Original Research Article

Bacterial Pattern and Antibiogram of Isolates from the Patients Admitted in a Pediatric Intensive Care Unit of Central Gujarat: A Prospective Observational Study

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Abstract

Background: The incidence of hospital acquired infection (HAI) is 5-7 folds more in ICU set up. In last two decades, along with antibiotic related adverse effects, HAI has become a special health problem resulting in increased morbidities, mortalities and burden of cost. There is a wide diversity in the incidence of microbial agents and their antimicrobial susceptibility from the various set ups such as indoor wards, Neonatal intensive care units (NICUs), PICUs etc. There is also variation in the proportion and types of infections among different subsets of patients within the same PICU at different season and due to geographical variation of the diseases. **Objective:** To assess the antimicrobial sensitivity pattern of bacterial isolates from the patients admitted in the PICU of a tertiary care center of central Gujarat. **Methodology:** This was a prospective observational hospital-based study, carried out at tertiary care center at Kashiben Gordhandas Patel children hospital, Vadodara, Gujarat, India from September 2019 to May 2020. Patients admitted to PICU were assessed for eligibility and enrolled after obtaining parental consent and checking for inclusion criteria. Patients were inquired about the presenting symptoms and were examined thoroughly. Clinical profile and demographical details were taken as per proforma. Basic hematological investigations such as complete blood count and C reactive protein were done in all cases. Various tissue samples were taken from the patients admitted in a PICU with positive septic screen to identify the bacterial isolates and their sensitivity pattern. **Results:** A total of 691 cases were admitted in PICU. Among the total 90 positive cultures, 61(67.7%) bacterial isolates were Gram negative (GN) bacteria, while 23(25.5%) were Gram-positive (GP) bacteria and 6(6.6%) were mycobacterium tuberculosis. S.typhi was the commonest bacteria found in 27% of the clinical specimens, followed by E.coli found in 22%, P. aeruginosa and Klebsiella pneumoniae in 7% each. Among GP isolates, Staphylococcus aureus was found in 14% of which MRSA was seen in 2%. S.pneumoniae and Enterococcus spp. were detected in 7% and 4% respectively**.** **Conclusion:** Common microorganisms found were Salmonella typhi in blood, E coli in urine, S. aureus in pus, pseudomonas and streptococcus pneumonia in CSF culture. Gram-negative bacteria were the predominant pathogens. Most gram-negative bacterial isolates showed resistance to multiple antibiotics but S Typhi still have good sensitivity for ceftriaxone/cefotaxim. Gram positive isolates especially S aureus showed resistance to commonly used antibiotics like penicillin, pipercillin+tazobactum but high sensitivity for newer drugs like linezolid, vancomycin, teicoplanin & tigecycline.

Keywords: Pediatrics Intensive Care Unit, Bacterial Isolates, Culture, Antibiotic Sensitivity.

Introduction

A pediatric intensive care unit (PICU) provides the topmost medical and nursing care of the sick children. A major proportion of admissions in the PICUs are related to various infections. After a first discovery of penicillin in 1928, many newer molecules were discovered between 1960 and 1980. Since then, not many new classes of molecules have been discovered and now deaths due to resistant infection are slowly increasing[1]. Without the use of proper antibiotics, the infection may flare up and may lead to the point of organ damage or even death[2]. The choice of antibiotics is largely determined by factors such as source of infection, patient's immunological status, genetic variation, nosocomial or community acquired infection, bactericidal or bacteriostatic drug, drugs crossing blood brain barrier and usage of combination of antibiotics.

