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Original Research Article

Clinical and bacteriological profile of children with community acquired pneumonia admitted in pediatric ward in tertiary care hospital of central Gujarat, India

Ritesh A. Chaudhari*, Rinki H. Shah

Department of Pediatrics, Baroda Medical College, Vadodara, Gujarat, India

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***Correspondence:**
Dr. Ritesh A. Chaudhari,
E-mail: drritesh1612@gmail.com

ABSTRACT

Background: Community-acquired pneumonia is the leading cause of mortality of under-five children in developing countries, including India. Based on the burden of CAP, India is among the top five countries and has over 23% of the global cases. Accurate, reliable, and rapid determination of etiology in childhood CAP is important because it would influence individual treatment decisions, antibiotic policy in the community, and also rational immunization policy at a national level. Objectives of current study were to study the clinical and bacteriological profile of children admitted with CAP and to determine sensitivity and resistance patterns to various antibiotics to these organisms.
Methods: This was a prospective and observational study conducted over one year in the Paediatric ward SSG hospital Vadodara, Gujarat, India. Blood culture and Oropharyngeal swab/endotracheal swab for culture and sensitivity were collected in all study patients. Organisms isolated in blood culture and oropharyngeal/ET swab were analysed in percentage and frequency.
Results: Chest retraction (88%) was the commonest sign observed in this study followed by tachypnoea (74%). In blood culture, Acinetobacter was the most common organism isolated and in oropharyngeal and ET swab culture was Klebsiella spp. Major co-morbidity contributing to mortality was severe anemia followed by severe acute malnutrition.
Conclusions: Bacterial cultures of blood and oropharyngeal/ ET secretion swab culture have grown predominantly Acinetobacter and Klebsiella pneumoniae in this study. Administration of sensitive antibiotics as per the geographical bacteriological profile of community-acquired pneumonia will help to improve outcomes and prevent antibiotic resistance.

Keywords: Community acquired pneumonia, Blood culture, *Acinetobacter*, *Klebsiella*

INTRODUCTION

Community-acquired pneumonia (CAP) is a lower respiratory tract infection occurring in a child who has not been admitted to a hospital or health care facility in the preceding 14 days.[1] The sign and symptoms of pneumonia in older children include fever, cough, tachypnea and occasionally, hypoxia progressing to apnea and need for ventilatory support. The WHO has defined clinical criteria for making the diagnosis of pneumonia.[2] The criteria consists of the presence of a fever and cough associated with tachypnea. Bacterial pneumonia is classically associated with the abrupt onset of fever with chills and rigors, and a productive-sounding cough (truly productive cough is very uncommon in children). The child more commonly appears toxic and physical examination reveals decreased breath sounds and crackles that are typically confined to one lobe. In contrast, atypical pneumonia has an insidious onset and is associated with a non-productive cough, low-grade fever, and generally, the children are not

as toxic as those with bacterial pneumonia. The chest X-ray shows more diffuse involvement. It should be noted that typical bacterial pathogens, such as *S. pneumoniae* and *Haemophilus influenzae* are most commonly associated with the classic presentation and atypical pneumonia is more commonly associated with *M. pneumoniae* and *C. pneumoniae*. However, all of these organisms may present in either fashion somewhere between the two extreme clinical pictures.[3] CAP is the leading cause of mortality of under-five children in developing countries, including India. Annually there are 151.8 million new cases of CAP.[4] Based on the burden of CAP, India is among the top five countries and has over 23% of the global cases.[5] Nowadays, there is an increase in the resistance pattern of drugs due to overuse and inappropriate use of drugs by inexperienced fellows. Accurate, reliable, and rapid determination of etiology in childhood CAP is important because it would influence individual treatment decisions, antibiotic policy in the community, and also rational immunization policy at a national level. With this thought in mind, this study was conducted to identify the common bacteriological agents causing CAP and the sensitivity pattern of bacteria of CAP in admitted cases in tertiary care hospitals in Vadodara.

