CAUSES OF RESPIRATORY DISTRESS IN CHILDREN

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Abstract- There is a lack of large, prospective epidemiologic studies concerning acute lung injury (ALI) and acute respiratory distress syndrome (ARDS) in pediatric population. To determine the different causes of respiratory distress in children, we performed a retrospective study and included 567 children with respiratory distress referred to our hospital. Using their medical files, data including age, sex, and causes of respiratory distress were collected. SPSS 13.0 (statistical software) applied for statistical analysis. Pneumonia, asthma, and croup were the major causes of ARDS in children with a rate of 38.4, 19.04, and 16.5 percent, respectively. It seems that infectious factors are at the top of the list of ARDS causing factors which must be considered in approach and management of such patients. We suggest vaccinating these at risk groups against common infectious agents such as *Hemophilus influenza* and respiratory syncytial virus (RSV) which can either cause pneumonia or induce asthma.

Acta Medica Iranica 2008; 46(5): 405-408.

Keywords: Acute lung injury, acute respiratory distress syndrome, pneumonia, asthma

INTRODUCTION

In 1994, an American-European Consensus Conference (AECC) defined the criteria for what has been known as acute respiratory distress syndrome (ARDS) (1) and was first described by Ashbaugh *et al.* in 1968 (2). This consensus was necessary because in the past heterogeneous criteria for ARDS were used to include patients in clinical studies, thus precluding comparative studies and definite conclusions. The intention of the AECC was to find a uniform definition to provide more homogeneity and comparability for future research in this field. As a result, acute lung injury (ALI) was introduced as a new term for this disease. This partly replaced the old term ARDS because ALI was considered to more accurately reflect latest insights on the pathophysiological process of this disease. Since then, the term ARDS has been reserved for the most severe form of ALI.

When ARDS was originally described by Ashbaugh *et al.* in 1968 in a series of 12 patients (2), case fatality approached 60% and remained at approximately that level through the early 1980s (3-5). Reported death rates have varied widely, but a study by Milberg *et al.* in 1993 found that ARDS case fatality had declined to 36% (6). Similarly, Abel *et al.* found that case fatality declined from 66% in a cohort of patients in 1990 to 1993, to 34% between 1993 and 1997 (7). Explanations for this temporal decrease are not clear.

Pathophysiologically, ALI is considered to be an acute inflammatory reaction of the lung with damage to the epithelial-endothelial barrier, causing high permeability pulmonary oedema. Lung compliance is decreased whereas the ventilation/perfusion mismatch increases, resulting in failure of gas exchange. Different intrapulmonary aetiologies, such as pneumonia and aspiration (direct lung injury) and extrapulmonary aetiologies, such as septicaemia and multitrauma (indirect lung injury), may trigger this process.

The recommendations of this conference have been widely used in adults with ALI or ARDS for

Received: 29 March 2007, Revised: 6 Oct. 2007, Accepted: 27 Jun. 2008

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both clinical investigations and clinical trials, but they have not been as widely accepted for use in critically ill pediatric patients, perhaps in part because of the lack of large, prospective epidemiologic studies using these definitions in this population. Most pediatric studies to date have been confined to single-center investigations with small numbers of patients (8-15).

Since the AECC, studies in adult patients have provided data on the incidence and outcomes of ALI/ARDS (16-18). Only one study investigated the incidence of ALI in children (15). Due to the lack of specific data on paediatric ALI, the authors aimed to determine the causes of ALI in children.

MATERIALS AND METHODS

We prepared a retrospective study and included the whole 567 children with respiratory distress referred to 17-Shahrivar Hospital, Rasht, Guilan after approval from the local Ethics Committee.

Children with all types of diseases had been admitted based on the following criteria: impending or manifest organ failure of at least one vital organ (respiration, circulation or central nervous system), patients with a high risk of organ dysfunction and failure due to general paediatric surgery (including multiply injured or neonatal surgical patients), post orthopaedic surgery, acute peritoneal dialysis, hemodialysis, post cardiac surgery, or post neurosurgery, and patients whose organ function needed to be closely monitored independent of the underlying disease.

