Antimicrobial resistance of bacterial pathogens in a Neonatal Intensive Care Unit

Farzana Ahmed, Aftab Yousuf Raj, Lutfun Nahar and Zahidul Hasan

Article Info

Department of Neonatology, Square Hospitals Ltd., Dhaka, Bangladesh (FA, AYR, LN); Department of Microbiology, Square Hospitals Ltd., Dhaka, Bangladesh (ZH)

For Correspondence:
Farzana Ahmed
farzanaahmedpaed@gmail.com

Received: 26 December 2017
Accepted: 11 January 2018
Available Online: 4 March 2018

ISSN: 2224-7750 (Online)
2074-2908 (Print)

DOI: 10.3329/bsmmuj.v11i1.35133

Keywords:
Antimicrobial resistance; Bacteria; Neonatal Intensive Care Unit

Cite this article:
Ahmed F, Raj AY, Nahar L, Hasan Z. Antimicrobial resistance of bacterial pathogens in a neonatal intensive care unit. Bangabandhu Sheikh Mujib Med Univ J. 2018; 11: 25-28.

Available at:
www.banglajol.info

A Journal of Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh

Abstract

The aim of this study was to identify the antimicrobial susceptibility pattern and relevant treatment options in a neonatal intensive care unit from January 2012 and June 2016. Out of the total 78 culture positive samples, Gram positive and Gram negative micro-organisms were 26% and 74% respectively. *Acinetobacter* remained the predominant isolate (32.1%) followed by *Klebsiella* species (18.0%). Most of the Gram positive isolates exhibited higher resistance to penicillin, cephalosporin, macrolides, gentamycin and quinolones. Gram positive isolates had sensitivity of 100% to linezolid, vancomycin, chloramphenicol followed by rifampicin (84%). In comparison to other commonly used antibiotics, sensitivity to these four medicines was statistically significant ($p<0.05$). Similarly, most of the Gram negative bacteria showed resistance to cephalosporin, aminoglycosides. About two-third cases showed resistant to meropenum, quinolones and combination preparation of piperacillin and tazobactam. Overall sensitivity among the Gram negative isolates was to polymixin B (100%) and minocycline (97%), followed by colistin (83%). In comparison to other commonly used antibiotics, sensitivity to these three medicines was statistically significant ($p<0.05$).

Introduction

With the improvement of health care facilities and development of public awareness, neonatal mortality rate decreased significantly in Bangladesh from 36.8/1,000 live birth in year 2004 to 20/1,000 live birth in year 2015.[1]

However, neonatal sepsis is, still, responsible for 30-50% of total neonatal deaths each year.[2] Globally, around 20% of neonates suffer from sepsis.[3] Since the aim of empirical therapy is to target the infectious microorganism(s), it is essential for every neonatal unit to survey the profile of causative microorganism and their susceptibility in order to ensure effective antimicrobial treatment.[3, 4]

The pathogens causing neonatal sepsis varies overtime and places.[3,4] Group B *Streptococcus* and *E. coli* still contribute to 70-75% of cases of neonatal septicemia in the North America and Europe.[4, 5] Whereas, Gram negative micro-organisms remain the major cause of neonatal sepsis, particularly early onset sepsis in most of the developing countries.[4-10]

Due to inappropriate use of antibiotics which is often seen in some developing countries, resistant microorganisms can grow in the community.[11-14] So, periodic surveillances are essential to identify antibiotic sensitivity pattern of the common pathogens.[15]

Materials and Methods

The study was conducted retrospectively from January 2012 and June 2016. All the cases of positive cultures (n=78) were included in the study and skin commensals, contaminates and fungal pathogens were excluded.

After collection of the sample (2-3 mL of blood for culture, culture of tip of endotrachial tube, culture of aspirate from endotrachial tube) with all aseptic precaution, culture bottles were transported immediately to the Microbiology Laboratory and were processed as per standard microbiological techniques and the isolates were identified.