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For each use of medicine, there is a drawback of its misuse and overuse. Unnecessary and over prescription of antibiotics, noncompliance of a drug, improper doses, irrational combinations, poor infection control in the hospitals, lack of antibiotic policy in the hospitals contribute to the widespread drug resistance. The incidence of hospital acquired infection (HAI) is 5-7 folds more in ICU set up. In last two decades, along with antibiotic related adverse effects, HAI has become a special health problem resulting in increased morbidities, mortalities and burden of cost[3]. In our country, antibiotic resistance to a newer antibiotic may be due to indiscriminate use of antibiotics, over-the counter availability of antibiotics, laxity of regulatory bodies in approval of antibiotics, lack of public awareness about antibiotic resistance, overburdened health infrastructure, and inequity in healthcare[4]. A national program for antimicrobial resistance (AMR) containment was launched in 2012-2017 with AMR surveillance was started to generate data from various surveillance network sites across the country.There is a wide diversity in the incidence of microbial agents and their antimicrobial susceptibility from the various set ups such as indoor wards, Neonatal intensive care units (NICUs), PICUs etc. There is also variation in the proportion and types of infections among different subsets of patients within the same PICU at different season and due to geographical variation of the diseases. A thorough knowledge of common organisms and their sensitivity pattern is necessary to set an empirical antibiotic protocol for the PICU patients. The present study is therefore designed to assess the antimicrobial sensitivity pattern of bacterial isolates from the patients admitted in the PICU of a tertiary care center of central Gujarat. Based on identification of bacterial isolates and assessing its sensitivity pattern from various clinical samples, a future protocol for anti-bacterial agents may be formed for treating the infections of different community and HAI.

Objective

To assess the antimicrobial sensitivity pattern of bacterial isolates from the patients admitted in the PICU of a tertiary care center of central Gujarat.

Methodology

This was a prospective observational hospital-based study, carried out at tertiary care center at Kashiben Gordhandas Patel children hospital, Vadodara, Gujarat, India from September 2019 to May 2020. Institutional Ethical Committee approval was taken and before enrolling the patients for a study, a written informed consent was taken from the respective parents and legal guardians of the patients. Patients who were admitted in a PICU, were inquired about the presenting symptoms and were examined thoroughly. The cases were included in the study only if they were satisfying the inclusion criteria. Inclusion criteria includes children from a PICU, suspecting clinically to have infection on or prior to admission or clinically suspected of having acquired any infection after 48 hours of admission to a PICU; in whom blood culture, urine culture or other relevant fluid cultures were sent to identify bacterial isolates and their antibiotics sensitivity pattern. The cases in whom more than one bacterial isolate were isolated or same microorganism was isolated from the repeat specimen/s in a single admission were excluded from the study to avoid duplication of results. Clinical profile and demographical details were taken as per proforma. Basic hematological investigations such as complete blood count and C reactive protein were done in all cases. Various tissue samples were taken from the patients admitted in a PICU with positive septic screen to identify the bacterial isolates and their sensitivity pattern. Whenever possible all samples were tried to collect before starting antibiotic. Samples were collected from the site based on clinical diagnosis and where one anticipates the yield for the microorganism. All aseptic and antiseptic precautions were taken while collecting the different cultures and before collecting the samples, patients, parents / guardian were counseled about the process and a need of the test. Proper sterile containers were used to collect the samples in the appropriate amount and for the transportation of the samples. All samples were delivered safely to a laboratory attached to this hospital. Sufficient information was provided to a laboratory by filling a written form appropriately and also by giving additional information telephonically if required by pathologist & microbiologist.

Specimen Selection and Collection

Possible Septicemia: Blood culture

Bacterial Meningitis: Blood culture, cerebrospinal fluid (CSF) culture, swab from ear discharge if present

Bacterial Pulmonary Infections: Blood culture, endotracheal tube secretion culture (if on mechanical ventilation), sputum, throat swab, bronchoalveolar lavage (BAL)

Urinary Tract Infections (UTI): Clean catch midstream urine, catheterization in morbid patients to collect urine

Infective Endocarditis: 3 blood cultures

Diarrhea (not responding to first two lines antibiotics or in an immunodeficient child): Stool culture

Wounds /Abscesses: Purulent drainage - Wound margins

Empyema: Pleural fluid culture, tip of ICD tube in a suspected case of HAI

Ventilator associated pneumonia: Tips of the endotracheal tube, tracheal aspirate

Standardized methods were used for collecting the samples and for processing.

