CLINICAL SPECTRUM OF ACUTE RESPIRATORY DISTRESS SYNDROME IN PEDIATRIC INTENSIVE CARE UNIT IN A TERTIARY SETTING

THESIS

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By
Basant Salah Saad Meligy
(MBBCH. MSc)
Faculty of Medicine - Cairo University

Supervised by

Prof. Dr. Ahmed Saad Al Deen Al Beleidy
Prof. of pediatrics
Faculty of Medicine - Cairo University

Prof. Dr. Mohamad A. Badawi
Prof. of Pediatrics
Faculty of Medicine - Cairo University

Prof. Dr. Mohamed Hesham Sayed Ahmed
Prof. of Pediatrics
Faculty of Medicine - Cairo University

Department of Pediatrics- Faculty of Medicine
Cairo University
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Abstract

Introduction

Acute respiratory distress syndrome (ARDS) is a severe clinical syndrome of acute lung injury, noncardiogenic pulmonary edema and severe hyopxia. There are no reports on the magnitude of problem of this entity and its predisposing causes in the pediatric age group in Egypt. The present study was undertaken to examine the pattern of ARDS in a pediatric intensive care unit (PICU).

Patients and methods

This research follows cohort analytical study design, 20 pediatrics hypoxic patients needing mechanical ventilation constituted the study group. The records of the children admitted to PICU from January 2004 to January 2007 were reviewed.

Results

Based on the results of the present study, the following can be concluded: 1)The incidence rate of ARDS in the PICU is 13.9 /1000 admissions. 2)The most common cause of ARDS was due to direct lung injury due to pneumonia. 3) Morality rate was 85%, mostly due to respiratory failure.

Recommendations.

Based on the results of the present study further studies are recommended to study the incidence pattern of ARDS in other PICUS in Egypt

Key words:

Acute lung injury; ARDS; incidence; pediatric; clinical spectrum.

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LIST OF ABBREVIATIONS

ABC	Airway, Breathing, Circulation
ABMA	Anti-Basement Membrane Anti body
ACE	Angiotensin Converting Enzymes
AEP	Acute eosinophilic pneumonia
AHRF	Acute Hypoxemic Respiratory Failure
AIP	Acute interstitial pneumonia
ALI	Acute Lung Injury
APACHE	Acute Physiologic and Chronic Health Evaluation
ARDS	Acute Respiratory Distress Syndrome
$ARDS_{exp}$	Extrapulmonary Acute Respiratory Distress Syndrome
$ARDS_p$	
BAL	Bronchoalveolar Lavage
BALF	Bronchoalveolar Lavage Fluid
BOOP	Bronchiolitis obliterans organizing pneumonia
CaO_2	Arterial Oxygen Content
CNS	Central Nervous System
CO	Cardiac output
COX-2	Cyclo-Oxygenase-2
CT	Computed Tomography
CVD	Collagen Vascular Disease
DAD	Diffuse Alveolar Damage
DO_2	Oxygen Delivery
DAH	Diffuse alveolar hemorrhage
DIC	Disseminated Intravascular Coagulation
ECM	Extracellular Matrix
ECMO	Extracorporeal Membrane Oxygenation
ETs	Endothelins
FACTT	Fluid and Catheter Therapy Trial
FDP	Fibrin Degeneration Product
FIO_2	Fraction of Inspired Oxygen
FRC	Functional Residual Capacity
GALT	Gut-Associated Lymphoid Tissue
G-CSF	Granulocyte-Colony Stimulating Factor
HDR	Host Defense Response
HFOV	High Frequency Oscillatory Ventilator
HP	Hypersensitivity pneumonitis
HPV	Hypoxic Pulmonary Vasoconstriction
I:E	Inspiration to Expiration

IEDs Immune-enhanced diets
IL-1 Interleukin-1
iNO Inhaled Nitric Oxide
IRV Inverse Ratio Ventilation
LIS Lung Injury Score
LTs Leukotrienes
MAP Mean Airway Pressure
MODS Multiple Organ Dysfunction Syndrome
MOFS Multiple Organ Failure Syndrome
NAC N- acetylcysteine
NADPH Nicotinamide Adenine Dinucleotide Phosphate
NAECC North American European Consensus Conference
NHLBI National Heart, Lung, and Blood Institute
NNIS National Nosocomial Infection Surveillance System
NO Nitric Oxide
NP Nosocomial Pneumonia
N-PCP-III N-Terminal Procollagen Peptide-III
PAF Platelet-Activating Factor
$PaCO_2$ Partial Pressure of Carbon Dioxide
PaO_2 Partial Pressure of Oxygen
PAWP Pulmonary Artery Wedge Pressure
PCIRV pressure-controlled inverse ratio ventilation
PEEP Positive End Expiratory Pressure
PEEPi Intrinsic PEEP
PG Prostaglandin
PICU Pediatric Intensive Care Unit
PIP Peak Inspiratory Pressure
PMN Polymorphonuclear leukocytes
PRISM Pediatric Risk of Mortality
PSB Protected Specimen Brush
RCT Randomized Control Study
RNS Reactive Nitrogen Species
ROS Reactive Oxygen Species
SaO_2 Arterial Oxygen Saturation
SIRS Systemic Inflammatory Response Syndrome
SOFA Sequential Organ Failure Assessment s
TGF- β Transforming Growth Factor –β
TGF Expression of Transforming Growth Factor
TNF-α Tumor Necrosis Factor-Alpha
TRALI Transfusion-Related Acute Lung Injury