All positive culture reports were checked, verified and analyzed. The sensitivity and resistance pattern of the various antibiotics against the isolated pathogens were also noted.

The obtained data were statistically analyzed using Fisher's exact test using an $r \times c$ exact contingency table. We also used Statistical Package for Social Sciences (SPSS) version 16 for data analysis.

Table I

Antibiotic sensitivity pattern for Gram positive microorganisms (n=20)

Antibiotics	Coagulase negative *Staphylococci*	*Streptococcus pneumonia*	*Enterococcus faecium*
Ampicillin	2/13	1/4	1/3
Cefuroxime	3/13	1/4	1/3
Gentamicin	3/13	1/4	1/3
Co-trimoxazole	6/13	2/4	1/3
Ciprofloxacillin	5/13	2/4	2/3
Erythromycin	2/13	1/4	1/3
Clindamycin	5/13	2/4	1/3
Rifampicin	11/13	3/4	2/3
Linezolid	13/13	4/4	3/3
Vancomycin	13/13	4/4	3/3
Chloramphenicol	13/13	4/4	3/3

p<0.05; Fisher's exact test

Results

Out of these 78 bacterial isolates, 74% were Gram negative microorganisms, 26% were Gram positive microorganisms.

Table I shows overall sensitivity pattern of Gram positive microorganisms. Most of the Gram positive isolates exhibited higher resistance to penicillin, cephalosporin, macrolides, gentamicin and quinolones. Susceptibility to commonly used was found to vancomycin (100%), chloramphenicol (100%), rifampicin (84%) and linezolid (100%). In comparison to other commonly used antibiotics, sensitivity to these four medicines was statistically significant (p<0.05).

Table II showing overall sensitivity pattern of Gram negative organism, *Acinetobacter* spp. (32.1%) are the commonest microorganisms responsible for infection in neonate followed by *Klebsiella* species (n=14, 18.0%). Most of the Gram negative bacteria showed resistance to cephalosporin, aminoglycosides; about two-third showed resistant to meropenem, quinolones and combination preparation of piperacillin and tazobactam. Best overall sensitivity among Gram negative isolates was to polymixin B (100%) and minocycline (97%), followed by colistin (83%). In comparison to other commonly used antibiotics, sensitivity to these three medicines was statistically significant (p<0.05).

Surprisingly, sensitivity pattern for *Acinetobacter* spp. have not been changed significantly over the last four and half years (Figure 1).

Discussion

In the present study, Gram negative organisms were responsible for majority cases of neonatal sepsis about 74% and only 26% septic cases were by

Table II

Antibiotic sensitivity pattern for Gram negative microorganisms (n=58)

Antibiotics	*Acinetobacter*	*Klebsiella* spp.	*Stenotrophomonas maltophilia*	*Enterobacter*	*Burkholderia cepacia*	*Pseudomonas* spp
Ceftazidime	2/25	1/14	1/7	1/6	0	0
Cefipime	2/25	1/14	1/7	1/6	0	0
Gentamicin	2/25	1/14	1/7	1/6	0	0
Amikacin	4/25	3/14	2/7	2/6	1/5	0
Tobramycin	0	0	0	0	0	0
Co-trimoxazole	6/25	3/14	2/7	2/6	1/5	0
Levofloxacillin	7/25	4/14	2/7	2/6	1/5	0
Piperacillin and tazobactam combination	10/25	6/14	3/7	3/6	2/5	0
Chloramphenicol	10/25	5/14	3/7	3/6	2/5	0
Meropenum	6/25	4/14	2/7	2/6	1/5	0
Colistin	21/25	11/14	6/7	5/6	4/5	1/1
Polymixin B	25/25	14/14	7/7	6/6	5/5	1/1
Minocycline	25/25	14/14	7/7	6/6	5/5	1/1
Cefuroxime	4/25	2/14	1/7	1/6	1/5	0
Cefixime	5/25	3/14	2/7	2/6	1/5	0
Ceftriaxone	5/25	4/14	2/7	2/6	1/5	0

