

Diagnosis of Thermal Burn Damage to Respiratory Tract in Children with Severe Burns

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ABSTRACT

Inhalation traumas occur in 10 - 30 of cases among patients with burns with this frequency of unfavorable outcomes of the diseases is 16% higher than in burns of the having the same area of damage. During a 3-year period, 28 children with deep burns of III-IV degree were treated at Burns Department of Republican Scientific Center of Urgent Medical Aid (RSCUMA), Samarkand, Uzbekistan. Performing sanitation bronchoscopy, early respiratory supporting, rational anti-bacterial therapy and adequate nutritive supporting are the perspective way of the complex therapy for such type of the patients. Thus thermal damage to respiratory tract in combination with skin burns in children cause high lethal outcome that requires to apply more informative method, i.e. of bronchoscopy which makes it possible to diagnose presence of thermal inhalation trauma, to determine prevalence and severity of damage, and to carry out medical manipulations as well.

Keywords

Children, Burn disease, Thermo-inhalation injury, Treatment.

Introduction

Thermal burns in pediatric patients are frequently seen in the practice of the emergency clinician. Approximately 1% of all annual United States ED visits are due to burns [1], and burns in patients aged < 14 years are consistently among the top causes of injury-induced mortality [2]. Most pediatric burns occur because of accidents in the home [3]. The majority of pediatric burns are due to scald injuries, a burn caused by hot liquids spilling onto the skin. Scalds and contact burns from sources such as stoves and hot irons together account for 85% of burns seen by emergency clinicians [4].

Inhalation traumas occur in 10 - 30 of cases among patients with burns with this frequency of unfavorable outcomes of the diseases is 16% higher than in burns of the having the same area of damage [5,6]. The patients with thermal burn damage are considered to be the category with critical injuries. This is a complex pathologic condition both in diagnostic and therapeutic aspects [7-10].

Pathological process developing in combination of skin burns and thermal inhalation traumas is not just a double injures but the reaction of the whole body. This Syndrome is marked in literature a Syndrome of Mutual Aggravation. Inhalation traumas are the main cause of children's death in fires [11] as lethal outcome risk in children is higher than in adults due to their different anatomic and physiological features. For example, in 2017 Americans died of thermal burn injuries of them 314 were children aged under 14 years [12].

Material

During a 3-year period, 28 children with deep burns of III-IV degree were treated at Burns Department of Republican Scientific Center of Urgent Medical Aid (RSCUMA), Samarkand, Uzbekistan. The age of hospitalized patients was from 8 month to 14 years. When the causes of the burn's injuries were examined, the most causes of injuries were flame twenty-four (85.7%); and sandal burns - 4 (14.3%).

Methods and Results

On examination of victims, particular attention was paid on: burns localization on the head and chest; singing of external nasal

meatus hair, eyebrows, moustache, i.e., hairy part of the head; presence of soot in the oral cavity, pharynx; on auscultation - on rough breath sounds or relief of breathing in inferior portions, presence of rales. After primary examination of children diagnostic fibro bronchoscopy (diameter of endoscopes is 2.8-4.9 mm) on suspicion to thermal inhalation injury was carried out in first 24 hours after getting trauma or after transference from other in-patient departments.

More informative method is bronchoscopy making it possible to diagnose thermal inhalation trauma to determine the prevalence and severity of damage as well as to carry out medical manipulations (sanation of soot and secretion, introduction of medicines) in primary examination and in dynamics in revealing endobronchitis (catarrhal, fibrinous, purulent). During bronchoscopy bronchial washing off can be taken for cytological and microbiological studies.

Indications for bronchoscopy are:

- Anamnesis data (patient's stay in a fire zone or smoky building),
- Burn localization on the face, neck, chest,
- Sungeing of external nasal passages hair, eyebrows, hairy part of the head,
- Soot of the tongue, oral cavity, on the back wall of the pharynx and in nasal passages,
- Husky voice, soot in sputum, breathlessness, complaints on difficult breathing,
- Signs of bronchoobstruction in auscultation,
- Signs of growing hypoxemia with metabolic acidosis.

