47%), Klebsiella pnuemoniae (12.3%) and Pseudomonas aeruginosa (11.12%). Most of the isolates obtained were multi-drug resistant.
Conclusion: Since the frequency of multiple drug resistance among both gram positive and gram negative bacteria is alarmingly high, therefore periodic monitoring of antimicrobial susceptibility profile of the infectious agents causing wounds infections in hospital settings is needed. This will benefit not only the patient but also assists physician in selection of appropriate chemotherapy.

Keywords: Pus isolates, Bacteriological profile, Antibiotic sensitivity patterns.

Introduction
Pus formation is one of several cardinal indicators of suppurative infections caused by pyogenic bacteria, resulting in aggregation of dead leukocytes, bacteria and tissue debris.[1] Wound is a breach in skin integrity caused due to injury. Exogenous wounds are usually associated with traumatic injuries, burns etc. whereas endogenous wounds and abscesses may be associated with appendicitis, cholecystitis etc.[2] Colonization and proliferation of bacteria in wound may lead to wound infection. Most of the latter are hospital acquired and usually following an invasive procedure or a surgical intervention. Hospital acquired infections are a world-wide in problem being an important cause of morbidity and mortality among hospitalized patients. A WHO sponsored survey showed that the prevalence of nosocomial infections was 3-21% with wound infections accounting for 5-34%.[3]
Therefore the knowledge of infectious agents causing wound infection is necessary for selection of appropriate antimicrobial therapy. Previous data have shown that most common pathogens associated with wound infections are *Staphylococcus aureus, Enterococcus* spp, *Escherichia coli, Klebsiella* spp, *Pseudomonas* spp, *Proteus mirabilis, Candida albicans*.[4,5] The present study was undertaken to know the bacteriological profile and antibiotic susceptibility patterns of pathogens causing pyogenic infections in our hospital in order to help clinician formulate an empirical treatment for the patients.

Aims and Objectives
To identify and characterize aerobic bacterial pus isolates onto specie level
To determine antimicrobial sensitivity patterns of the isolates

Material and Methods
Study Design and Data Collection
It was a cross-sectional study, carried out over a period of two years, from January 2017 to December 2018, in the Bacteriological section of Microbiology department of a tertiary care hospital in North India. During this time period all pus/wound swab samples (n=2516) received for aerobic culture & sensitivity testing, from various clinical departments of the Institute, were include in the study.
Data collection included information about, age & sex of the patients from whom samples were taken, a brief history of illness.

All pus samples were processed as per standard bacteriological techniques for aerobic cultures.[6] They were inoculated on both Blood agar and Mac-Conkey's agar and incubated aerobically for 24-48 hours at 37 degree, before reporting them as sterile. Gram staining was performed on growth obtained in positive cultures. Isolates were identified to specie level by Vitek-2 Compact (Biomerieux) using gram positive, gram negative, and yeast identification cards as per manufacturer's guidelines.

Antimicrobial sensitivity testing was also determined by same system using AST cards. Antibiotic sensitivity results were interpreted as per CLSI guidelines.[7]

Ethical approval: Ethical approval was taken from the ethical committee of the institution**.**

Statistical analysis: SPSS version 17.0 software and MS excel 2007 were used for statistic analysis.

Results

The study comprised of a total 2516 samples of patients with wound infection. Among these, those with positive cultures were 1672 (66.45%) and of these 984 (58.85%) samples were from male patients and 688 (41.15%) from females. Majority of these patients were in the age groups of 20–40 years (Table 1&2, Fig 1&2).

Bacterial Isolates

Out of total 2516 pus/wound swab samples, 1672(66.45%) were positive for bacterial growth and of these 1672 positive culture, 1312(78.46%) were pure isolates and 360(21.53%) cultures had grown more than one organism (poly-microbial). So the total number of isolates under study was 2032 of which 594(29.23%) were Gram positive cocci and 1438(70.76%) were Gram negative bacilli. The most common pathogen isolated was *Escherichia coli* (29.23%) followed by *Staphylococcus aureus (*20.47%), *Klebsiella pnuemoniae* (12.3%) and *Pseudomonas aeruginosa* (11.12%), (Table 3).