Antibiotic Susceptibility Testing: Antibiotic susceptibility testing was done for the isolates by VITEK 2 automation system and manual disc diffusion methods, using Clinical and Laboratory Standard Institute guidelines for interpretation as resistant, intermediate sensitive and sensitive. All reports were reported by experienced microbiologist attached to this institute.

Sample Size Calculation: Minimum of 576 patients were required for the study to estimate 40% positive microbial culture with 10% relative precision and 95% confidence[5].

Statistical Analysis: Pearson's Chi square test was applied to check relation between two categorical variables. P value is considered significant at 5% level for all the tests. SPSS 20 version was used.

Results

Over a study period of 9 months, 691 cases were admitted in PICU. There were 307(44.4%) cases with positive culture reports, males (61.9%) are dominant than females (38.1%), the mean age of the cases was 4.3 years with Standard Deviation (SD) of ± 4.1 years.

Most of the patients had a primary complaint of fever found in 98%, followed by breathlessness in 41%, cough in 38%, vomiting in 15%, abdominal pain in 14%, seizures in 9% and urinary complaints in 7% of cases. Each case was presented with more than one complaint. Most common etiologies detected in cases were septicemia (19.2%), pneumonia (16.3%), fever without focus which had included enteric fever (12.7%), empyema (10.4%), UTI (8.5%) and meningitis (7.5%).

Out of 307 various culture samples sent, blood cultures were the most frequently sent samples (n-206). The yield of bacteria was only 18.5% from the blood culture samples but was found to be 70.3% and 80% from urine and pus culture samples respectively. Among the total 90 positive cultures, 61(67.7%) bacterial isolates were Gram negative (GN) bacteria, while 23(25.5%) were Gram-positive (GP) bacteria and 6(6.6%) were mycobacterium tuberculosis (Table 1)S.typhi was the commonest bacteria found in 27% of the clinical specimens, followed by E.coli found in 22%, P. aeruginosa and Klebsiella pneumoniae in 7% each. Among GP isolates, Staphylococcus aureus was found in 14% of which MRSA was seen in 2%. S. pneumoniae and Enterococcus spp. were detected in 7% and 4% respectively (Table 2)S typhi was predominant gram-negative isolate in blood culture and gram positive was streptococcus pneumoniae. Urine cultures were dominated with gram negative bacilli (E coli). S aureus was dominant in pus culture (Table 3)

S.typhi, E coli, klebsiella pneumonia and pseudomonas aeruginosa were common GN isolates found in different culture. Ceftriaxone and cefotaxim has highest susceptibility rate (100%) for S Typhi. Colistin, polymyxin B, amikacin, imipenem and meropenem have good sensitivity for E coli. Sensitivity pattern of K. pneumonia and P. aeruginosa remains same (Table 4)Staphylococcus aureus, streptococci pneumoniae and enterococcus were three common GP isolates from different cultures. In GP isolates, Linezolid (100%) had the highest sensitivity for streptococcus pneumonia, enterococcus and MRSA. In almost all the GP isolates, teicoplanin, tigecycline were highly sensitive (100%) (Table 5)

Table 1: Number of positive culture tests from various specimens

Specimen	Total samples (n)	Positive results (n)	Percentage (%)
Blood culture	206	38	18.5%
Pleural fluid	31	11	35.5%
Urine	27	19	70.3%
CSF culture	15	06	40%

Pus culture	10	08	80%
Gastric aspirate	05	01	20%
Ascitic fluid	04	01	25 %
Tip of Endo tracheal tube (ET)	03	03	100%
Stool	02	00	00%
Throat swab	02	01	50%
BAL fluid	01	01	100%
Sputum (induced)	01	01	100%
Total	307	90	29.31%