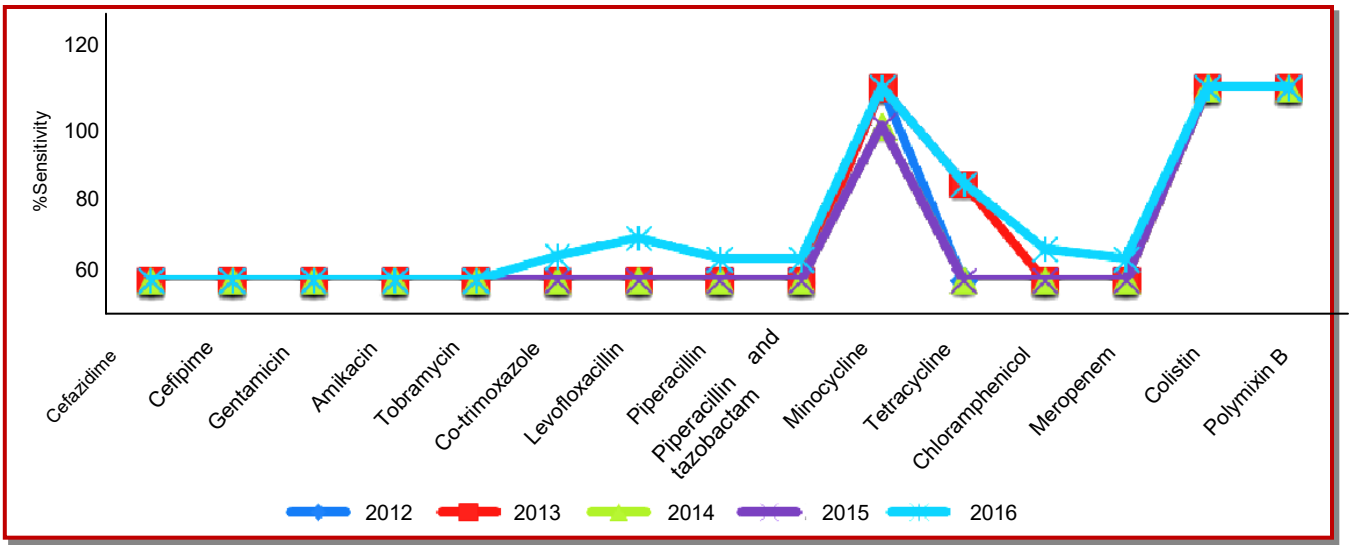

Figure 1: Percentage of antibiotic sensitivity pattern for *Acinetibacter* spp. over four and half years

Gram positive organisms. A recent study conducted by Muley et al. (2015)[16] in India reported 70.8% neonatal septicemia cases caused by Gram negative isolates. Almost similar results were reported by Pooja et al. (2015) where Gram negative and Gram positive organisms were isolated in 79.9% and 18.2% cases respectively.[17] Karlowicz et al. (2000) reported that Gram positive organisms caused 73% of bacterial sepsis but highest mortality rate was observed in Gram negative septic cases.[18]

Geographical variations are observed among the pathogens causing neonatal sepsis. Recently, Gram negative organisms like *Acinetobacter, Klebsiella, Escherichia coli* and *Pseudomonas* are commonly isolated.[19] Of the Gram positive organisms, *Staphylococcus aureus,* coagulase negative *Staphylococcus, Streptococcus pneumonia* and *S. pyogenes* are most commonly isolated.[20] In this study, we found *Acinetobacter* remained the predominant isolate (32.1%) followed by *Klebsiella* species (18.0%) implycated in neonatal sepsis. Sharma et al. (2013)[21] and Shah et al. (2012)[22] reported coagulase negative *Staphylococcus* mainly responsible for neonatal sepsis and were sensitive to vancomycin only.[20-22] We found coagulase negative *Staphylococcus* were 100% sensitive to linezolid, vancomycin and chloramphenicol.

