Prevalence of Respiratory Syncytial Virus in Egyptian Pediatric Patients suffering from Pneumonia

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ABSTRACT

Background and study aim: *Respiratory syncytial virus (RSV) is one of the major causes of viral respiratory tract disease in young children and infants. In children less than one year-old, it was the principal cause of bronchiolitis and pneumonia and, a common cause of hospitalization in young children. We aim to study the prevalence of RSV and its subtypes in pediatric patients suffering from pneumonia and broncho-pneumonia with the evaluation of routinely used method for diagnosis.* ***Patients and Method:*** *This study included 68 patients, attended the pediatric hospital, faculty of medicine-Cairo University at the period between 2007-2008, who exhibited lower respiratory tract symptoms in the form of pneumonia and bronchopneumonia. They were subjected to clinical examination, chest X-ray examination. Nasopharyngeal aspirate (NPA) samples were taken and sent to National Cancer Institute for microbiological, virological and molecular examinations.* ***Results:*** *High prevalence of RSV 85% (58/68) was detected, of these, 21% (12/58) were group A, 36% (21/58) were group B, and 43% (25/58) were subtype A & B. Highly affected children were from 2-3 months (44.8%) and rate of infection decreased as age increasing. RSV infection was statistically significant with some clinical findings and radiological findings.* ***Conclusion:*** *RSV is an important etiological agent causing pneumonia and bronchopneumonia in infancy. RT-PCR for NPA was a good method in detecting virus and may provide important information in establishing the etiology and improving management of the patients.*

Key Words: *Respiratory syncytial virus (RSV), RSV subtypes, Nested Reverse Transcriptase Polymerase Chain Reaction*

INTRODUCTION

Respiratory syncytial virus (RSV) is associated with a million of deaths/year worldwide in children[(1)]. It is self-limited to common cold symptoms in most patients. It is an enveloped RNA virus belonging to the Paramyxoviridae family[(2)] and has two major RSV subtypes A and B[(3,4)]. The virus infects the ciliated epithelial cells that line the airways that resulting in rapid destruction causing the symptoms of the infection[(5)], such as fever, rhinorrhea, and cough and wheezing[(6)]. In children less than one year-old it is the principal cause of bronchiolitis and pneumonia[(7,8)] and is a common cause of hospitalization in young children[(9)]. RSV may cause repeated infections throughout life, with serious complications occurring in the elderly and immunocompromised patient[(10,11)] that may progress to severe pneumonia, with an increased chance of morbidity or death[(12)] .

No safe and effective RSV vaccine is available, only few effective prophylactic or therapeutic treatments exist. In Egypt to date, no epidemiological pattern for each specific RSV group had been established. Rapid diagnosis of RSV may affect patient care by influencing decisions for appropriate treatment of it[(13)]. Numbers of techniques are available for RSV detection and identification[(14)]. Conventional RT-PCR, which has been used for the detection of RSV and its subtypes, is a more sensitive and specific diagnostic method [(15,16)].

This work was done to study the RSV infection and its subtypes in Egyptian pediatric patients suffering from pneumonia and broncho-pneumonia less than one-year-old and to evaluate the routinely used methods for viral diagnosis.

PARTICIPANTS & METHODS

This study includes 68 children, 35 males and 33 females, their ages ranged from 2-12 months. Those patients were classified into 4 groups according to their ages. Group I included 31 patients having 2 to 3 month-old, Group II

included 20 patients having 3 to 6 month-old, Group III included 11 patients having 6 to 9 month-old, and Group IV included 6 patients having 9 to 12 month-old. They were admitted to the Pediatric Hospital, Faculty of Medicine-Cairo University at the period between 2007-2008, suffering from lower respiratory tract symptoms in the form of pneumonia and bronchopneumonia and signed consent was obtained from the parents of each child included in this study. All the practical work was done at the Cancer Biology Department, National Cancer Institute, Cairo University.

Afterwards, a questionnaire was administered to ascertain information about clinical and demographic data, e.g., age, gender, gestational age, clinical symptoms, and risk factors such as immunodeficiency, chronic respiratory disorders (bronchopulmonary dysplasia, cystic fibrosis), congenital heart disease and prematurity. Also, Clinical examination for preliminary screening of symptoms, as cough, fever, wheezes and tachypnea, and physical signs, as fever, intercostals muscles retraction, inspiratory crepitations and cyanosis, of lower respiratory tract infection were done. Chest X-ray examination for the detection of radiological abnormalities as hyperinflation and abnormal increase of broncho-vascular markings were done.