Table 2: Bacteria isolated from the various clinical specimens

Name Of Organism	Frequency n=90	Percentage
S.typhi	24/90	27%
E.coli	20/90	22%
Methicilin sensitive S.aureus (MSSA)	11/90	12%
S.pneumoniae	06/90	7%
P.aeruginosa	06/90	7%
K.pneumoniae	06/90	7%
M.tuberculosis	06/90	7%
Enterococcus spp.	04/90	4%
S.maltophilia	03/90	3%
B.cepacea	02/90	2%
Methicillin resistant S.aureus (MRSA)	02/90	2%

Table 3: Yield of organisms (gram negative and gram-positive isolates) from different specimens

Organism	S. typhi (n=24)	E. coli (n=20)	S. aureus MSSA (n=11)	P. aerugi nosa (n=6)	Klebsie lla pneum onia (n=6)	S. pneumon iae (n=6)	M. tuberc ulosis (n=6)	Entero coccus spp (n=4)	Stenotr ophom onas maltop hilia (n=3)	MRSA (n=2)	Burkho lderia cepacia (n=2)
Blood culture, n=38	24/38 (100%)	3/38 (15%)	1/38 (13%)		4/38 (67 %)	2/38 (33%)		1/38 (25%)	1/38 (33%)	1/38 (50%)	1/38 (50%)
Urine, n=19		15/19 (75%)			1/19 (17%)			3/19 (75%)			
Pleural fluid, n=11			3/11 (37%)	1/11 (16%)			4/11 (67%)		2/11 (67%)		1/11 (50%)
Pus, n=8			6/8 (55%)	1/8 (16%)						1/8 (50%)	
CSF, n=6		1/6 (5%)		2/6 (33%)		2/6 (33%)	1/6 (17%)				
Tip of Endo tracheal Tube, n=3			1/3 (9%)	1/3 (17%)	1/3 (17%)						
Throat swab, n=1						1/1 (16.7%)					
BAL Fluid, n=1						1/1 (17%)					
Ascitic fluid, n=1		1/1 (5%)									
Gastric aspirate, n=1							1/1 (17%)				
Sputum, n=1				1/1 (17%)							

Table 4: Sensitivity patterns of gram-negative bacteria isolates

Name Of Drug	Salmonella typhi N=24	E.Coli N=20	Klebsiella Pneumonia N=6	Pseudomonas aeruginosa N=6	Stenotrophom onas maltophilia N=3	Burkholderia Cepacia N=2
Penicillin	15(63%)	1(5%)	0(0%)	0(0%)	0(0%)	0(0%)

Amoxyclav	21(88%)	7(35%)	3(50%)	0(0%)	1(33%)	0(0%)
Piperacillin Tazobactum	21(88%)	10(50%)	4(67%)	3(50%)	0(0%)	0(0%)
Ceftriaxone	24(100%)	1(5%)	2(33%)	2(33%)	0(0%)	0(0%)
Cefotaxime	24(100%)	2(10%)	3(50%)	2(33%)	0(0%)	1(50%)
Ceftazidime	17(71%)	2(10%)	2(33%)	4(67%)	1(33%)	1(50%)
Cefoperazone/ Sulbactum	18(75%)	11(55%)	3(50%)	4(67%)	0(0%)	0(0%)
Amikacin	1(4%)	15(75%)	4(67%)	5(83%)	0(0%)	0(0%)
Gentamicin	3(13%)	12(60%)	4(67%)	3(50%)	1(33%)	0(0%)
Cotrimoxazole	20(84%)	7(35%)	2(33%)	1(17%)	0(0%)	2(100%)
Azithromycin	21(86%)	2(10%)	0(0%)	0(0%)	0(0%)	0(0%)
Clindamycin	1(4%)	0(0%)	1(17%)	2(33%)	0(0%)	0(0%)
Ciprofloxacin	1(4%)	2(10%)	1(17%)	2(33%)	0(0%)	0(0%)
Levofloxacin	21(88%)	3(15%)	3(50%)	1(17%)	2(67%)	2(100%)
Meropenem	22(92%)	14(70%)	3(50%)	4(67%)	1(33%)	2(100%)
Imipenem	21(88%)	15(75%)	4(67%)	3(50%)	1(33%)	1(50%)
Vancomycin	1(4%)	0(0%)	1(17%)	0(0%)	0(0%)	0(0%)
Rifampicin	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)
Chloramphenicol	23(96%)	2(10%)	2(33%)	0(0%)	1(33%)	2(100%)
Tetracycline	0(0%)	0(0%)	0(0%)	2(33%)	0(0%)	0(0%)
Teicoplanin	0(0%)	1(5%)	1(17%)	0(0%)	2(67%)	1(50%)
Tigecycline	22(92%)	11(55%)	5(83%)	3(50%)	1(33%)	0(0%)
Polymyxin B	10(42%)	19(95%)	5(83%)	5(83%)	3(100%)	0(0%)
Colistin	14(58%)	20(100%)	6(100%)	5(83%)	2(67%)	0(0%)