METHODS

This was a prospective and observational study conducted over one year between October 2020 to September 2021 in the Paediatric ward and pediatric ICU, SSG Hospital Vadodara, Gujarat, India. Informed written consent was taken before the enrolment of the patients. Inclusion criteria were children aged 1 month to 12 years who presented with a history of fever, cough and difficulty in breathing fulfilling WHO case definition of CAP. A total of 100 children admitted with CAP were enrolled. Sampling method After the admission of a child, detailed history of fever, cough-cold, fast breathing/difficulty in breathing was taken from the parents. Anthropometric measurements were recorded in each case; which were then used to diagnose severe acute malnutrition and/or moderate acute malnutrition by using WHO criteria. A thorough clinical examination was done including the general condition of the patient at the time of admission, vital signs including axillary temperature, pulse rate, respiratory rate and blood pressure were noted. SpO_2 was taken in all patients with pulse oximeter without oxygen support to note hypoxia. Detailed clinical examination of the respiratory system was done and another significant positive finding of the other system was also noted. A blood sample was drawn by venepuncture for routine investigations. Oropharyngeal swab for culture and sensitivity was collected in all patients except those who require mechanical ventilation. Endotracheal swab for culture and sensitivity was collected in intubated patients who required mechanical ventilation. Chest X-ray was done to examine the site, type, and associated complications. Blood culture was collected from a vein under strict aseptic measures using povidone-iodine, rectified spirit for skin sterilization in each patient. About 5 ml of blood was collected in BD BACTEC culture vial before administration of parenteral antibiotics, which was observed for the growth of organisms after 24 hours and 72 hours. Sample for oropharyngeal swab was taken by tilting up and opening patient's mouth; depress tongue with a tongue depressor and posterior pharynx will be swabbed with swab stick by avoiding tonsils with proper aseptic precaution and endotracheal secretion swab in a patient requiring intubation and mechanical ventilation with standard precaution and sent in microbiology lab. Exclusion criteria in current study were newborns, hospital-acquired infections, children with wheeze with a diagnosis of asthma, respiratory distress due to other causes like metabolic, CNS, etc and pneumonia due to COVID-19 infection.

Statistical analysis

Data analysis and chart preparation were done using the Microsoft® Excel® 2019 MSO (version 2111 build 16.0.14701.20254) 64-bit. Values for continuous data were expressed as mean±SD (if normally distributed) and median (range) if not normally distributed. Percentage and frequency were considered in most of the other data analysis.

RESULTS

In this study total of 100 patients were enrolled as per inclusion criteria. Among 100 patients, 58 were male and 42 were female children with a male to female ratio of 1.38:1. A total of 66 (66%) patients were in the age group of 1-12 months 29 (29%) patients were in the 13-59 months of age group and 5 (5%) patients were >5 years in age with the mean age of presentation of 17.4 months. 48 (48%) were from the rural area, 38 (38%) were from urban are and 14 (14%) were from a tribal area (Table 1).

Table 1: Demographic profile of study patients.

Parameter	N	%
Age		
1-12 months	66	66
13-59 months	29	29
>5 years	5	5
Sex		
Male	58	58
Female	42	42
Geographical data		
Rural	48	48
Urban	38	38
Tribal	14	14

Fever, cough and cold, fast breathing were the most common presenting complaints present in 100% while an inability to drink was present in 26% of the patients. Mean days of fever was 4.3 days with 3.6 SD and mean

days of cough and cold complain were 4.5 with 3.7 SD while mean days of difficulty in breathing/fast breathing were 2 with 1.4 SD (Figure 1).

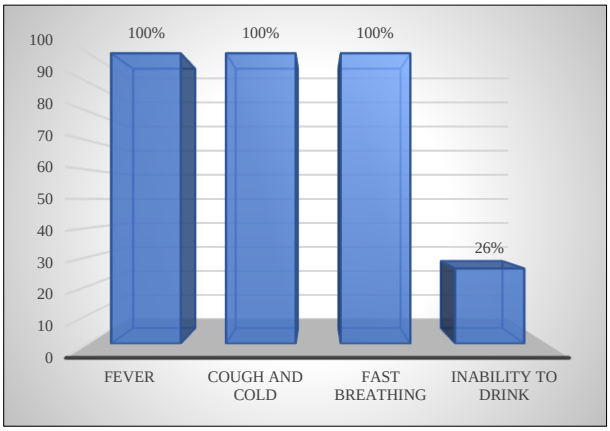

Figure 1: Mode of presentaion (symptoms).

In 28% of patients, fever was present on admission, tachypnea was present in 74% of patients, 88% of patients had chest retraction, clinical cyanosis was present in 33% due to respiratory cause after ruling out cardiac causes clinically, 63% had hypoxia as per spo2 measurement by pulse oximeter and 20% patients were presented with the sign of shock (Figure 2).

