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ORIGINAL ARTICLE

MICROBIAL ETIOLOGY OF COMMUNITY ACQUIRED PNEUMONIA AMONG INFANTS AND CHILDREN ADMITTED TO ZAGAZIG UNIVERSITY PEDIATRIC HOSPITAL

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ABSTRACT

Background: While recognizing the etiology of community-acquired pneumonia is necessary for formulating local antimicrobial guidelines, limited data is published about this etiology in Egyptian pediatric patients. The aim of this study is to elucidate the common bacterial pathogens causing CAP among immunocomptent infants and preschool children admitted to Zagazig university Pediatric hospital. **Methods:** 48 infant and preschool children admitted to pediatric hospital of Zagazig university and presented with signs of pneumonia according to WHO. Etiological agents were identified using conventional bacteriological identification methods and Ig M antibodies detection against common a typical bacteria and respiratory viruses. **Results:** *Staph. Aureus 35.4%* is the most common pathogen detected in sputum regardless the age group .In blood culture results negative results in most cases of pneumonia 62.5%. *Staph. Aureus* is the most common pathogen detected in blood culture in positive cases regardless the age group 18.7% , E Coli 6.25%, Klebsiella 2.08.In Serology results significant difference according to age in viral pneumonia occurrence and non significant difference in bacterial pneumonia based on serological findings with higher diagnosis of *Legionella pneumophila 33.33%* as a causative organism. **Conclusion:** This study provides preliminary data regarding the spectrum and frequency of microorganisms causing CAP in infants and preschool children.

Key words: Pneumonia; respiratory infection; bacterial; viral.

INTRODUCTION

Community-acquired pneumonia (CAP) is asignificant cause of respiratory morbidity and mortality in children especially in developing countries. Worldwide, CAP is the leading cause of death in children younger than five years **[1].**

*Streptococcus pneumoniae*is the most common bacterial cause of (CAP).*Mycoplasma pneumoniae*, Chlamydophila Pneumoniae*and S. pneumoniae*are the predominant etiologies of CAP in school-aged children. *Haemophilus Influenzae* and group A Streptococcus are less common causes. Viruses cause a significant percentage of CAP infections, especially in children younger than two years **[2].**

The prevalence of viral pneumonia decreases with age. Respiratory syncytial virus, influenza A, and parainfluenza types 1 through 3 are the most common viral agents. Other viral

pathogens include adenovirus, rhinovirus, influenza B, and enteroviruses **[2].**

Common physical findings in CAP include fever, tachypnea, increasingly labored breathing, rhonchi, crackles, and wheezing. Hydration status, activity level, and oxygen saturation are important and may indicate the need for hospitalization **[3].**

Chest radiography is often used to diagnose CAP. Bacterial and viral pneumonia may be suspected based on radiographic findings; however these findings are not highly specific **[4].**

C-reactive protein, white blood cell count, and erythrocyte sedimentation rate have limited use in the diagnosis of bacterial pneumonia **[5].**

Sputum cultures are of limited use in diagnosis or therapy. Blood culture and serological analysis play also role in diagnosis of CAP **[6].**

The initial antibiotic treatment of CAP is empiric because the pathogen is rarely known at the time of diagnosis. Empiric antibiotic choices should be based on the patient's age and severity of illness, and local resistance patterns of common pathogens **[7].**

The aim of this study is to elucidate the common bacterial pathogens causing CAP among immunocomptent infants and preschool children admitted to Zagazig university Pediatric hospital.

METHODS

Site of study:

This study will be conducted in Zagazig university pediatric hospital.

Sample size:

A comprehensive sample of 48 cases per 6 months was included in this study.

Inclusion criteria

Children aged 1-72 months old admitted to Pediatric hospital of Zagazig university and presented with signs of pneumonia according to world health organization criteria. **(WHO).**

Written informed consent was obtained from all participants, parents and the study was approved by the research ethical committee of Faculty of medicine , Zagazig University. The work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Exclusion criteria

Children aged less than one month and those having underlying chronic diseases, immunosuppressed status, history of recurrent attacks of pneumonia, antibiotic intake within the previous month, those who received pneumococcal vaccine, health care and hospital acquired pneumonia.

Type of study:

Cross sectional study

All patients enrolled in the study were subjected to the following:

1-Data collection

2-chest x-ray

3-Routine laboratory investigation

4-Microbiologic work up included blood culture and sputum analysis. Respiratory specimens were subjected to the following:

a- Inoculation on blood agar, heated blood agar and Mac-Conkey agar media.

b- Direct smear staining with Gram stain for microscopic examination.