Table 5: Sensitivity patterns of gram-positive bacterial isolates

Name Of Organism	Staphylococcus aureus N=11 (MSSA)	Streptococcus pneumoniae N=6	Enterococcus spp N=4	MRSA N=2
Penicillin	0(0%)	3(50%)	1(25%)	1(50%)
Methicillin	11(100%)	0(0%)	0(0%)	0(0%)
Amoxyclav	1(9%)	3(50%)	1(25%)	1(50%)
Piperacillin Tazobactum	0(0%)	2(33%)	0(0%)	0(0%)
Ceftriaxone	5(46%)	5(83%)	1(25%)	1(50%)
Cefotaxim	0(0%)	5(83%)	1(25%)	0(0%)
Ceftazidime	0(0%)	2(33%)	0(0%)	1(50%)
Cefoperazone/Sulbactum	3(27%)	2(33%)	0(0%)	0(0%)
Amikacin	0(0%)	2(33%)	0(0%)	0(0%)
Gentamicin	7(64%)	0(0%)	1(25%)	2(100%)
Cotrimoxazole	2(18%)	0(0%)	1(25%)	0(0%)
Azithromycin	6(55%)	6(100%)	0(0%)	0(0%)
Clindamycin	8(72%)	4(67%)	1(25%)	0(0%)
Ciprofloxacin	0(0%)	0(0%)	0(0%)	0(0%)
Levofloxacin	1(9%)	6(100%)	0(0%)	0(0%)
Meropenem	0(0%)	2(33%)	0(0%)	0(0%)
Vancomycin	10(91%)	6(100%)	3(75%)	2(100%)
Linezolid	7(64%)	6(100%)	4(100%)	2(100%)
Rifampicin	6(55%)	4(67%)	0(0%)	2(100%)
Chloramphenicol	6(55%)	6(100%)	0(0%)	0(0%)
Tetracycline	4(36%)	2(33%)	0(0%)	1(50%)
Teicoplanin	11(100%)	4(67%)	4(100%)	2(100%)
Tigecycline	11(100%)	6(100%)	3(75%)	2(100%)
Polymyxin B	0(0%)	1(17%)	1(25%)	0(0%)
Colistin	0(0%)	3(50%)	0(0%)	0(0%)

Discussion

Antimicrobial resistance is present in every part of the country. Antimicrobial resistance occurs naturally over a time; however extensive use of antibiotics has been closely linked to the problem of antibiotic resistance. In addition, the empirical use of antibiotics without bacterial culture and sensitivity results also contribute to antimicrobial resistance. In a study done by Sritippayawan S.et al[6] suggested that two weeks of broad-spectrum antibiotic therapy increased the risk of multi drug resistance bacteria by 9.7 times. New resistance mechanisms are emerging and spreading rapidly all over globally and making us difficult to treat common infectious diseases.