Clinical symptoms were divided into: bronchiolitis, bronchitis (laryngotracheobronchitis, bronchospasm, Pertussis-like syndrome, whooping cough, and bronchitis), pneumonia (bronchopneumonia and pneumonia) and upper respiratory tract infection (acute otitis media, rhinitis, sinusitis, flu and upper respiratory tract infection). Exclusion criteria are neonates (1st month of life), cases with congenital cyanotic heart disease, broncholitis, and patients with chest symptoms admitted to hospital for more than 24 hours.

Laboratory investigations of complete blood picture and erythrocyte sedimentation rate were done. Nasopharyngeal aspirate (NPA) samples were collected by suction using a sterile pediatric suction catheter size (2.7 mm) (Delee Suction Catheter with Mucus Trap, Tyco Health Care England). The nasopharyngeal aspirate was collected automatically in mucus traps (size 20cc) attached to the suction catheter. Then small part of the NPA was taken for bacterial culture to exclude bacterial pneumonia and the remaining portion of NPA was frozen immediately after collection and stored at -70°C for RT-PCR

RSV detection: Total RNA were extracted from NPA by the Viral RNA Mini kit (Qiagen, California). The primers used for group determination were generated against the N and P regions of the RSV genome, according to the methods by Stockton et al[17]. In brief, The one step RT-PCR was performed in 50ul of a reaction mixture containing 5ug of total RNA, 1X PCR buffer (10mM Tris-HCl [pH 9.0], 50mM KCl, 1.5mM MgCl2, 0.01% gelatin, 0.1% Triton X-100), 0.2mM of each deoxynucleoside triphosphate, 100ng of each primer pair, RSV AB1, 5'-GTCTTACAGCCGTGATTAGG-3' and RSV AB2, 5'-GGGCTTTCT-TTGGTTACTTC-3' and 1ul of each RT-T*aq* polymerase enzyme (Qiagen; Valencia, Calif.) was amplified in a thermal cycler (Eppendorf, Germany). The cycling protocol included one hour for RT at 50°C, followed by 10 min activation step for the *Taq* polymerase at 95°C. Then 40 cycles of PCR, each cycle consisted of denaturation at 95°C for 1 min., primer annealing at 55°C for 1 min., and extension at 72°C for 2 min. with a final extension step at 72°C for 10 min.

Two microliters of the first-round PCR are amplified in nested PCR containing 1× reaction buffer, 0.2 uM dNTPs, 100 pmol of primer mix (containing inner primer), 1.5 mM MgCl2, and 2.5 U of hot start Taq polymerase (Amplitaq Gold; PE Biosystems, Foster City, Calif.). Type-specific primer pairs for RSV serotype A (RSV A) and RSV B were used for nested PCR :(inner primers: RSV A1, 5'-GATGTTACGGTGGGGAGTCT-3' RSV A2 5'-GTACACTGTAGTT-AATCACA-3'; RSV B1, 5'-AATGCTAAGATGG-G-GAGTTC-3'; and RSV B2, 5'-GAAATTGAGTTAATGACAGC-3'). Cycling conditions of the second round of PCR included a 12-min activation step of the *Taq* polymerase at 94°C, followed by 30 cycles of 30 s of denaturation at 94°C, 30 s of primer annealing at 50°C, and 90 s of primer extension at 72°C for both serotypes. Ten ul of each PCR reaction product was analyzed by electrophoresis through a 1.2-% agarose gel in Tris-Acetate-EDTA buffer (pH 8.0) and ethidium bromide staining. Water and RSV A-infected and RSV B-infected vero cell cultures served as negative and positive controls that were included in every assay, were run together in each RT-PCR assay to validate the amplification process and to exclude the presence of contaminants.

Statistical analysis: By using SPSS V.12 software, data were statistically described in terms of frequencies (number of cases) and relative frequencies (percentages). Yates correction equation was used instead when the expected frequency is less than 5. A probability value (*p* value) less than 0.05 was considered statistically significant. Categorical variables were examined by using the Fisher's exact test (two-tailed) with 95% confidence intervals (CI). For analyses in which the dependent variable was continuous, non-paired Mann-Whitney was used.

RESULTS

RSV was positive in 58 (85%) patients' nasopharyngeal aspirate (table 1) those were further sub typed into RSV A (21%, n=12), RSV B (36%, n=21) and sub type A & B co infection were found 43%, n=25.