The antimicrobial sensitivity patterns of gram negative isolates of Enterobacteriaeace family, Non-fermenting isolates and gram positive isolates are listed in Tables 4, 5 and 6 respectively. Most of the gram negative isolates were multi-drug resistance (MDR). However most of the strains of *S. aureus* were sensitive to Vancomycin and Linezolid (Fig 5-7).

Table 1: Sex wise distribution of aerobic culture positive pus/wound swab samples (n=1672)

Sex	Patients with positive cultures
Male	984 (58.85%)
Female	688 (41.15%)

OR: 2.079; CI : 1.757-2.460; p <0.001; Highly significant

Table 2: Age wise distribution of aerobic culture positive pus/wound swab samples (n=1672)

Patient's age group	Number of positive samples
< 20 years	170
20-40 years	898
40-60 years	206
> 60 years	398

OR: 1.702; CI: 1.439 – 2.014; p < 0.001; Highly significant

Table 3: Categorization of aerobic bacterial isolates obtained from positive pus cultures (n=2032)

Gram positive cocci (GPC)			**Gram negative bacilli (GNB)**		
Isolate	**Number**	**%**	**Isolate**	**Number**	%
Staphylococci aureus	416	20.47	*Escherichia coli*	594	29.23
CONS	138	6.79	*Klebsiella pneumoniae*	250	12.3
Enterococcus sp	36	1.77	*Enterobacter sp*	100	4.92
Streptococcus sp	4	0.2	*Citrobacter sp*	28	1.37
			Proteus sp	64	3.14
			Pseudomonas aeruginosa	226	11.12
			Acinetobacter sp	176	8.66

Table 4: Antibiogram enterobacteriaeace

GNB Isolated	***E. coli***	***Klebsiella sp***	***Enterobacter sp***	***Proteus sp***
No of isolates	594	250	100	64
Antibiotic	**% Sensitive**	**% Sensitive**	**% Sensitive**	**% Sensitive**
Ampicillin	4.7	4.8	0.0	_
Gentamicin	58.9	27.2	24.0	**84.4**
Amikacin	78.8	29.6	44.0	56.3
Amoxy-clavulate	12.5	10.4	4.0	_
Cefoperazone-Sulbactam	46.7	20.8	34.0	62.5
Piperacillin-Tazobactam	37.0	14.4	28.0	62.5
Cefepime	16.2	12.0	16.0	21.9

Ceftriaxone	8.4	3.2	14.0	_
Ertapenem	55.6	20.0	22.0	_
Imipenem	70.0	22.4	42.0	12.5
Meropenem	34.7	25.6	44.0	34.4
Ciprofloxacin	10.4	11.2	20.0	28.1
Tigecycline	94.6	52.8	56.0	3.1
Trimethoprim/Sulfamethoxazole	25.2	3.2	24.0	25
Colistin	94.6	97.6	78	62.5

Table 5: Antibiogram Non fermenters

GNB Isolated	***Pseudomonas aeruginosa***	***Acinetobacter sp***
No of isolates	226	176
Antibiotic	**% Sensitive**	**% Sensitive**
Ceftazidime	38.6	5.3
Gentamicin	56.8	8.8
Piperacillin-Tazobactam	40.9	9.7
Amikacin	64.8	15.0
Aztreonam	22.7	9.7
Cefoperazone-Sulbactam	51.1	13.2
Cefepime	44.3	8.0
Doripenem	47.7	11.5
Imipenem	61.4	11.5
Meropenem	58.0	12.4
Ciprofloxacin	45.5	8.8
Levofloxacin	34.1	15.0
Tigecycline	21.6	61.1
Trimethoprim/Sulfamethoxazole	84.0	13.2
Colistin	79.6	85.2

