RESEARCH ARTICLE / Araştırma Makalesi

The analysis of burns due to an explosion in a school laboratory

Bir okul laboratuvar patlamasına bağlı yanıkların analizi

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Abstract

Introduction Explosions in laboratories usually affect more than one person, and chemical burns, flame burns and inhalation burns occur in these people. The study involved a retrospective review of burn admission of patients to Dr. Lutfi Kırdar Kartal Education and Research Hospital Burn Center due to laboratory explosion in an elementary school Istanbul. **(Sakarya Med J 2017, 8(1):121-127)**

Methods The clinical data evaluated included the patient's age and sex, the depth of the burn injury, the total burned surface area, the distribution of the burn areas and treatment. Six patients were admitted to hospital with flame burns caused by lab explosion on the elementary school in Istanbul. Patients consisting of 2 males and four females.

Results Mean age of patients were 14,3(11-28 years). Mean total burned surface area was 18.3 %(5%-45%). Two patients were treated in burn intensive care unit due to inhalation injuries. Mean length of stay in burn unit was 12 days(2-36 days). Outcome included; 4 discharges, two transferred out to other wards, and no patient died, but two children were operated for three times for reconstruction of keloids and contractures, and they were followed up for five years. Psychologic support to these children and their parents were given because of the stress disorder, and the scars occurred in them.

Conclusion Burn injuries in children are an essential public health issue and one of the most frequent injuries among pediatric patients in all countries. Laboratory accidents are preventable if necessary precautions are taken properly in managing the laboratory environment. We must promote some changes in the education of teachers in this issue and in first aid and preventive measures such as using eyeglasses, protective clothes, and gloves.

Keywords pediatric burn; explosion; laboratory accidents; school accidents

Öz

Amaç Laboraturlarda gerçekleşen patlamalar genellikle birden fazla insanı etkiler ve bu hastalarda inhalasyon yanıkları gerçekleşir. Bu çalışma İstanbul'da gerçekleşen laboratuar patlaması sonucu oluşan yanık başvurularının retrospektif bir gözden geçirilmesidir.
(Sakarya Tı Dergisi, 2017, 8(1):128-135).

Gereç ve Yöntemler Değerlendirilen klinik bilgiler hastaların yaş, cinsiyet, yanık derinliği, total yanık yüzey alanı, yanık alanlarının dağılımı ve tedavi seçenekleridir. İstanbul' da bir orta okulun laboratuarında meydana gelen patlamaya bağlı alev yanığı oluşan 6 hasta hastaneye başvurmuştur. Bu hastaların 2'si erkek ve 4'ü kadındır.

Bulgular Hastaların ortalama yaşı 14.3 (11-28)' dir. Ortalama total yanık yüzey alanı %18.3(%5-45)' tür. 2 hasta inhalasyon hasarlarına bağlı yanık yoğun bakımda tedavi edilmiştir. Yanık merkezinde ortalama yatış süresi 12 gündür (2-36 gün). 4 hasta taburcu edilmiş, 2 hasta diğer servislere transfer edilmiştir ve hiç ölüm gerçekleşmemiştir ancak 2 çocuk keloidler ve kontraktürlerin rekonstrüksiyonu için 3 kez opere edilmişlerdir. Çocuklara ve ailelerine stres bozukluğu ve oluşan skarlar nedeniyle psikolojik destek verilmiştir.

Sonuç Bu önlenebilir komplikasyonlardan korunmak için gerekli tedbirler alınmalıdır. Bu konu ile ve koruyucu gözlükler, elbiseler ve eldivenlerin kullanımı ve ilk yardım eğitimi ile ilgili öğretmenlerin eğitimlerinde bazı değişiklikler yapılmalıdır.

Anahtar Kelimeler: pediatrik yanık; patlama; laboratuar kazaları; okul kazaları

Intrıduction

Burn injuries are a significant cause of morbidity and mortality in children. Burn injuries rank third among injury-related deaths in children aged 1 to 9 years[1]. Studies have identified that the risk of burn injuries is highest in the home, particularly in the kitchen, and that such damages are primarily preventable[2]. The schools are places in which the children spend time other than their houses and burn cases may also occur in schools. Burns in schools can result in injuries in more than one child and even in adults. Science and chemistry laboratories of institutions involve dangers about burn injuries. For the attention of these risks, we report an accident in a school resulted in multiple burn injuries.

