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Original Research Article

Bronchoalveolar lavage for etiological diagnosis of childhood pneumonia

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ABSTRACT

Background: Pneumonia is the most common cause of childhood morbidity and mortality in age group less than 5 years. Identification of causative organism is a real challenge in these children though many of them are responding to the first line antibiotics therapy. Isolation of the organism is of paramount importance those who fails to respond to first line therapy. The objective of this study was to determine the relative efficacy of Bronchoalveolar Lavage (BAL) over blood culture in finding out causative organisms of childhood non responder community acquired pneumonia and to study antibiotic-sensitivity pattern of causative organisms.
Methods: BAL and blood culture was performed in 17 patients of age 2 months to 5 years with pneumonia or severe pneumonia. Lavage fluid was cultured and growth of organism 10000CFU/ml was considered positive. Blood culture was taken on the same day. Antibiotic sensitivity was tested.
Results: BAL isolated the organism in 82.35% (n=14) cases out of 17 patients and in 11.76% (n=2) by blood culture (p=0.002). Streptococcus pneumoniae was the most common organism isolated (58.82% (n=10)), followed by K. pneumoniae (23.53% (n=4)). Antibiotic therapy was changed in 58.82% (n=10) cases according on culture report. Transient rise in temperature, tachycardia and tachypnea was noted after procedure but no major complication was associated with BAL.
Conclusions: BAL fluid culture in childhood pneumonia has high diagnostic value and better efficacy over blood culture in isolating causative organism without increased risk of complication and decreases unwanted exposure to empiric antibiotic in children with community acquired pneumonia who did not respond to initial 1st line therapy.

Keywords: Antibiotic resistance, Bronchoalveolar lavage, Blood culture, Childhood pneumonia

INTRODUCTION

Pneumonia, represent any inflammatory condition involving the lungs, is a substantial cause of morbidity and mortality in childhood throughout the world.[1] It's one of the oldest disorders known to human kind. It is referred as "pneumonitis" when the cause is non-infectious.[2]

As per World health organization (WHO) ARI control programmed pneumonia is defined as "The presence of cough with fast breathing of 60/min or more in less than 2 months of age, 50/min or more in 2 months to 12 months of age and 40/min or more in 12 months to 5 years of age".[3] The presence of lower chest wall in drawing is taken as evidence of severe pneumonia. The presence of refusal of feed, central cyanosis, lethargy and

convulsions is taken as evidence of very severe pneumonia.[3] In India annually approximately 3.7 lakh children die of pneumonia, contributing to 50% of World's pneumonia deaths.[4] Adequate appropriate antimicrobial therapy as per WHO recommendation is the cornerstone of successful management of community acquired childhood pneumonia.

Pneumonia can be caused by a myriad of microorganisms, but most cases are caused by bacteria. Diagnosis of pneumonia is relatively straightforward; however, since so many microorganisms can cause pneumonia, determining the cause of a patient's pneumonia very challenging. Blood investigations and chest x-ray help in diagnosis but are not specific. Serologic techniques can also be used to diagnose a recent respiratory viral infection but generally require testing of acute and convalescent serum samples and is laborious, slow, and clinically not useful because the infection usually resolves by the time it is confirmed serologically.[1]

Blood culture is of value in neonates, because most neonatal pneumonias are hematogenous in origin and others serve as a focus for secondary seeding of the bloodstream. But blood culture results are positive in only 10% of children with pneumococcal pneumonia, even less in patients with Staphylococcus infection.[1] Blood culture is still recommended in complicated cases of pneumonia to identify the pathogen and its antimicrobial susceptibility patterns. Bronchioalveolar lavage (BAL) is a method used to obtain a representative specimen of fluid and secretions from the lower respiratory tract, which is useful for the cytologic and microbiologic diagnosis of lung diseases. Studies in patients with ventilator associated pneumonia showed that Intracellular bacteria and gram stain from bronchoalveolar secretions were very specific (95% and 81%, respectively) and cultures were very sensitive (90%).[5]

Because definitive information about the causative organism is usually unknown, the choice of antibiotic is empiric.[6] Moreover antibiotic exposure is a cause for antibiotic resistance; therefore, limiting exposure to any antibiotic, whenever possible, is preferred and limiting the spectrum of activity of antimicrobials to that specifically required to treat the identified pathogen is preferred.[7] Unnecessary antibiotic use also leads to wastage of healthcare resources, and unnecessarily exposes patients to risk of adverse effects.