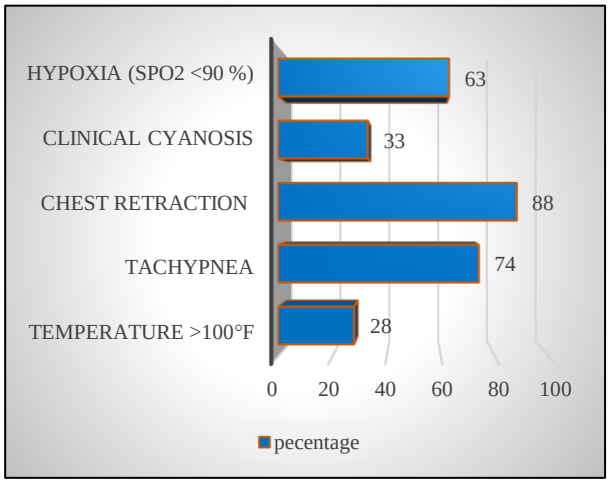

Figure 2: Mode of presentation (sign).

Although fever, cough-cold, and difficulty/fast breathing were main presenting complain, multiple patients presented with danger signs including vomiting, inability to drink, lethargy, and convulsion. Convulsion was most probably attributed to hypoxia after ruling out other causes clinically. 26% patients have complained of inability to drink, 17% complained of lethargy, and 4% with convulsion. As per the national immunization program in, 15% were completed up to primary immunization, 22% were partially immunized, 11% were immunized between MR-2 and DPT-B2 where else 18% were completely unimmunized in this study. 34% patients were immunized up to age in this study as per national immunization program. 36% were fell into severe acute malnutrition (SAM), 12% into moderate acute malnutrition (MAM) as per WHO criteria. 34% of patients were well-nourished and 18% were undernourished. In our study, we have observed that the majority of the patients had mild anemia (62%), followed by severe anemia (19%), moderate anemia (13%), and 6% of patients had no anemia. In our study, mild respiratory distress involves tachypnea and shortness of breath, moderate respiratory distress involves nasal flaring and subcostal retraction and, severe respiratory distress involves suprasternal retraction, apnea, gasping respiration, head bobbling. 32% of patients presented with mild respiratory distress, 45% presented with moderate respiratory distress, and 23% patients presented with severe respiratory distress. Based on chest X-ray, 58% of the patients had bronchopneumonia, 34% had a lobar pneumonia-like picture which also includes multilobar pneumonia, 4% of the patients were showing viral pneumonia-like chest X-ray findings. 2% of the patients had sympneumonic effusion and, 2% had effusion which on further evaluation turned out to be empyema (Table 2).

Table 2: Age wise distribution of chest X-ray diagnosis.

Chest X-ray	Age group	N
Bronchopneumonia	1-12 months	39
	13-59 months	17
	>5 years	2
Lobar pneumonia	1-12 months	21
	13-59 months	11
	>5 years	2
Viral pneumonia	1-12 months	4
Empyema	1-12 months	1
	>5 years	1
Sympneumonic effusion	1-12 months	1
	13-59 months	1
Total		100

Total 80% of patients among the 100 enrolled in the study did not isolate any organism in the blood culture and 20 % of patients had isolated the organism in the blood culture. *Acinetobacter spp.* (6%) is the most frequently isolated organism in the blood culture followed by staphylococcus aureus which isolated in 4% of the patients. *E. coli* and coagulase-negative *Staphylococcus* (CONS) each isolated in 3% patients. *Pseudomonas spp.* and methicillin resistant coagulase negative *staphylococcus* (MRCONS) each were isolated in 2% of patients (Table 3).

In oropharyngeal & ET swab culture, a total 26% of patents have positive growth in study patients. The most common organism isolated organism was *Klebsiella spp.* (9%) followed by *Acinetobacter spp.* (8%), *E. coli* (5%), *pseudomonas spp.* (3%) and *Staphylococcus aureus* (1%) (Table 4).

Table 3: Distribution of organism isolated in blood culture.

Organism isolated	N (%)
No organism	80 (80)
Acinetobacter spp.	6 (6)
Staphylococcus aureus	4 (4)
Cons	3 (3)
E. coli	3 (3)
Pseudomonas spp.	2 (2)
Mrcons	2 (2)

Table 4: Microbiological profile in oropharyngeal and ET culture.

Organism isolated	N (%)
No organism	74 (74)
Klebsiella spp.	9 (9)
Acinetobacter spp.	8 (8)
E. coli	5 (5)
Pseudomonas spp.	3 (3)
Staphylococcus aureus	1 (1)
Total	3 100

Table 5: Organism and antibiotics sensitivity.