Table 6: Antibiogram *Staphylococcus aureus*

GPC Isolated	***Staphylococcus aureus***
No of isolates	416
Antibiotic	**% Sensitive**
Cefoxitin	25
Erythromycin	48
Clindamycin	70
Trimethoprim/Sulphamethoxazole	35
Daptomycin	91.8
Linezolid	98
Teicoplanin	92.6
Vancomycin	97.9
Tetracycline	79.8
Tigecycline	84.6
Rifampicin	86.0
Ciprofloxacin	5.7
Levofloxacin	2.4
Gentamicin	57.2

Discussion

Of the total of 2516 study subjects bacterial pathogens were isolated from 1672; isolation rate being 66.45%. This was higher than the previous studies done in Gondar (52%), Bahir Dar (53%), but lower than Dessie (70.5%), and Muluye (70.2%).[8-11] Also 21.53% of the total growths showed poly-microbial growth. Open wounds provide an environment conducive to the growth of bacteria so these wounds can easily be invaded and colonised by them. This might have been a reason for poly-microbial growth.

There was preponderance of male (58.85%) over females (41.15%) as well as gram negative isolates (70.76%) over gram positive (29.23%), which was also shown by previous studies from India by Biradar A et al, Basu et al and Mantravadi et al.[12-14] The pre-dominant

isolates in the present study was found to be *Escherichia coli* (29.23%) which was also seen in a similar study by Deepali et al.[15] Other isolates in the decreasing order of isolation being *Staphylococcus aureus (*20.47%), *Klebsiella pnuemoniae* (12.3%) and *Pseudomonas aeruginosa* (11.12%). A study on wound microbiology conducted by Bowler et al also implies that the normal microbial flora of the gut, oral cavity, skin and genitourinary mucous membranes contain bacteria that can easily colonize wounds especially the ones in close proximity to those sites so this could be reason for *E. coli* preponderance.[16]

Antimicrobial sensitivity profile showed most of the gram negative isolates as multi-drug resistance. *E. coli* isolates were conspicously found to be resistant to ampicillin (95.3%), Cephalosporins (91.6%) and co-trimoxazole (74.8%) cases. Similar results were also shown by other studies nationwide.[12,15,17,18] These MDR strains were found to be sensitive mainly to Tigecycline and Colistin.

Among gram positive cocci, whereas 75% isolates of *Staphylococcus aureus* were resistant to Cefoxitin (MRSA) only 2.1% to Vancomycin. These finding were in agreement with those in Ethiopia, Nepal, and Italy where 83%, 60.6%, 74.2% of *Staphylococcus aureus* were found to be Methicillin resistance, respectively.[19,20,21] *Staphylococcus aureus* also showed a high resistance to erythromycin (58%) but high (98%) sensitivity to linezolid.

Conclusion

The frequency of multiple drug resistance among both gram positive and gram negative bacteria is alarmingly high. Thus, rational use of antimicrobials along with a strict compliance of hospital infection control practices can go a long way in fighting the menace of antibiotic resistance should be practiced.

Conflict of Interest: None.