According to gender, 58.3% (7/12) of the RSV A cases were males and 41.7% were females, compared with 23% (5/21) of the RSV B cases were males and 77% were females. However, the difference was not statistically significant.

By comparing the age of the patients, RSV infection is decreased as age increases from 26 (44.8%), 16 (27.6%), 10 (17.4%), and 6 (10.3%) in groups 1, 2, 3, and 4 respectively. However, these increases were not statistically significant. For RSV subtype B and coinfection with subtypes A&B were predominant in group1 (22.4%) while sub type A was predominant in-group 2 (12%).

Pneumonia and Bronchopneumonia were the clinical diagnosis more frequently observed in RSV-infected children (table 3). For clinical symptoms and signs, RSV infections highly present in patients having fever, inspiratory crepitations, cyanosis, tachypnea, cough, wheezing, and bronchial breathing. There was no statistical difference observed between the RSV infected group and the non-infected ones (table 3). There were no significant difference observed between the severity of the diseases and different RSV subtypes. In chest X-ray findings of patients, RSV was only significantly associated with single pneumonic patch (lung consolidation) and in significantly associated with the other chest X-ray findings (Table 3).

Table 1: RT-PCR and nested PCR Values and percentages for RSV:

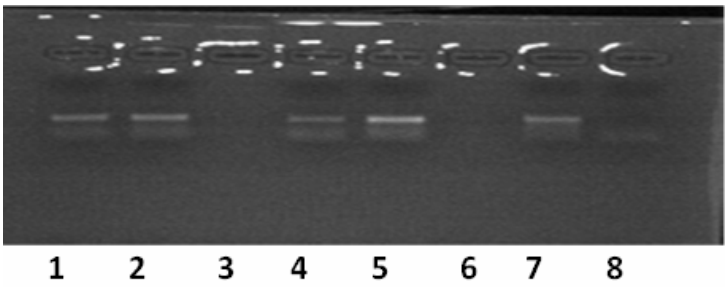
Item	Number of patients (%)
RSV positive	58 (85%)
RSV subtype A	12 (21%)
RSV subtype B	21 (36%)
RSV subtype A & B co-infection	25 (43%)

Table (2): Frequencies of PCR results in relation to age of the 58 patients:

	RSV +ve	RSV -ve	P-value	RSV subtype A	RSV subtype B	RSV subtype A&B
Age group						
2-3 month	26(44.8%)	5	0.961	3(5.1%)	13(22.4%)	13(22.4%)
>3-6 months	16 (27.6%)	4	0.627	7(12%)	4(6.89%)	6(10.34%)
>6-9 months	10 (17.4%)	1	0.947		2(3.44%)	7(12%)
>9-12 months	6 (10.3%)	0	0.663	2(3.44%)	1(1.72%)	1(1.72%)
Laboratory finding						
WBCs >15.0x10^9/l	(28/58)	(1/10)10%		10/12(83.3%)	3/20(15%)	15/27(55%)
ESR >30mm/h	48.3%	(2/10)20%		11/12(91.66%)	8/20(40%)	19/27(70.37%)
CRP > 80 mg/l	(38/58)	(1/10)10%		5/12(41.66%)	10/20(50%)	2/27(7.4%)
CRP >129 mg/l	65.5%	(3/10)30%		2/12(66%)	4/20(20%)	6/27(22.22%)
	(17/58)					
	29.3%					
	(12/58)					
	20.7%					

Table (3): RSV in relation to clinical diagnosis, symptoms and signs of patients:

	RSV +ve (n=58)	RSV -ve (n=10)	P-value
Symptoms & Signs			
Fever	51	7	0.296
Inspiratory crepitations	56	6	0.001*
Cyanosis	7	1	0.147
Tachypnea	59	9	0.193
Cough	45	7	0.955
Wheezing	22	4	0.880
Bronchial breathing	41	10	0.089
Diagnosis:			
Pneumonia	21	3	0.959
Bronchopneumonia	38	6	0.880
Bronchopneumonia with predominant wheezy chest	1	1	0.660
chest x ray findings			
Prominent broncho-vascular markings	30	4	0.733
Bilateral pneumonic patches	27	3	0.882
Single pneumonic patch	3	3	0.045*



Figure(A): Agarose gel showing RT-PCR amplified product for RSV. Lane 8 negative control; Lane 7 positive control 1.1kb; Lanes 1 to 6 are clinical samples.