A mean age was found at 4.385 years with ± 4.1288 SD which was similar to study done by Putra W I et al[3] in which mean age was 4 years. In a study done by Jyothi A.K. et al[7] found that 83.33% cases of PICU admissions were under the age of five years.

Out of total 691 admissions in PICU, 307(44.42%) cases were enrolled for this study. This suggests that infectious conditions were the prime reasons of PICU admissions. A study done by Bhavari V.L et al[8] found 3.4% admissions in a PICU due to sepsis while Jain S et al[9] reported neurological disorders were a leading causes of admission reported in 31.9%. A study done by Shah G. S. and Shah B. K[10] reported respiratory illnesses were the prime causes for the PICU admissions reported in 33% cases.

In this study, from 307 various clinical samples, 90 (29.31%) cases showed positive bacterial growth. Blood culture was the most frequently (n-206) sample sent, followed by pleural fluid (n-31), urine (n-27), CSF culture (n-15) and pus culture (n-10). Out of 206 blood cultures sent, 38 cases (18.5%) had shown the growth of bacteria. On comparing with other studies, it was found nearly similar results with a study done by Zaveri J R et al[11] who found positive blood culture in 15.22%. A study done by Roy M P et al[12] reported positive bacterial growth in14.9%. A study conducted on all age groups by Pal Net al[13] showed that from 121 cases of septicemia, 27 (22.3%) showed positive blood culture reports. In yet another study done by Tariq T.M. et al[14] who found that out of total 3360 blood cultures from all age groups, 410 showed microbial growth; making the frequency of positive blood culture at 12.2.%.

This study differs from a study done by Tiwari P et al[15] in which, blood culture was positive in 53% cases. Sangwan J et al[5] also reported that from 462 blood culture samples, positive blood cultures were obtained in 57.6%. The variation in the yield may be attributed to different age and morbidities, hospital set ups and a usage of antibiotics prior to a referral. Ours is also a prime referral tertiary center and many patients are referred late or when tertiary care is needed, hence most of the patients had already received one or other antibiotics therapy before referral.

Urine culture showed 70.3% positive cultures which was different from the study done by Badhan R et al[16] who found positive urine culture in 26.66%. Another study done by Thaddaani R et al[17] who detected 26.9% positive urine cultures. Pleural fluid samples were the other frequently sent samples with culture positivity was found of 35.5% which was nearly similar to a study done by Durga SV et al[18] in which pleural fluid culture positivity was 30.5% from all the age groups. In this study, 40% cases had shown positive CSF culture for bacterial growth, which was similar to a study done by Jagadevi J. et al[19] in which CSF culture was positive in 42.85%. Present study shows 80% positive pus culture which was more or less similar to a study done by Zaveri J et al[11] in which yield was in 72.72%. In yet another study done by Javeed I et al[20] who detected only 40.9% positive pus culture. Other different specimen samples were of small numbers and showed a variable positivity of bacterial isolation ranging from 0-100%.

Out of 90 culture proven samples, 61 (67.8%) were GN bacteria, 23(25.6%) were GP bacteria and 6(6.6%) were Mycobacterium tuberculosis bacteria. From various clinical samples sent, it was found that pus cultures had shown more GP bacteria than GN in comparison to specimens such as blood, urine, pleural fluid, CSF which had shown a yield of more of GN bacteria. In other clinical specimens such as throat swab, sputum, BAL etc., the positive yield for bacteria was too small to compare. Among GN bacteria, S.typhi (26.7%) and E.coli (22.2%) were the two most common GN bacteria detected from all various clinical samples. From GP bacterial isolates, Staph aureus (14.44%) was the most common isolates followed by S.pneumoniae (6.66%) and Enterococcus species (4.44%).