References

1. Rao R, Basu R, Biswas DR. Aerobic bacterial profile and antimicrobial susceptibility pattern of pus isolates in a South Indian Tertiary Care Hospital. *J Dent Med Sci* 2014;13(3):59-62
2. Koneman, W.K., Allen, S. D., Janda, W.M., Schreckenberger, P.C., Propcop, G.W., Woods, G.L. and Winn, W.C., Jr. Philadelphia Color Atlas and Textbook of Diagnostic Microbiology, 6th ed. Lippincott-Raven Publisher, 2005; pp: 624-62.
3. Mayon-White RT, Ducel G, Kereselidze T. An international survey of the prevalence of hospital-acquired infection. *J Hosp Infect* 198811(A):43-8.
4. National Nosocomial Infections Surveillance (NNIS) System. NNIS report, data summary from October 1986-April 1996, issued May 1996. A report from the NNIS System. *Am J Infect Control* 1996;24(5):380-8.
5. Tayfour MA, Al-Ghamdi SM and Alahamdi AS. Surgical wound infections in King Fahed Hospital at Al-baha Saudi. *Med J* 2005;26(8):1305-07.
6. Cheesbrough M: District laboratory practice in tropical countries volume II: microbiology. Cambridge (UK): Cambridge University Press; 2006:1–479.
7. Clinical and Laboratory Standards Institute (CLSI): Performance standards for antimicrobial susceptibility testing. *Twent Inf* 2017;27th ed:1–249.
8. Mulu A, Moges F, Tessema B, and Kassu A, "Pattern and multiple drug resistance of bacterial pathogens isolated from wound infection at University of Gondar Teaching Hospital, northwest Ethiopia," *Ethiop Med J* 2006;44(2):125–31.
9. F. Biadglegne, B. Abera, A. Alem, and B. Anagaw, "Bacterial isolates from wound infection and their antimicrobial susceptibility pattern in Felege Hiwot Referral Hospital, North west Ethiopia," *Ethiop J Health Sci* 2009;19(3):173–7.
10. M. Kibret and B. Abera, "Bacteriology and antibiogram of pathogens from wound infections at Dessie Laboratory, North East Ethiopia," *Tanzania J Health Res* 2011;13(4):1–11.
11. Muluye D, Wondimeneh Y, Ferede G, NegaT, Adane K, Biadgo B, et al. Bacterial isolates and their antibiotic susceptibility patterns among patients with pus and/or wound discharge at Gondar university hospital. *BMC Res Notes* 2014;7: 619.
12. Biradar A, Farooqui F, Prakash R, Khaqri SY, Itagi I. Aerobic bacteriological profile with antibiogram of pus isolates. *Indian J Microbiol Res* 2016;3(3):245-9.
13. Basu S, Ramchuran PT, Bali ST, Gulati A, Shukla V. A prospective, descriptive study to identify the microbiological profile of chronic wounds in outpatients. *Ostomy Wound Manage* 2009;13(1):14–20.
14. Mantravadi H.B, Chinthaparthi M. R, Shravani V. Aerobic isolates in pus and their antibiotic sensitivity pattern: a study conducted in a teaching hospital in Andhra Pradesh. *Int J Med Sci Public Health* 2015;4(8):1076-79.
15. Roopa. C, Deepali.V. Pus culture isolates and their antibiotic sensitivity at a Tertiary Care Hospital in Hyderabad Karnataka Region. *Int J Med Microbiol Tropical Dis* 2017;3(4):140-5.
16. Bowler PG, Duerden BI, Armstrong DG. Wound Microbiology and Associated Approaches to Wound Management. *Clin* 2001;14(2):244-69.
17. Duggal S, Khatri PK, Parihar RS, Arora R. Antibiogram of various bacterial isolates from pus samples in a tertiary care centre in Rajasthan. *Int J Sci Res* 2015;4(5):1580-4.
18. Rugira Trojan, Lovely Razdan, and Nasib Singh, "Antibiotic Susceptibility Patterns of Bacterial Isolates from Pus Samples in a Tertiary Care Hospital of Punjab, India," *Int J Microbiol* 2016.
19. Gebre-Sealsssie S: Antimicrobial resistance patterns of clinical bacterial isolates in southwestern Ethiopia. *Ethiop Med J* 2007;45:363-70.
20. Khanal LK, Jha BK: Prevalence of Methicillin resistant *Staphylococcus aureus* (MRSA) among skin infection cases at a hospital in Chitwan, Nepal. *Nepal Med Coll J* 2010;12:224-8.
21. Giacometti A, Cirioni O, Schimizzi AM. Epidemiology and microbiology of surgical wound infections. *J Clin Microbiol* 2000;38:918-22.

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