The age group of the admitted children ranged from newborns with a birth weight of > 2000 g (independent of post-conceptional age) to older children with a maximum age of 9 years. Using their medical files, data including age, sex, and causes of respiratory distress were collected.

All of the analyses were performed by using SPSS 13 for Microsoft Windows (SPSS Inc, Chicago, IL).

RESULTS

There were 347 boys (61%) and 220 girls (39%). We classified their age into 4 groups including up to 28 days, 28 days to one year, 1-3 years, and older than 3 years (16.9, 32, 28, and 23.1 percent, respectively). The most common causes of ARDS constituted of pneumonia, asthma, croup, and bronchiolitis (38.4, 19.04, 16.5, and 6.1 percent, respectively). The most common causes of ARDS according to the patients' age groups were as follows (Table 1):

First age group: sepsis and pneumonia formed near half of the cases (48.9%). Other causes were meconium aspiration, respiratory distress syndrome (RDS), transient tachypnea, cardiac diseases, and tracheopharyngeal fistula. Choanal atresia, Morgangi hernia, and hernia diaphragmatica was also seen in this group.

Second age group: pneumonia, bronchiolitis, asthma, and croup formed the majority of cases. The rate of cardiac diseases decreased in comparison to the 1st group. However, foreign body aspiration and laryngomalacia were the new causes. Laryngeal mass, Morgagni hernia, and tracheopharyngeal fistula were also seen in this group.

Table 1. Causes of ARDS in different age groups*†

Causes	Group 1	Group 2	Group 3	Group 4
Pneumonia	23	99	51	45
Asthma		20	50	38
Croup		15	50	29
Bronchiolitis		30	3	2
Cardiac diseases	7	8		3
Sepsis	24			
Meconium aspiration	14			
RDS	13			
Foreign body		3	4	2
Transient tachypnea	8			
Pulmonary abscess				6
Laryngomalacia		3		1
Tracheal fistula	3	1		
Plural effusion				3
Morgagni hernia	1	2		
Diaphragmatic hernia	1			
Choanal atresia	2			
Epiglottitis				1
Laryngeal Mass		1		
Tuberculosis				1

Abbreviation: ARDS, acute respiratory distress syndrome; RDS, respiratory distress syndrome.
*Data are given as number.
†Group 1, newborns; group 2, infants; group 3, toddlers; group 4, children.

Third group: pneumonia, asthma, and croup were the most common causes. Foreign body aspiration had its highest rate in this group. Bronchiolitis was also seen.

Fourth group: common causes of ARDS were similar to the 3rd group. Pulmonary abscess, plural effusion, and epiglottitis were new causes. There was one case of tuberculosis among patients of 4th age group.

DISCUSSION

According to our results, pneumonia, asthma, and croup were the major causes of ARDS in children with a rate of 38.4, 19.04, and 16.5 percent, respectively. Among newborns, sepsis and pneumonia with similar rates were the most common causes. This finding is in contrast to the latest reports that introduced RDS as the most prevalent (1, 4, 6, 11).

Among infants, laryngomalacia was believed to be the most common cause of ARDS while we found pneumonia to have a clear higher rate (1, 4). In our hospital, laryngomalacia was rare.

Despite recent reports that have been indicated croup as the most frequent case of ARDS in toddlers, we demonstrated that pneumonia and asthma had a similar rate to croup as the cause of ARDS in this age group (1).

Similar to other studies, pneumonia, asthma, and croup had the highest rate in older children with ARDS (1, 12, 15, 17).

Infants were the most involved age group that places this age group at a higher risk. Overall male to female ratio was 3 to 2, a ratio that was relatively constant in all age groups.

In conclusion, it seems that infectious factors are at the top of the list of ARDS causing factors, a finding that must be considered in approach and management of such patients. We suggest vaccinating these at risk groups against common infectious factors such as *Hemophilus influenza* and respiratory syncytial virus (RSV) which can either cause pneumonia or induce asthma.

Conflict of interests

The authors declare that they have no competing interests.

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