From blood cultures, S. typhi was the most commonly isolated GN bacteria followed by Klebsiella and E.coli. S.aureus was the most common GP bacteria isolated which was followed by S.pneumoniae and Enterococci. These findings were similar to study done by Tiwari P. et al[15]. We could see from the different studies that Klebsiella pneumoniae and S.auerus were the two common GN and GP bacteria isolated since last 10-15 years. Present study also had similar findings. Isolation of S.typhi is mainly related to sampling of patients. From urine cultures, E.coli was the most common GN bacteria found which was followed by Klebsiella. Enterococcus was the only GP bacteria isolated. E.coli was the most common bacteria isolated from all different studies. In the present study, S.maltophilia was the most common GN isolates from the pleural fluid which was similar to study done by Putra W.I. et al[3] and S.aureus was the most common GP isolates which was similar to study done by Durga V.S.et al[18]. In a present study, S.aureus was the commonest GP bacteria that was isolated from the pus culture, which was similar to other two studies done by Zaveri J.R.et al[11]and Javed I.et al[20].

Antibiotic Sensitivity

All the bacterial isolates were subjected to antibiotics sensitivity.

Sensitivity pattern of GN isolates

Commonly used antibiotics against E.coli such as Ciprofloxacin, Co-trimoxazole, Ceftriaxone, Levofloxacin, Amoxy-clav had sensitivity ranging between 5-50% in various studies done by Thaddanee R et al[17], Putra W.I[3]and Pawar S.K et al[21]. Present study had detected more or less same percentages of sensitivity with above antibiotics. Amikacin(75%) and Gentamicin(60%) showed a higher sensitivity than antibiotics mentioned above. One can still consider them as a first line antibiotics in GN infections for indoor cases. Second and third line used antibiotics such as Meropenem, Imipenem and Colistin had higher sensitivity ranging between 70-100% in majority of studies. Thereby, it is viewed that first line common antibiotics are showing very less sensitivity to E-Coli bacteria and empirical usage may be not beneficial to the indoor critical patients.

Third generation cephalosporins are used as a first line antimicrobial against S.typhi. As shown in the above table 4, present study shows that S,typhi was found to be 100% sensitive to third generation cephalosporins which was similar to a study done by K.Suresh et al[22] but was different from a study done by Langhari G.S.et al[23] where sensitivity to Cefixime and Ceftriaxone was ranging from 60-66%. In all the three studies, sensitivity to Chloramphenicol was ranging between 90-96%. In a study done by K.Suresh et al[22] sensitivity to Ciprofloxacin was 95%, in present study sensitivity to Ciprofloxacin was only 4.2% which points that over a period of 4-5 years, resistance has developed and it should never be considered as a first line even though it is cheap and orally available. Azithromycin which is used as an adjuvant drug shows less sensitivity (87.5%) than 3rd generation Cephalosporins and is perhaps not having any added advantage. Thus 3rd generation Cephalosporins and Chloramphenicol are still the best drug against S.typhi.

K.pneumoniae was the 3rd most common GN bacteria isolated in this present study. Commonly used antibiotics like Amoxyclav, Co-trimoxazole, Ceftazidime, Ceftriaxone, Meropenem and Ciprofloxacin were found sensitivity in the range of 15-50%. These findings were similar to a study done by Javeed I et al[20], Arora A. et al[24], and Pawar S.K.et al[21] but differs to a study done by Cai X.F.et al[24] in which it was found 100% sensitive to Ciprofloxacin, Amikacin and 88.24% to Meropenem. This variation could be due to different geographical region or over a period of time bacteria might had acquired resistance to these antimicrobial agents. Other antimicrobials such as Amikacin, Imipenem, Gentamicin, Piperacilin +Tazobactum and newer antibiotics like Colistin and Polymixin-B were found to be sensitive ranging from 65- 100%. High sensitivity of these newer drugs could be due to their less frequent usage as these are available only in parental form. Pseudomonas was the other GN isolate found which was sensitive to Colistin, Polymixin-B, Meropenem, Amikacin, Ceftazidime, Cefoparazone + Sulbactam(50-100%).