5-Serological diagnosis: by indirect immunofluoresent technique for the presence of specific Ig M antibodies against common respiratory pathogens.

Statistical Analysis

All data were analyzed using Minitab 17.0 statistical software (Minitab Inc., Pennsylvania, USA). Continuous variables were expressed as the mean±SD, and the categorical variables were expressed as a number (percentage). Continuous variables were checked for normality by using Shapiro-Wilk test. Independent sample Student's t-test was used to compare two groups of normally distributed data while ANOVA test was used to compare two independent measurements of normally distributed data in more than 2 groups. All tests were two sided. $P < 0.05$ was considered statistically significant (Sig.), $p < 0.01$ was considered highly statistically significant (HS), and $p \geq 0.05$ was considered non-statistically significant (NS).

RESULTS

Staph. aureus is the most common pathogen

detected in blood and sputum culture in positive cases regardless the age group. According to serology results Significant difference according to age in viral pneumonia occurrence and non significant difference in bacterial pneumonia based on serological findings with higher diagnosis of *Legionella pneumophila 33.33%* as a causative organism, RSV 20.83% in viral pneumoniae, Influenza A virus 10.41% ,M Pneumoniae and C Pneumoniae 6.25% , Adenovirus 4.16% ,Influenza B virus 2.08%.

Table (1): Demographic characteristics of all patients with identified and unidentified etiologies based on serological findings

	Bacterial		Viral		Mixed		Unidentified pathology		Total		Test*	P-value
	(N=22)		(N=7)		(N=18)		(N=1)		(N=48)			
	Mean±SD		Mean±SD		Mean±SD		Value		Mean±SD			
Age (months)												
All cases	34.3±44.9		40.4±58.6		31.3±41.8		165		36.6±47.9		1.70	0.158 (NS)
≤24 months	7.8±6.1		4.5±2.3		29.7±43.6		---		7.1±5.6			
>24 months	72.5±49.6		88.3±65.6		35.6±41.2		165		78±50.4			
Weight(Kg)	10±6.8		11.5±10.6		10.7±7.6		30		10.9±8.03		1.5	0.207 (NS)
	NO	**%**	**NO**	**%**	**NO**	**%**	**NO**	**%**	**NO**	**%**		
Sex												
Male	9	40.9	4	57.1	9	50	0	0	29	60.4	13.97	0.006 (Sig.)
Female	13	59.1	3	42.8	9	50	1	10	19	39.5		

Table (2): Radiological findings in all patients with identified and unidentified etiologies

	Bacterial		Viral		Mixed		Unidentified pathology		Total	
	(N=22)		(N=7)		(N=18)		(N=1)		(N=48)	
	NO	%	NO	%	NO	%	NO	%	NO	%
lobar consolidations	9	40.9	2	28.5	2	11.1	0	0	13	27.1
Patchy consolidation	11	50	4	57.1	10	55.5	1	100	26	54.1
Interstitial consolidation	2	9.1	1	14.2	6	33.3	0	0	9	18.7

Table (3): Etiological agents identified in the study population based on serological findings

	Cases ≤ 2years (N=28)		Cases > 2years (N=20)		Total (N=48)		Test●	P-value
	No.	%	No.	%	No.	%		
Negative	5	17.85	3	15	8	16.66		
Positive	23	82.14	17	85	40	83.33		
Bacterial								
Legionella pneumophila	7	25	9	45	16	33.33		
Mycoplasma pneumoniae	2	7.14	1	5	3	6.25		
Chlamydia pneumoniae	1	3.57	2	10	3	6.25		
Total	10	35.7	12	65	22	45.8	6.2	0.54(NS)
Viral								
RSV	6	21.42	4	20	10	20.83		
Influenza A	4	14.28	1	10	5	10.41		
Influenza B	1	3.57	0	0	1	2.08		
Adenovirus	2	7.14	0	0	2	4.16		
Total	13	46.4	5	25	18	37.5	2.4	0.041(Sig.)