METHODS

The study was conducted in the department of Pediatrics of Assam Medical College and hospital which is a tertiary care teaching hospital from July 2013 to June 2014. Study protocol was approved by hospital ethical committee. Written informed consent was taken from the parents. Children between 2 months to 5 years of age who were admitted between July 2013 to June 2014 with diagnosis of pneumonia and severe pneumonia as per WHO criteria and with x-ray features suggestive of pneumonia who did not respond to first line antimicrobial therapy were included. Children who continued to have fever and or tachypnea after 48 hours of receiving first line antibiotics were considered as non-responders. Children with very severe pneumonia (as per previous WHO guideline), congenital heart disease, bleeding diathesis, uncorrectable hypoxia are excluded.

Chest X-ray was obtained in all enrolled patients. Patients with infiltrates in chest X-ray were investigated further for hemoglobin percentage, total and differential leucocyte count, ESR by collecting venous blood. Platelet count, BT/CT was measured to rule out any bleeding diathesis. Patients fulfilling the inclusion criteria were prepared for blood culture and bronchoalveolar lavage.

Venous blood was obtained for culture from peripheral veins away from existing I/V lines after proper antiseptic dressing. 5 ml blood was inoculated in 50 ml blood culture bottle, containing trypticase soy broth and mixed thoroughly by gentle inversion. After collection the blood culture bottles were transported directly to the laboratory and incubated aerobically at 37°C. Primary plates were observed for any visible growth after 24 hours and if there was no growth within 24 hours, the plates were re incubated for 24 hours.

Bronchoalveolar lavage was performed after achieving adequate depth of anaesthesia. BAL was carried out using normal sterile pyrogen-free saline previously warmed to body temperature (37ºC). It was instilled in 2 aliquots of 1 ml/kg body weight. Each instillation was followed by sufficient air to ensure that the channel's dead space was empty and then it was recovered by using the mechanical aspiration. Negative pressure was applied for obtaining BAL fluid with a suction machine attached to a mucus extractor for controlled aspiration through the suction channel of the bronchoscope. The two aliquots collected in the sterile mucus extractor were used for culture. Primary plates were observed for any growth after 24 hours, growth of 10000 CFU/ml is considered positive growth and if there was no growth within 24 hours, the plates were re incubated for 24 hours. All patients were monitored for 4 hours or till full consciousness was regained after the procedure. During this time continuous monitoring of heart rate and oxygen saturation were done. Respiratory rate recorded at 30 min interval and temperature monitoring was done 1 hourly. Nebulization with salbutamol was given at 2-hour interval.

Data was recorded on a predesigned proforma and managed on excel spread sheet. The yield in blood culture and bronchoalveolar lavage was compared. Data analysis was performed using Microsoft excel. Sensitivity, specificity and comparison were done by using GraphPad InStat version 3.10 software. In this

study p value less than 0.05 was considered as statistically significant.

RESULTS

Total 17 cases fulfilling the inclusion criteria were enrolled. Majority 52.94% were between one to five years of age with male to female ratio of 2.4: 1. Clinically 10 cases were diagnosed as severe pneumonia. Hurried breathing (100%), fever (100%), cough (94.12%) were most common symptoms whereas refusal to feed (52.94%) and grunting (11.76%) were fewer common presentations (Table 1).

Table 1: Demographic with clinical features.

Variable	Number of cases (n)	Percentage
Total number of cases	17	100
Male	12	70.59
Pneumonia	7	41.17
Severe pneumonia	10	58.83
Symptoms and signs		
Hurried breathing	17	100
Fever	17	100
Cough	16	94.12
Crepitations	14	82.35
Chest retraction	10	58.82
Refusal to feed	9	52.94
Grunting	2	11.76

In this study causative organism was able to be isolated in 15 cases (88.24%). By bronchoalveolar lavage organism was isolated in 14 cases out of the total 17 cases (82.35%) whereas by Blood culture yield was only 11.76% (2 cases) (p value 0.002). In 1 case same organism was isolated by both BAL and blood culture (Table 2).

Table 2: Organism isolated in BAL and blood culture.

Causative organism	Bronchoalveolar lavage		Blood culture	
	n	%	n	%
S. pneumoniae	9	52.94	1	5.88
K. pneumoniae	4	23.53	1	5.88
P. aeruginosa	1	5.88	0	0.00
Sterile	3	17.65	15	88.24
Total	17	100	17	100

The most common organism isolated in present study was *Streptococcus pneumoniae*, isolated in 10 children (58.82%). *Klebsiella pneumonia* was isolated in 4 cases (23.53%), out of which 3 cases (75%) by BAL and in 1 case by both blood culture and BAL culture. Pseudomonas aeruginosa was found in 1 case (5.88%) by BAL only. *Streptococcus pneumoniae* was sensitive to piperacillin-tazobactam and amikacin in all cases (100%), and to amoxyclav only in 30% (n=3) cases in our children. *Klebsiella pneumoniae* was sensitive to piperacillin-tazobectum, ceftriaxone and ciprofloxacin in all 4 cases (100%) and sensitive to amoxyclav and amikacin in only 25% cases. Similarly, Pseudomonas aeruginosa was sensitive to piperacillin-tazobactam and ceftriaxone in all cases (Table 3).