Organism isolated	common antibiotics sensitive
Acinetobacter spp.	Meropenem, levofloxacin, vancomycin, linezolid, gentamycin, cefepime, polymyxin B
Staphylococcus aureus	Vancomycin, linezolid, cefoxitin, gentamycin, amoxiclav, erythromycin.
E. coli	Piptaz, amikacin, meropenem, levofloxacin
Coagulase negative staphylococci	Vancomycin, linezolid, clindamycin, gentamycin, cefoxitin
Mrcons	Vancomycin, linezolid
Pseudomonas spp.	Piptaz, cefepime, meropenem, gentamycin, levofloxacin
Klebsiella spp.	Levofloxacin, meropenem, piptaz, ceftriaxone, ceftazidine

As per the antibiotic sensitivity pattern observed in the isolated organism in blood culture, oropharyngeal swab, and ET swab culture and sensitivity, more common antibiotics sensitive are mentioned in (Table 5).

Total 81% of patients received oxygen support in the form of nasal prongs, non-rebreathing masks, oxygen hood, etc., 91% patients received antipyretic and analgesic, 50% patients received iv fluid while 33% patients received the mechanical ventilation support from total study patients in the present study. The median duration of the stay in hospital in the study patients was 10 with inter quartile range between 7 to 14. 76% of patients were successfully discharged from the health care system, 19% patients were expired during the treatment course, while 5% of patients took discharged against medical advice (DAMA) due to various reasons from the study patients. Detail demographic profile of expired patients is given in (Table 6). Contributing factors (co-morbidities) in mortality in this study were as follows.

Table 6: Demographical profile in expired patients.

Parameter	N	%
Age		
1-12 months	11	57.8
13-59 months	08	42.1
>5 years	00	0
Sex		
Male	11	57.8
Female	08	42.1
Geographical data		
Rural	7	36.8
Urban	9	47.3
Tribal	3	15.7
Immunization status		
Primary immunization	4	21.5
Partialy immunization	11	57.8
Unimmunized	4	21.5

Table 7: Comparison of organism isolated in various studies in oropharyngeal/nasopharyngeal swab culture.

Study	Results
Western Rajasthan based study-32.3% positive culture	The most common organism isolated was *S. pneumonia* (18.5%), followed by *S. aureus*, *Hemophilus influenza*, *Klebsiella*, and *Pseudomonas*.
Jhansi, UP based study-18% positive culture	The most common organism isolated was *S. pneumonia* (10%), followed by *S. aureus* (4%), *E. coli* (2%), and *Klebsiella spp.* (2%)
Agra, UP based study-40% positive culture	The most common organism isolated was *S. aureus* (18.7%), followed by *S. pneumonia* (6%), *E. coli* (4.7%), *Klebsiella* (4.7%), Coagulase negative *Staphylococci* (CONS) (3.3%) and *Pseudomonas* (2.7%).
Telangana based study-31% positive culture	The most common organism isolated was klebsiella (14.0%), followed by *S. aureus* (13.6%), *S. pneumonia* (0.91%) *Pseudomonas spp* (0.9%) and *Citrobacter 1* (0.9 %)
Our study	*Klebsiella spp.* (9%) was the most common organism isolated followed by *Acinetobacter spp.* (8%), *E. coli* (5%), *Pseudomonas spp.* (3%) and *S. aureus* (1%).

Total 79% of the patients had severe anemia, 21% had moderate anemia, 52.6% of the expired patients were SAM, 5.2% were MAM while 5% patients were

undernourished. Among SAM patients in expired group, 6 were in infant age group and, 4 were in 13-59 months of age out of 10. Other factors include AKI (26.3%), pyogenic meningitis (5.25%), and septic shock in 26.3% of expired patients. Out of 19 patients expired, 6 patients (31.5%) expired primarily due to severe pneumonia within 72 hour of admission, other causes of expiry include septicemia with septic shock (21%), ARDS with septic shock (15.7%), severe anemia with CCF (5.2%), pyogenic meningitis (5.2%), septic shock with AKI (5.2%), ARDS with severe pneumonia (5.2%) and, pneumonia with severe anemia (5.2%). In our study, mortality is 19% which is close.

DISCUSSION

Pneumonia continues to be the leading cause of mortality and morbidity of children in developed and developing countries in spite of improvement in immunization, socioeconomic status, and early diagnosis and treatment. Antimicrobial-resistant bacterial species have been evolved due to various factors like the widespread and sometimes inappropriate use of antimicrobial agents and the increase in regional and international travel with which antimicrobial-resistant bacteria cross geographical barriers.[6]

In our study, 100 patients of community-acquired pneumoniae were enrolled.