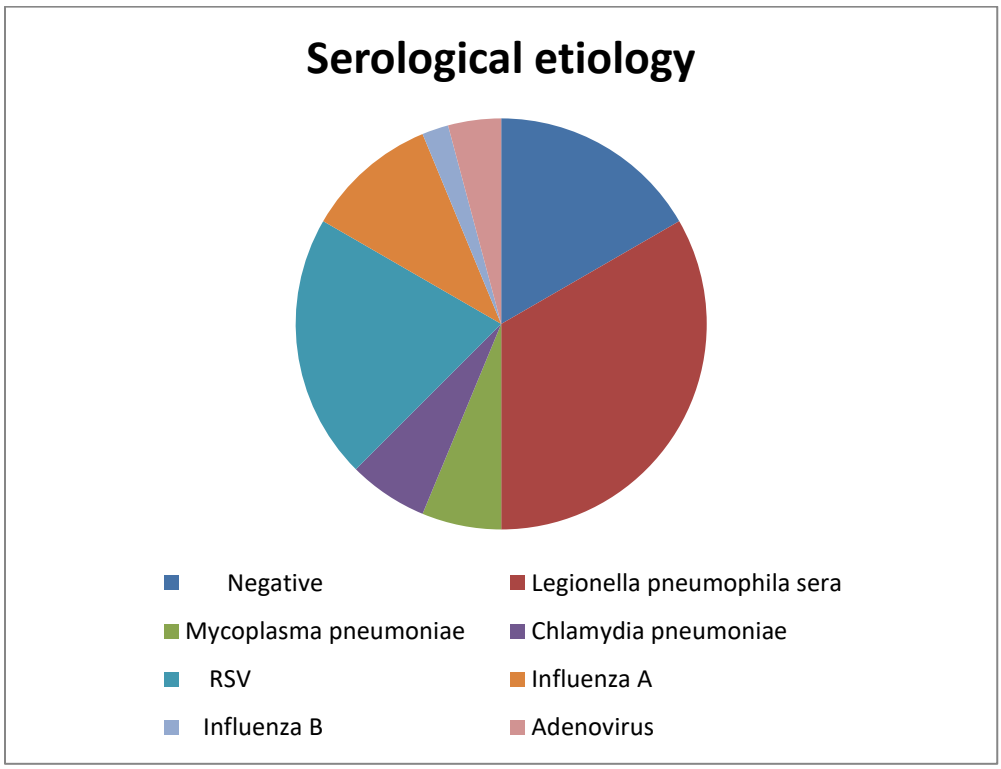
Table (4): Etiological agents identified in the study population based on sputum culture

	Cases ≤ 2 years (N=28)		Cases > 2 years (N=20)		Total (N=48)	
	No.	%	No.	%	No.	%
Negative	11	39.28	8	40	19	39.58
Positive	17	60.71	12	60	29	60.41
Staph. aureus	9	32.14	8	40	17	35.41
candida	3	10.71	3	15	6	12.5
Klebsiella	4	14.28	0	0	4	8.33
Pseudomonas aeruginosa	1	3.57	1	5	2	4.16

Table (5): Etiological agents identified in the study population based on blood culture

	Cases ≤ 2 years (N=28)		Cases > 2 years (N=20)		Total (N=48)	
	No.	**%**	**No.**	**%**	**No.**	**%**
Negative	16	57.14	14	70	30	62.5
Contaminated	5	17.85	0	0	5	10.41
Positive	7	25	6	30	13	27.08
Staph.aureus	4	16	5	25	9	32.14
Klebsiella	1	3.57	0	0	1	2.08
E-coli	2	7.14	1	5	3	75

Figure (1) :Etiological agents identified in the study population according to serological investigations .



DISCUSSION

Community-acquired pneumonia (CAP) is asignificant cause of respiratory morbidity and mortality in children especially in developing countries. Worldwide, CAP is the leading cause of death in children younger than five years. The deaths resulting from pneumonia are potentially preventable if appropriate clinical and laboratory tools are in place to facilitate early detection of pneumonia, identification of the pathogen involved and institution of appropriate therapy or even better implementation of appropriate vaccination schedules **[1].**

This study aims to elucidate the common bacterial pathogens causing CAP among

immunocomptentEgyption infants and preschool children admitted to Zagaziguniversity Pediatric hospital.It included 48immunocompetent infants and preschool children hospitalized for CAP in a trial to identify the causative microbial etiology.

As regard demographic data in (Table 1) showed significant difference between the studied groups as regard sex compared to non-significant difference in their age and weight.The results showed 60.4% of patients were males and 39.5% were females.Muenchhoff M reported that males are more likely to develop lower respiratory tract infections **[8].** The greater resistance found in females can be explained by their enhanced Th1 immune response. In the contarary there were no major differences in gender according to Mathew J **[9].**

As regard radiological finding in all patients with identified and unidentified etiologies (Table 2) shows that patchy consolidation is the most common radiological finding in all patients54.1% with higher incidence in mixed infection followed by lobar consolidation 27.1%with higher incidence in bacterial pneumonia.At least interstitial consolidation18.7%.This is in agreement with El Seify **[10],** who found that patchy consolidation was the predominant finding (81.1%), followed by lobar (15.6%) and interstitial (3.3%) patterns of consolidation ,and there was no correlation between radiological findings and etiologies .