The present study shows that most of the Gram negative organisms were resistant to commonly used antibiotics like aminoglycosides and cephalosporin. About two-third cases showed resistant to meropenem, quinolones and combination preparation of piperacillin and tazobactam. Similar association had also been found in many other studies.[22-24] According to Pitout et al. (1998)[25] Gram negative organisms can produce extended spectrum beta-lactamases which is responsible for this multidrug resistance pattern.[25]

In this study, among the Gram negative isolates, maximum sensitivity was observed to polymixin B (100%) and minocycline (97%), followed by colistin (83%). In comparison to other commonly used antibiotics, sensitivity to these three medicines was statistically significant ($p<0.05$). Mustafa and Ahmed (2014) reported higher sensitivity to imipenem and linezolid which were statistically significant ($p<0.05$), but they recommended not to use these medicines indiscriminately to prevent resistance to these drugs may develop.[26]

Although multidrug resistance is a burning issue now-a-day and its severity is increasing day by day.[26] Surprisingly, in this study it was found that antibiotic sensitivity pattern for *Acinetobacter* spp. have not been changed significantly over the last four and half years.

Conclusion

Gram negative organisms specially *Acinetobacter* and *Klebsiella* were commonly responsible for the neonatal sepsis. Organisms were resistant to most of the commonly used antibiotics. Gram negative organisms were commonly sensitive to polymixin B, minocycline and colistin. Gram positive organisms were commonly sensitive to vancomycin, chloramphenicol, rifampicin and linezolid.

Ethical Issue

Approval for the study was taken from the ethical committee of the hospital.

References

1. Ghosh CR. Sample vital statistics 2015. Bangladesh

Health Bull. 2nd ed. MIS, DGHS, Dhaka, 2016.