In our in-patient department, the diagnosis of thermal inhalation damage to respiratory tract is endoscopically confirmed in all patients. The examination was carried out by Olympus fibrobronchoscope of 2,8 mm and 4,9 mm diameter through intubation tube of through the mask / laryngeal mask under general anesthesia. The problem concerning intubation and moving to artificial pulmonary ventilation (APV) was resolved by resuscitation based on clinical symptoms such as husky voice, aphonia, stertorous breathing, auscultation findings, the area and severity of skin damage and laboratory study of carboxihemoglobin level, signs of acidosis. In primary examination, the degree of damage severity was determined and the plan of dynamic endoscopic observation was made up.

In children, the burn of upper respiratory tract of mild and average degree of severity was diagnosed. 20 children got burn on the lower respiratory tract: the mild degree of damage was established in 5 children, the average degree of damage in 9 and severe degree in 14 patients. Bronchoscopy was carried out every day up to complete sanation of soot and subsequently every day or in a day depending on the character of endobronchitis (catarrhal, fibrinous, purulent), amount of secretion and findings of x-ray examination (existence of hypoventilation signs, atelectasis). Sanation number made from 1-2 in a mild degree of damage 8-9 sanations to one patient in average and severe damage. For sanation 0,9% NaCl solution was used. In the presence of adhesive and purulent secretion used flumucil – antiliotic preparation 0.5% metrogil solution according to age dosages was used.

An important constituent in treatment of children with thermal inhalation trauma is inhalation therapy. In a complex with endoscopic sanation the children received inhalation of moistened oxygen, inhalation with physiological saline solution, lasolvan or flumucil - antibiotic (in purulent endobronchitis), and was pulmicort according to age doses. The patients undergoing APV received inhalation through breathing circuit, after extubation, inhalations were continued through nebulaser. Endoscopic control in dynamic was carried out up to disappeared of visible signs of damage to mucous membrane of larynx, trachea and bronchi. All children with severe damage underwent control bronchoscopy before being discharge. In one case there was revealed posttraumatic cicatricial stenosis of sub folded part of larynx of the 1st in a girl aged 2 years and 10 months which did not need treatment.

Conclusions

Thermal inhalation trauma is combined impairment of respiratory tract which occurs in of hot air, steam, smoke, volatile toxic chemical combination formed in the process of burning of different natural and synthetic materials. Thermal inhalation damage occurs in patients being in closed space – in dwelling and workers' house transport, elevators, basement, etc. in such situation severe damage to respiratory tract may develop in injured people without visible signs of skin burns. The main factors that cause injuries are a high temperature of inhaled air and burns products: carbonic oxide, CO₂, hydrogen chloride, hydrocyanic acid, ammonia, sulfur dioxide, phosgene, aldehydes, fluorohydrogen, etc. [15,16].

According to the date of literature combination of skin burns with damage to the respiratory tract occurs in 30% of patients with fire burns and there is a clear tendency to its increase [17,18]. First of all, it is connected with increase of number of patients with burns who got injured as a result of high temperature, toxic gases, etc.

The National Burn Repository of the American Burn Association reports up to 10.3% of the burn patients has concomitant inhalation injury [19,20]. As such, 1 in 10 burn patients surviving to admission will have the inhalation injury with the respective increase in the mortality rate. The pulmonary system has three fundamental functions: ventilation, oxygenation, and expectoration. The duration of smoke exposure, temperature of the inhaled smoke, and composition of the smoke are determinants of injury severity. According to our data, the frequency of combined inhalation injury in severely burned children is 13.4%, and the mortality rate reaches 34%. The prognosis depends on timely and objective diagnosis of inhalation injury, adequate local treatment, and early respiratory and intensive care [21].

Severe burn in children with inhalation injury are at greater risk than adults due to immaturity of anatomical and functional structures, imperfections of protective and adaptive responses of organs and body systems, and inadequate response to stress.

Thus thermal damage to respiratory tract in combination with skin burns in children cause high lethal outcome that requires to apply more informative method, i.e. of bronchoscopy which makes it possible to diagnose presence of thermal inhalation trauma, to

determine prevalence and severity of damage, and to carry out medical manipulations as well.

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