Bacterial pneumonia tends to be lobar although Staphylococcus aureus cancause a patchy bronchopneumonia. Viral and atypical bacterial pathogens, suchas Mycoplasma pneumonia, tend to causeinterstitial infiltrates on chest radiography. However, atypical bacterial pathogens occasionally cause lobar infiltrates **[11].**

Etiological agents identified in the study population based on serological findings (Table 3) showed significant difference according to age in viral pneumonia occurrence and non significant difference in bacterial pneumonia based on serological findings with higher diagnosis of *L pneumophila 33.33%*as a causative organism, RSV 20.83% in viral pneumoniae, Influenza A virus 10.41% ,M Pneumoniae and C Pneumoniae 6.25% ,Adenovirus 4.16% ,Influenza B virus 2.08%.The use of conventional methods of bacterial isolation parallel to the serological detection of specific IgM antibodies against common respiratory pathogens led to identifying at least one organism in 83.33% of the patients.

In similar worldwide studies, the rate of pathogen detection varied widely ranging from as low as 38.4% to >80% **[3].** The high rates of detection in the later studies could not be achieved in our study, considering their employment of invasive methods of specimen collection in some cases and the wide armamentarium of microbiologic diagnostic methods including viral isolation, antigen detection, and molecular techniques. Besides that, the negative history of antimicrobial intake before presentation could not be guaranteed, considering thefact that antimicrobials are readily purchased in Egypt without prescription.

The results in (Table 4,Table 5) Most of the identified microbes were isolated culture of respiratory specimens and blood .Table 8 shows that *staph. Aureus 35.4%* is the most common pathogen detected in sputum regardless the age group, Candida 12.5%, Klebsiella 8.33%, Pseudomonus 4.16%.Table 9 shows that blood culture gives negative results in most cases of pneumonia62.5%. *Staph.aureus* is the most common pathogen detected in blood culture in positive cases regardless the age group 18.7% , E Coli 6.25% ,Klebsiella 2.08%.

Blood culture yield was limited 27.08%. Contamination was found in 10.4%. Most investigators suggest that blood cultures are likely to be unhelpful for management and can be omitted especially in mild and moderate CAP for cost–benefit reasons, while others still find that positive blood cultures can guide antibiotic therapy to narrow spectrum. The findings in this study were also conflicting, as, though the yield of blood culture was relatively

low. Therefore, the role of blood culture in redirecting the antimicrobial therapy still needs to be elucidated.

Pneumoslide-M was used in the study as it has been previously evaluated as a rapid feasible multiple panel test for detection of several viruses and atypical bacteria with sensitivity comparable to polymerase chain reaction (PCR) **[12].**

In the light of fact that each community has its specific pathogens as a leading cause of CAP, the use of pneumoslide-M was a tool for expanding the panel of pathogen identification and we did not aim to evaluate the sensitivity of the test; however, results of this study revealed a higher rate of positive results using pneumoslide-M(40/48;83.33%when compared with other studies (31/60; 51.66%) **[13].**

In this study, S. aureus was found the most common typical respiratory pathogen causing CAP in contrast to other published reports **[14].** However, our finding is supported by that of Atwa ZTH **[4]**, who detected S. aureus as the most common isolated organism from sputum of children with CAP in Egypt. These findings highlight the potentially rising role of this pathogen in our community where methicillin re-sistance has been extensively reported lately . The role of S. aureus in CAP has also been the focus of other studies. It was reported after influenza epidemics and was found the most common bacterial coinfection among adults during influenza pandemic in 2009 with the majority being methicillin-resistant S. aureus and associated with unfavorable prognosis **[15].**

Evidence of Legionella Pneumophila infection in this study 33.3%,. This finding drives the attention to the role of CAP caused by L. pneumophila in children more than 2years old even if the rates had not reached those recorded among younger age groups .The most common viral infection causing CAP was RSV 20.8%. Earlier studies had named influenza virus as the best example of primary viral pneumonia. Comparable rates were documented in the same age group by more recent studies **[16].**

Chen, K **[12]** reported that some pathogens may have a higher seasonal incidence than others in certain geographic areas, and the diagnosis of those causing prevalent diseases would be of value. It was therefore important to know the etiology of pneumonia and to determine whether there was an association between age or season and etiological organism. Among children in their study, there were 4 major viral and atypical bacterial pathogens causing CAP that were detected with the Pneumoslide IgM test.