TX	Thromboxane
uPA	Urokinase Plasminogen Activator
VC-IRV	Volume-Controlled Inverse Ratio Ventilation
VILI	Ventilator-Induced Lung Injury
V/Q	Ventilation Perfusion Ratio
WBCs	White Blood Cells

INTRODUCTION AND AIM OF WORK

Acute respiratory distress syndrome (ARDS) is an acute form of severe alveolar-capillary injury that evolves after a direct or indirect lung insult. It begins as noncardiogenic pulmonary edema. Mortality remains high among children with ARDS, particularly when serious underlying conditions co-exist, sepsis occurs, and when there is multi-organ failure. (***Redding, 2001)***

The American European Consensus Conference on ARDS, 1994 was convened to bring clarity and uniformity to the definition of acute lung injury (ALI) and ARDS. The Conference defined ALI as the acute onset of bilateral infiltrates on chest radiograph without evidence of left atrial hypertension and with a partial pressure of oxygen (Pa_{O2})/fraction of inspired oxygen (FI_{O2}) ratio of less than 300 and ARDS as the acute onset of bilateral infiltrates without left atrial hypertension and a Pa_{O2}/FI_{O2} ratio of less than 200. The Consensus included a return to the use of acute rather than adult as an acknowledgment that ARDS is not limited to the adult population. (***Artigas et al, 1994)***

Despite a large number of initiating factors, the pathophysiologic events are similar: pulmonary hypertension, intra-pulmonary shunting with severe hypoxemia and myocardial dysfunction. This syndrome was first described in adults and is now increasingly being recognized in children. (***Lodha et al, 2001)***

ALI and ARDS are rare diseases in pediatric intensive care unit with a high mortality. (***Dahlem et al, 2003)***

Aim of work

The aim of work is to identify the clinical spectrum of the acute respiratory distress syndrome in pediatric intensive care unit. This included; incidence, risk factors, prognostic factors, mortality rate and giving particular attention to the changes in pulmonary gas exchange and hemodynamics and to other organ dysfunction among ARDS pediatric patients to develop more effective ventilator effective strategies.

Definition of Acute respiratory distress syndrome

Acute respiratory distress syndrome (ARDS) is a syndrome and not a specific pathophysiologic disease. Therefore, patients are determined to have ARDS when they meet specific diagnostic criteria. Since the initial description of ARDS investigators have made several attempts to refine these criteria. ***(Silverboard et al, 2003)***

The concept of acute respiratory failure could develop as a consequence of certain non-pulmonary conditions was not new in 1967. Since the World War II, the occurrence of severe pulmonary dysfunction has been noted in soldiers suffering from non-thoracic trauma. The terms "*wet lung*' or "*Da Nang lung*" have been applied to the development of acute pulmonary edema following severe injury received during combat. The syndrome achieved widespread recognition during the Viet Nam War, when the first time effective field resuscitation and rapid evacuation to hospitals permitted the survival for severely injured well hydrated patients who would have died in earlier wars. In 1992, the term "acute respiratory distress syndrome" replaced "adult respiratory distress syndrome" because the syndrome can occur in children, although it is much less common in children than adults. **(*Russell et al, 1999)***

In 1967 Ashbaugh and colleagues described a clinical syndrome of tachypnoea, hypoxaemia resistant to supplemental oxygen, diffuse alveolar infiltrates, and decreased pulmonary compliance in 12 patients who required positive pressure mechanical ventilation. The onset of the syndrome was acute, typically within hours of the inciting clinical disorder. The majority of patients did not have a history of pulmonary disease. Adequate oxygenation required the use of continuous positive pressure with end expiratory pressures (PEEP) of 5–10 cm H_2O. The earliest radiographic findings were patchy infiltrates indistinguishable from cardiogenic pulmonary edema that usually became confluent with progressive clinical deterioration.
(*Ashbaugh et al, 1967*)

Post mortem examination of the lungs of seven of them revealed atelectasis, vascular congestion and hemorrhage, severe pulmonary edema and hyaline membranes. Shortly afterwards, Petty and Ashbaugh called this constellation of findings adult respiratory distress syndrome (adult RDS). (***Petty and Ashbaugh, 1971)***

Since then, adult RDS has been recognized globally as an entity and been the subject of considerable academic activity, revealing a wealth of information about the clinical features, physiological disturbances, prognosis and pathology of adult RDS. (***Artigas, 2002*)**

However the criteria for diagnosing ARDS lacked uniformity and raised concern that the requirement for a pulmonary artery catheter may significantly delay the diagnosis of ARDS and delay the initiation of therapy. **(*Silverboard et al, 2003*)**

The definition was not sufficiently specific, was open to varying interpretations, and did not require the clinical etiology of the syndrome to be specified. Investigators used different criteria to enroll patients in clinical studies making comparison of results across trials difficult. (***Atabai and Matthay, 2002)***

In **1988 Murray and colleagues** introduced the lung injury score (LIS) to provide more specific and rapidly diagnostic criteria (Table.1). In the setting of identifiable causes of lung injury, this 4-component score included: ratio of PaO_2/FiO_2, the number of quadrants with alveolar consolidation seen on a frontal chest radiograph, the amount of positive and-expiratory pressure (PEEP), and a measure of static respiratory system compliance for ventilated patients. (***Murray et al, 1989*)**

However the 4-point chest radiograph scoring system could introduce significant variation in radiographic interpretations, and thereby change the overall Lung Injury Score, depending on which radiologist interpreted the film. Also the inclusion of PEEP in the scoring system might create variability secondary to difference in utilization of PEEP by the physician in charge. A modified lung injury score is created based on only two criteria a) chest radiographic abnormalities; and b) hypoxemia. **(*Moss et al, 1995*)**