Total 66 (66%) patients were reported in the age group of 1-12 months, 29 (29%) were reported in the age group of 13 months to 59 months and 5(5%) were >5 years of age. This is in accordance with other studies in India, in a study done in 2009 in western Rajasthan majority of patients, 65.8% belonged to the age group 2-11 months followed by 34.2% belonging to the 12-59 age group.[7] Low immunity, smaller and narrower airways and frequent exposure to infection, poor nutritional status as well as more susceptibility of infants to viral and general infections are several factors that attribute to more occurrence of pneumonia cases in children less than one year of age. In our study, male were more affected than female children (58 % vs. 42%) with a male to female ratio of 1.38:1. In the study done in Agra, Uttar Pradesh in 2021, The male (54.7%) outweighs the females 68 (45.3 %), with a male:female ratio of 1.21.[8] In the current study, cough, and cold (100%), fever (91%), fast breathing/ difficulty in breathing (76%), chest retraction (88%), refusal to feed/ inability to drink (26%), and vomiting (23%), central cyanosis (21%), peripheral cyanosis (12%) were the common clinical feature and majority of the patients presented with moderate respiratory distress (45%) while 23 % were received in severe respiratory distress. In another similar study (8) common clinical features were cough (90.7%), fever (88%), difficulty in breathing (81.3%), and refusal to feed (41.3%). In one study done in Tertiary Health Care Centre in Odisha 2017 cough, tachypnoea, and chest in-drawing were present in 100% of studied cases, fever in 97.16%, severe respiratory distress in 40.42% and central cyanosis in 0.7%, inability to take food or refusal to food in 40.42% cases.[9]

In our study, 34% of patients were immunized up to the age, 22% were completed up to primary immunization, 15% were partially immunized, 11% were immunized between MR-2 and DPT-B2 whereas else 18% were completely unimmunized. Not a single child was immunized against *Pneumococci* in our study as PCV was not introduced in the government immunization program during this study period. 52.3% of children were completely immunized and 19.2% children were partially immunized in a western Rajasthan-based study.[7] Currently, the Government of India is introducing the pneumococcal vaccine in the national immunization program which very welcoming step from the government to improve vaccination coverage and to reduce childhood pneumonia cases in the country. In our study, 66 % of patients were malnourished those are including severe acute malnutrition (36%) and moderate acute malnutrition (12%) in the age group of 6 months to 5 years of age and other 18 % undernourished children of more than 5 years of age and infant of 1 month to 6 months of age. Malnutrition was associated with 48.7% of cases and asthma with 3.9% of cases in the study done in western Rajasthan.[7] Malnutrition was the most common co-morbidity associated with CAP. This was in coordination with other studies that show malnutrition to be the significant risk factor associated with pneumonia.[10] Malnourished children have a higher incidence and severity of infections due to deterioration of immune function, limited production, and/or diminished functional capacity of all cellular components of the immune system. These factors increase the risk of fatal outcomes in children with pneumonia who have co-morbidity of severe acute malnutrition, increasing the fatality 15 times compared to those who do not have severe acute malnutrition. The comparison of blood culture and oropharyngeal swab culture of various studies are given in (Table 7). Although *S. pneumoniae* is the most common organism associated with CAP, the sensitivity of blood cultures for *S. pneumoniae* is reduced due to production of autolysin by the organism itself and contamination of cultures with fast-growing organisms mainly in developing countries, Despite the fact that, automated blood culture systems provide the option of immediate sub-culture by identifying bottles with growth of any bacteria, most microbiology laboratories do not work around the clock and thus, even where automated detection of growth in blood cultures exist, there may be a delay between the signal of growth in the culture bottle and sub-culturing. These factors may lead to lower sensitivity of pneumococcal isolation from blood cultures and thus, reduced estimates of disease burden as happened in our study.[12]

In the current study, mortality was 19% with a case fatality rate of 6% with major contributing factors include severe anemia, SAM, AKI and, sptic shock. Comparing

other studies, 8.5% mortality was observed in western Rajasthan-based study, 8% mortality in Jhansi, UP based study and 21.98% mortality were observed in Odisha based study.[6,7] Compared to UNICEF analysis based on WHO and Maternal and Child Epidemiology Estimation Group interim estimates in 2019 pneumonia contributes to 12% under 5 years of age mortality date, close to 19% mortality in our study.[13]

Limitations

Limitations of current study were; as this was a hospital-based study, different forms and aetiologies of CAP does not represent to entire population. Viral pathogens isolation was not included in this study due to non-availability of PCR facility for viral isolation in our centre.

CONCLUSION

The conclusion from our study is that incident of CAP is more common in children of infant age group, children with malnutrition, anaemia and lack of vaccination coverage. This sensitivity and resistance pattern of antibiotics for isolated organism observed in this study can be used to formulate the antibiotic policy in children with community acquired pneumonia in study hospital.

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