Table 3: Antibiotics sensitivity to organism isolated.

Antibiotics	*S. pneumoniae*		*K. pneumoniae*		*P. aeruginosa*	
	n	%	n	%	n	%
Amoxyclav	3	30	1	25	0	0
Piperacillin and Tazobactum	10	100	4	100	1	100
Amikacin	10	100	1	25	0	0
Ceftriaxone	4	40	4	100	1	100
Ciprofloxacin	9	90	4	100	0	0

Change in antibiotics was required in 58.82% cases depending on the sensitivity pattern of the organism isolated and the clinical condition of patient.

DISCUSSION

Pneumonia remains the leading cause of death in children worldwide. The majority of pneumonia cases are preventable or treatable. Early diagnosis and use of appropriate antibiotics are the key factors in preventing deaths due to pneumonia for which a better understanding of the range of pneumonia pathogens is needed. In present study, authors were able to isolate a causative organism in 15 cases (88.24%). Authors were able to isolate organism in 14 cases (82.35%) in BAL. which is in comparison with study done by De Blic J et al, (60%), De Schutter I et al, (76%) and Selimović A et al, (85%).[8-10] Whereas, organism was isolated only in 11.76% cases by blood culture. Similar results were found in studies by Kabra SK et al, (16%), Falade AG et al, (18%) and Myers A L et al, (7%) too.[11-13] Causative organism was isolated by bronchoalveolar lavage in 82.35% cases and in

11.76% in blood culture which was highly significant (p <0.01). This was in comparison with the study done by Luna CM et al, where BAL was positive in 55.56% and blood culture in 16.67% cases.[14] Similar results were also obtained by Khattab AA et al, where BAL was positive in 100% cases and blood culture in 38.4%.[15]

The most common organism isolated from culture, *Streptococcus pneumoniae* has highest sensitivity to aminoglycoside like amikacin (100%), Penicillin's/inhibitor combination like piperacillin tazobactam (100%) and fluoroquinolone like ciprofloxacin (90%). Low sensitivity was seen to the commonly used penicillin group antibiotic like amoxicillin (30%). Similar sensitivity results were also obtained by Devi U et al, showing increasing penicillin resistance in this part of country.[16]This may be because of the fact that amoxicillin being most commonly used antibiotic for any type of infection in children particularly respiratory tract infection, which has led to high percentage of resistance of the organisms to these drugs. *Klebsiella pneumonia* the second most common organism isolated was sensitive to piperacillin tazobactam, ceftriaxone and ciprofloxacin in all cases (100%). Low sensitivity was seen to amoxyclav and amikacin (25% each).

Antibiotic resistance is a global public health problem. ARI are the most common cause of unnecessary antibiotic use. There are reports of increasing antibiotic resistance among common pneumonia causing bacteria (*Streptococcus pneumoniae* and *Hemophilus influenzae* b), including India.[17] Unnecessary and inappropriate use of antibiotics is the main cause of antibiotic resistance. Though number of studies have been conducted for isolation of organism in children with ventilator associated pneumonia but there was very little data on CAP. Various other methods had been used for isolation of organism including blood culture, sputum culture and induced sputum culture but very few studies done on BAL culture as a modality of choice. This is because of unavailability of bronchoscope in most of the centers and risk related to procedure in a child. BAL was associated with transient tachycardia and fever after the procedure, which subsided within 2-5 hours {mean (±SD) = 3.4 hours (±1.17)). There was transient increase in respiratory rate after the procedure, but the increase was statistically not significant, no patient required transfer to the intensive care unit or respiratory support in present study. Similar complications were also noted in their study by Somu N et al, and Blic JD et al.[8,18] No case of respiratory complication was associated with bronchoscopy or bronchoalveolar lavage. No cases of hemorrhagic complications were observed during the study. The measure limitation to present study was sample size. A larger sample size would have shown better results. The other limitation was, BAL fluid and blood was used for culture only, addition of other microbiological procedure like PCR, antigen detection could have increased the yield.

CONCLUSION

Bronchoalveolar lavage is able to isolate the causative organism in most of the cases and has a significantly high yield when compared with blood culture and has a high diagnostic value. Inappropriate use of amoxyclav in children has led to increased resistance of the organisms to this drug. However, further study needs to be done with larger sample size to improve the sensitivity and specificity, so that BAL can be used an important diagnostic tool in tertiary care centres where the facility is available.

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