CONCLUSION

S. aureus, L. pneumophila, and RSV were the most detected causative agents identified in the study. Local therapeutic and prevention guidelines for CAP should have special focus on these agents. Clinical manifestations and radiologic findings could not be relied upon to differentiate between bacterial and viral pneumonia, which necessitate the adoption of rapid feasible microbiologic diagnostic technique to aid in the diagnosis and management of hospitalized patients. Although we could not determine the causative agent in some studied cases, this study provides preliminary data regarding the spectrum and frequency of microorganisms causing CAP in Egyptian infants and preschool children.

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Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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REFERENCES

1-Izadnegahdar R, Cohen AL, Klugman KP, Qazi SA. Childhood pneumonia in developing countries. Lancet Respir.Med 2013; 1(7): 574–584.

2-Honkinen M, Lahti E, Österback R, Ruuskanen O , Waris M . Viruses and bacteria in sputum samples of children with community-acquired pneumonia. Clin Microbiol Infect 2012; 18(3): 300–307.

3-Jain S, Self WH, Wunderink RG ,Fakhran S,

Balk R ,Bramley AM et al., Community acquired pneumonia requiring hospitalization among.U.S. adults. N Engl J Med 2015.

4- Abdelsalam M, Diab H.S , Ragab Y. Radiological finding in patients with H1N1influenza pneumonia. Egypt .J.Chest Dis.Tuberc.2016; 65: 135-142.

5-Atwa ZTH. Usefulness of gender and abnormal blood count for predicting pneumonia outcome in children. Egypt J Chest Dis 2015; 64 (1): 169-174.

6-Loens K, Leven M. Mycoplasma pneumoniae;Current Knowledge On Techniques and Serological Diagnosis; Front Microbial.2016; 7: 44-48.

7-Community Acquired Pneumonia Guideline Team,Cincinnati Children Hospital Medical Centre (2014) .Evidence -based care guidelines for medical management of ccommunity acquired pneumonia in children 60 days to 17 years of age Guideline .www.cincinnati,childrens.org/svc/alpha/h/health -policy/ evbased /pneumonia.htm (last accessed on September2014).

8-Muenchhoff M, Goulder P. J. Sex differences in pediatric infectious diseases. The Journal of infectious diseases 2014; 209 (suppl_3), S120-S126.

9-Mathew JL, Singhi S, Ray P, Hagel E, Saghafian –Hedengren S, Basal A et al Etiology of community acquired pneumonia among children in India: prospective, cohort study. J glob health (2015); 5(2).

10-El Seify MY, Fouda EM, Ibrahim HM, Fathy MM , Al Husseiny A , Khater WS et al Microbial etiology of community-acquired pneumonia among infants and children admitted to the pediatric hospital, Ain Shams University. European Jf Microbiol Immunol 2016; 6 (3): 206-214.

11-Esposito S, Bosis S, Cavagna R, Faelli N ,Begliatti E ,Marchisio P et al. Characteristics of streptococcus pneumoniae and a typical bacterial infections in children 2-5 years of age with community acquired pneumonia Clin Infect Dis 2002; 35(11):1345-1352.

12-Chen K, Jia R, Li L, Yang C, Shi Y. The aetiology of community associated pneumonia in children in Nan-jing, China and aetiological patterns associated with age and season. BMC Public Health 2015; 15(1): 1–6 .

13-El-Sahrigy SAF, Abdel-Rahman AMO, Shady EAEA, Attia H, Gomaa HE. Pneumoslide-M technique for rapid detection of atypical pathogens in critically ill chil-dren with lower respiratory tract infections. J Med Sci 2006; 6 (5): 793- 799.

14-Gentile A, Bardach A, Ciapponi A, Garcia – Marti S, Arug P ,Glujovsky D et al **.** Epidemiology of community-acquired pneumonia in children of Latin America and the Caribbean: a systematic review and meta-analysis. Int J Infect Dis 2012 16 (1): e5–15.

15-Rice TW, Rubinson L, Uyeki TM, Vaughn F L ,John B B ,Miller LL et al. Critical illness from 2009 pandemic inf luenza A virus and bacterial co-infection in the United States. Crit Care Med 2012; 40(5): 1487–1498.

16-Cevey-Macherel M, Galet to -Lacou r A ,Gervaix A, Seigrist CA ,Bille J, Bescher – Ninet B et al: Etiology ofcommunity-acquired pneumonia in hospital-ized children based on WHO clinical guidelines. Eur J Pediatr 2009; 168 (12): 1429–1436

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