2. Chan GJ, Baqui AH, Modak JK, Chaves AM, Mahmud AA, Boyd TK, Robert EB. Early-onset neonatal sepsis in Dhaka, Bangladesh: Risk associated with maternal bacterial colonisation and chorioamnionitis. Trop Med Int Health. 2013; 18: 1057-64.
3. Russell AB, Isaacs D. Infection in newborn. In: Rennie & Roberton's Textbook of neonatology. 5th ed. Churchill Livingstone Elsevier, 2012, pp 1013-64.
4. Stoll BJ. Infections of the neonatal infant: Pathogenesis and epidemiology. In: Nelson Textbook of pediatrics. 20th ed. Saunders, 2016, pp 909-25.
5. Zaidi AK, Thaver D, Khan TA, Ahmed T. Pathogens associated with sepsis in newborns and young infants in developing countries. Pediatr Infect Dis J. 2009; 28: 10-18.
6. Zaidi AK, Huskins WC, Thaver D, Bhutta ZA, Abbas Z, Goldmannet DA. Hospital-acquired neonatal infections in developing countries. Lancet 2005; 365: 1175-88.
7. Shrestha RK, Rai SK, Mandal PK. Bacteriological study of neonatal sepsis and antibiotic susceptibility pattern of isolates in Kathmandu, Nepal. Nepal Med Coll J. 2013; 15: 71-73.
8. Ahmed ASMNU, Chowdhury MAKA, Hoque M, Darmstadt GL. Clinical and bacteriological profile of neonatal septicemia in a tertiary level pediatric hospital in Bangladesh. Indian Pediatr. 2002; 39: 1034 -39.
9. Begum S, Baki MA, Kundu GK, Islam I, Kumar M, Haque A. Bacteriological profile of neonatal sepsis in a tertiary hospital in Bangladesh. J Bangladesh Coll Phys Surg. 2012; 30: 66-70.
10. Chan GJ, Modak JK, Mahmud AA, Baqui AH, Black RE, Saha SK. Maternal and neonatal colonization in Bangladesh: Prevalence, etiologies and risk factors. J Perinatol. 2013; 33: 971-76.
11. Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, Rudan I, Campbell H, Cibulskis R, Li M, Mathers C, Black RE. Global, regional, and national causes of child mortality: An updated systematic analysis for 2010 with time trends since 2000. Lancet 2012; 379: 2151-61.
12. Darmstadt GL, Saha SK, Choi Y, El Arifeen S, Ahmed NU, Bari S, Rahman SM, Mannan I, Crook D, Fatima K, Winch PJ, Seraji HR, Begum N, Rahman R. Population-based incidence and etiology of community-acquired neonatal bacteremia in Mirzapur, Bangladesh: An observational study. J Infect Dis. 2009; 200: 906-09.
13. Chan GJ, Stuart EA, Zaman M, Mahmud AA, Baqui AH, Robert E. Black RE. The effect of intrapartum antibiotics on early onset neonatal sepsis in Dhaka, Bangladesh: A propensity score matched analysis. BMC Pediatr. 2014; 14: 104.
14. West BA, Kaistha N, Gupta V. Antimicrobial susceptibility of isolates for neonatal septicaemia. Japan J Infec Dis. 2004; 57: 273-75.
15. Al-Shamahy HA, Sabrah AA, Al-Robasi AB, Naser SM. Types of bacteria and their antimicrobial profile. Sultan Qaboos Univ Med J. 2012; 12: 48-54.
16. Muley VA, Ghadage DP, Bhore AV. Bacteriological profile of neonatal septicemia in a tertiary care hospital from Western India. J Glob Infect Dis. 2015; 7: 75–77.
17. Pooja R, Sowmya KN, Shrikala B, Keerthiraj B. A spectrum of bacterial pathogens and its antibiotic susceptibility pattern isolated from neonatal sepsis in an NICU in a government pediatric hospital. Int Res J Biological Sci. 2015; 4: 50-54.
18. Karlowicz MG, Buescher ES, Surka AE. Fulminant late onset sepsis in a neonatal intensive care unit, 1988-1997 and impact of avoiding empiric vacomycin therapy. Pediatrics 2000; 106: 1387-90.
19. Zakariya BP, Bhat V, Harish BN, Arun Babu T, Joseph NM. Neonatal sepsis in a tertiary care hospital in South India: Bacteriological profile and antibiotic sensitivity pattern. Indian J Pediatr. 2011; 78: 413-37.
20. Vergnano S, Sharland M, Kazembe P, Mwansambo C, Heath PT. Neonatal sepsis: An international perspective. Arch Dis Child Fetal Neonatal Ed. 2005: 90: 220-24.
21. Sharma CM, Agrawal RP, Sharan H, Bhatia SS. Neonatal sepsis: Bacteria and their susceptibility pattern towards antibiotics in Neonatal Intensive Care Unit. J Clin Diag Res. 2013; 7: 2511-13.
22. Shah AJ, Mulla SA, Revdiwala SB. Neonatal Sepsis: High antibiotic resistance of the bacterial pathogens in a neonatal intensive care unit of a tertiary care hospital. J Clin Neonatol. 2012; 1: 72–75.
23. Shrestha RK, Rai SK, Mandal PK. Bacteriological study of neonatal sepsis and antibiotic susceptibility pattern of isolates in Kathmandu, Nepal. Nepal Med Coll J. 2013; 15: 71-73.
24. Jadba AHE, Yazji MS. Neonatal septicemia in Gaza City Hospitals. Pakistan J Med Sci. 2009; 25: 226-31.
25. Pitout JDD, Thomson KS, Hanson ND. Beta Lactamases responsible for resistant to expanded-spectrum cephalosporin in *Klebsiella pneumoniae, Esch. coli* and *Proteus mirabilis* isolates recovered in South Africa. Antimicrob Agents Chemother. 1998; 42: 1350–54.
26. Mustafa M, Ahmed SL. Bacteriological profile and antibiotic susceptibility patterns in neonatal septicemia in view of emerging drug resistance. J Med Allied Sci. 2014; 4: 2-8.