Sensitivity pattern of common GP isolates

S.aureus was the most common GP bacteria isolated from our study. Various studies done by Ergul A.B. et al[25], Pawar S K et al[21], Putra W.I et al[3], Javeed I et al[20] showed variable sensitivity pattern. In the present study, S.aureus was found highly sensitive to Vancomycin (90.90%) and Clindamycin(72.72%). Linezolid and Gentamicin were sensitive in 63.63% each. Regarding other drugs, S.aureus was found 100% resistant to Penicillin and Piperacillin + Tazobactam which was similar to study done by Pawar S.K et al[21] Teicoplanin a newer and less frequently used antimicrobial was found 100% sensitive to S.aureus in a present study, this finding was similar to study done by Ergul A B et al[25] and Javeed I et al[20]. Variable sensitivity to Levofloxacin was found with a range between 10-30% in the studies done by Pawar S.K.et al[21] and Putra W.I.et al[3] which was more or less similar to a present study.

S.pneumoniae was the other commonly isolated GP organism found in our study. As shown in a above table-5, S.pneumoniae was highly sensitive to 3rd generation Cephalosporins with sensitivity of 83.3%, which was similar to a study done by Ashtiani Mohammad A.B. et al[26] and Jagadevi J.et al[25](87-100%). Vancomycin is the another useful antimicrobials against S.pneumoniae with 100% sensitivity found in all the three studies. Regarding other drugs Linezolid was found 100% sensitive to S.pneumoniae which was similar to study done by Jagadevi J.et al[25]. Tigecycline, Teicoplanin, Levofloxacin and Rifampicin were the other more sensitive antibiotics showing sensitivity in the range between 66-100%.

Enterococci was another GP bacteria found. Penicillin and Vancomycin are the commonly used antimicrobials against the Enterococci. In this study, sensitivity to Penicillin was only 25% which was similar to study done by Sangwan J. etal[5] but was different to a study done by Thaddanee R. et al[17] in which sensitivity to Penicillin was 50%. Vancomycin (75%) and Linezolid (100%) were two highly sensitive drugs found against Enterococci. Though there is an emergence of vancomycin resistance enterococci (VRE), Vancomycin still has a good choice at the present time. Teicoplanin was the other drug found 100% sensitive to Enterococcus which was similar to a study done by Sangwan J. et al[5] (2016) who also found sensitivity to Clindamycin in 66.7% but present study showed only 25% to Clindamycin.

As sepsis and infectious diseases are common indications of the PICU admissions, knowledge of the causative agents and selection of antimicrobials are useful to reduce morbidity and mortality. In the current study, 49.2% cases required PICU stay of 1-3 days which was similar to a study done by Jain S et al[9] in which average duration of stay in PICU was 2-3 days.

Conclusion

Our study shows that the gram-negative bacteria are the predominant pathogens found in various clinical specimens. Common microorganisms found were Salmonella typhi in blood, E coli in urine, M tubercle bacilli in pleural fluid, S. aureus in pus, pseudomonas and streptococcus pneumonia in CSF culture. Most gram-negative bacterial isolates showed resistance to multiple antibiotics, but S Typhi still have good sensitivity for ceftriaxone/cefotaxim compared to other gram-negative isolates. Gram positive isolates especially S aureus showed resistance to commonly used antibiotics like penicillin, pipercillin+tazobactum but high sensitivity for newer drugs like linezolid, clindamycin, vancomycin, teicoplanin & tigecycline.

Updating the knowledge about the prevalence of the causative organisms and antibiotics sensitivity patterns helps to set proper management of infections in PICU. A changing trend in the antibiotic sensitivity pattern need to be monitored as there are limited newer drugs.

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