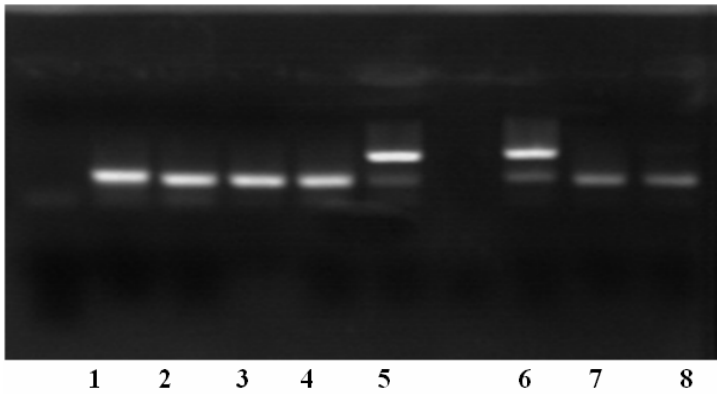


Figure (B): Agarose gel showing nested PCR product: lane 5 and 6 show RSV subtype A at 0.9 kb , lane 1,2,3,4,7,and 8 show RSV subtype B at 0.78 kb.

DISCUSSION

RSV infection may be difficult to be clinically differentiated from other seasonal respiratory viruses. The rapid and accurate detection of RSV facilitates appropriate clinical management, including supportive care, hospital admission, and isolation to decrease nosocomial transmission of the virus, antiviral treatment, and judicious antibiotic usage [18].

In this study, 68 children were tested for RSV detection. RSV was detected in NAP of 58 patients (85%). High incidence of RSV subtypes coinfection was detected (43%) followed by single subtype B 36% and subtype A 21% infection. Similarly, during the southern hemisphere winter months, RSV was identified in 61% in those less than two year-old hospitalized with bronchopneumonia[19]. In India, a very high percentage of cases of RSV infection occurred in children below one year of age[20].

Our results showed that cases with RSV B subtype were predominated over cases with RSV A. This finding is not agreed with the majority of such typing studies [21-23]. However, one study from Denmark, reported a predominance of RSV B infections [24].

In Belgium, both subgroups were more prevalent among children younger than 6 months[13] and this was in agreement with our result as RSV subtypes A and B coinfection were detected in 45% and most of them were younger than 6 months.

In the current study, as the age increases the rate of RSV infection decreases. RSV was 44.8%, 27.6%, 17.4%, and 10.3% in Group 1, 2, 3 and 4 respectively. These findings was consistent with the previous study[25] in which approximately 40% of RSV was infants younger than 3 months, 30% of those aged 3 to 6 months, 20% were 7–12 months, 10 % were 1 to 3 years and older then 3 years were less then 1%. In addition**,** RSV was the predominant viral pathogen only in children aged from 6 to 12 months and the rate of its detection decreased according to the age [26].

Regarding the sex of the patients, there was no statistically significant difference seen in relation to RSV infection. Similarly, other reported no statistically significant difference in both sex infected with RSV in children[20]. However, in other studies, male children were more susceptible to severe disease than females[7,27], but the reasons are still unknown [23]. In one study, they found that the majority of RSV A-infected children were male[23], also Sangaré[9], suggested that female was protective against RSV hospitalization.

We found that patients infected with RSV B and those with coinfection with A&B tended to be slightly younger than those infected with subtype A. Similarly, Papadopoulos[28] observed a predominance of RSV B infection in the youngest children based on the mean age. In contrast, Flores[29] found the RSV subtype A predominant in younger children.

In the present study, the main clinical manifestations of RSV infection were fever (88.3%) and inspiratory crepitations (87.8%) followed by cyanosis (87.5%) tachypnea (86.8%) and coughs (86.5%). As previously reported the main clinical manifestations of RSV infection were cough (88.57%) and coryza (78.57%) [30].

RSV is the most common viral cause of lower respiratory tract infection (pneumonia and bronchopneumonia) in infants and young children worldwide. RSV infections were involved in lower respiratory tract infections including pneumonia 35% and bronchopneumonia 63.3% of our studied patients. Similarly, other investigators reported that bronchiolitis was the most common clinical diagnosis, followed by pneumonia associated with RSV infection[7,9,31]. In addition, it was found that in the pediatric age group, RSV has been identified in 17-32% of lower respiratory tract infections, up to 1% of them was hospitalized for RSV LRTI during the first year of life. Of these children, 10% will develop respiratory insufficiency necessitating mechanical ventilation[20]. Also Nokes[32], estimated that 55-65% of RSV-associated with bronchopneumonia and occurred in children aged >6 months. In Brazil, viral respiratory infection prevalence was 38.7%, 36% of the bronchiolitis cases having RSV infection while only 7.7% of the pneumonia cases having RSV[33] , this was lower than its incidence in our cases.

In this study, we found no difference between the RSV subtypes and the severity of the disease. Similarly, Papadopoulos[28], using duration of hospitalization in the severity index, did not find significant differences between the RSV subtypes. Others have been, in relation to disease severity, reported differences between groups [23,34,35].

Regarding chest X-ray findings, statistically significant value was shown with lung consolidation of RSV infected patients while statistically insignificant with the other chest x ray findings. Similar to our data, the lobar or segmental consolidation is observed more often in children aged <6 months infected with RSV[(36)]. In addition, 74% of the patients with RSV infection, pulmonary consolidation or atelectasis on admission chest X-ray are reported in 55% [(37)].

Conclusions: RSV was highly prevalent viral infection and important etiological agent causing pneumonia and bronchopneumonia in infancy. A very high percentage of RSV infection occurred in children below one year of age. NPA was a sensitive method in detecting RSV infection in infancy. Tachypnea was the most prevalent clinical findings manifestation in RSV positive cases followed by inspiratory crepitations. Presence of RSV was observed with lung consolidation not with other radiological findings. More studies are required to evaluate the various diagnostic modalities available for RSV. Rapid and reliable techniques may provide important diagnostic information in establishing the etiology & improving management of the patients.

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انتشار فيروس المخلوى التنفسى في الأطفال المصريين الذين يعانون من مرض الالتهاب الرئوي

زينب حسن ، محمد محمود حافظ ، سهير هلال ، مها جعفر ، جيهان حسين ، محمود محمد كامل و نهال حسين
وحدة الفيروسات والمناعة قسم بيولوجيا السرطان ، المعهد القومي للاورام . قسم الباثيولوجيا الاكلينيكية والكيميائية، قسم الأطفال بكلية الطب القصر العيني ، وقسم . قسم الباثيولوجيا الاكلينيكية والكيميائية ، المعهد القومي للاورام ، جامعة القاهرة ، مصر

الخلفية و هدف الدراسة: الفيروس المخلوى التنفسي هو احد الأسباب الرئيسية لأمراض الجهاز التنفسي الفيروسية عند صغار الأطفال والرضع. كان السبب الرئيسي لالتهاب القصبات والتهاب الرئة في الأطفال أقل من سنة واحدة من العمر ، ، و لدخولهم المستشفيات للعلاج. ونحن نهدف إلى دراسة مدى انتشار فيروس المخلوى التنفسي وأنواعه الفرعية في مرضى الأطفال الذين يعانون من الالتهاب الرئوي مع تقييم الطريقة التي تستخدم بشكل روتيني لتشخيص المرض. المرضى والطرق : تحتوى هذه الدراسة على ٦٨ مريضا ، حضروا لمستشفى الأطفال في كلية الطب جامعة القاهرة في الفترة ما بين ٢٠٠٧-٢٠٠٨ ، وكانت عندهم أعراض فى التنفس في شكل الالتهاب الرئوي والتهاب رئوى شعبى. وقد خضعوا للفحص الاكلينيكى و الأشعة. اخذت عينات من افرازات البلعوم وإرسلت إلى المعهد القومى للاورام لعمل الاختبارات الميكروبيولوجية، الفيروسية والاختبارات الجزيئية. النتائج: اكتشف ارتفاع في معدل انتشار فيروس المخلوى التنفسي (58/68) 85% وكانت منهم (٥٨/١٢) ٢١ ٪ من مجموعة أ ، (٥٨/٢١) ٣٦ ٪ من المجموعة ب ،و (٢٥/٥٨) ٤٣% يجمع كلا المجموعتين أ وب. واكثر الاطفال تأثرا هم الاطفال من سن ٢-٣ أشهر (٤٤,٨ ٪) ولوحظ انخفاض معدل الإصابة مع زيادة العمر. وكان لفيروس المخلوى التنفسي دلالة إحصائية مع بعض النتائج الاكليكينيه والإشعاعية. والخلاصة : فيروس المخلوى التنفسي هو عامل مهم يسبب الالتهاب الرئوي والتهاب الرئوى الشعبى عند الاطفال. من هذه الدراسة اتضح ان عمل تفاعل البلمره المتسلسل العكسى لافرازات البلعوم للاطفال المرضى هى الطريقة الجيدة للكشف عن الفيروس وايضا توفر معلومات هامة في السيطرة علي مسببات المرض.