An explosion in an elementary school chemistry laboratory in Istanbul occurred with an unknown cause while the students were heating liquids in test tubes with their teacher. This event caused burn injuries to 5 students and one teacher. After first interventions in school, all of the patients were admitted to our burn center by ambulance service.

Patients and methods:

After institutional ethic committe approval we studied six patients who admitted to hospital with flame burns caused by laboratory explosion on the elementary school, Istanbul. Patients consisting of 2 males and four females. Mean age of patients were 14,3 (11-28 years). Mean total burns surface area was 18.3% (5%-45%). The depth of burns were 3 (3 patients) and 2 (3 patients). The anatomical locations of wounds were face (3 patients), neck (4 patients), upper extremities (3 patients), lower extremities (5 patients) and anterior trunk (2 patients).(Figure1,2,3)

Results:

Mean length of stay in burn unit was 12 days (2-36 days). Two patients were treated in burn intensive care unit due to inhalation injuries. Mean length of stay in burns intensive care unit was 11 days (7-15 days). Outcome included; 4 discharges, two transferred out to other wards and 0 deaths. The complications were severe scar contractures (2 patients) and hypertrophic scars (3 patients). For data analysis, descriptive statics were used.

In long term follow up of these patients, no mortality and no permanent deformities were obser-

ved in all patients but for relief of the psychological injury, long term psychiatric therapies were performed.

Discussion:

Severe burns may be lethal, and survivors often suffer from disfiguring and disabling scars, psychological trauma, and loss of productive years. Many injuries that occur in the first two decades of life are accidental and preventable. However, the severe burn is a leading cause of morbidity and mortality in children and injuries are the primary cause of injury-related death in this group3.

In this explosion, severe burn injuries occurred in 3 students, moderate burn injury occurred in 1 student, and mild burn injuries occurred in 1 student and one teacher (Table 1). In our study, there were two male patients and four female patients. These observations are similar to those described Kumar et al.4 found that females were affected more than males (74.1 vs. 25.9%). Severely injured students' faces were towards the experiment environment, and they had extended their hands to the test tube. As a result, burn injuries occurred on their faces, hands, arms, and trunks. After the explosion, a small fire occurred and inhalational burns occurred in 2 students due to smoke. These two students were followed up in burn intensive care unit with mechanical ventilation.

Table 1: Demogrphics data, TBSA, depth of burns,burn area, inhalation injuries of the patients

	Age (year)	Gender (M/F)	TBSA	Depth	Area	Inhalation injury
1	11	F	45%	2-3	Face, neck, left upper extremity, body, left lower extremity, right crus	+
2	11	F	20%	2-3	Face, neck, right upper extremity, right lower extremity	+
3	13	M	18%	2-3	Face, neck, right upper extremity, body	-
4	12	M	15%	2	Right lower extremity, neck,right arm, body anterior area	-
5	11	F	7%	2	Right lower extremity, right arm	-
6	28	F	5%	2	Right lower extremity	-

TBSA: Total Body Surface Area

As seen in our patients; burn occurrence was extremely high in the 0-12 year age group, making this a high-risk group and a prime target for prevention5. As expected, we found that an increase of the Total Body Surface Area(TBSA) burned leads to an increased risk length of hospital stay among children, a finding confirmed by other studies6. To our acknowledge the significant differences between burn management in children and adults is essential. Children have just about three times the body surface area to body mass ratio of adults. Fluid losses are proportionately higher in children than in adults. Consequently, children have relatively greater fluid resuscitation requirements and more evaporative water loss than adults[7].

School laboratory burns are severe and often cause severe debilitating sequelae. Due to the high heat occurred at the explosion, burn injuries were in 3rd degree in our three patients. Therefore, these burn injuries did not recover spontaneously even after treatment with surgical autografts. In our patients, one step dermal matrix (Matriderm®) was applied to face, neck, and extremities under autografts at the same session.

Rehabilitation processes were performed in all patients although there was no mortality. These rehabilitation is very crucial and as important as the survival of the patients and it is a very long and demanding period of the treatment. The aim of the rehabilitation is regaining the pre-injury physical and social status of the patient[8].

For this purpose; a multidisciplinary team, the child and the family must act together at every stage of rehabilitation. It should be kept in mind that pediatric burn cases may be difficult to adapt to the rehabilitation program unlike adults. The physical therapy programs to be applied should be closely followed by the family and should be called up regularly and the effectiveness of the program should be evaluated. Also, depending on the burns that occur in visible areas of the body such as the hands and face posttraumatic stress disorder occurred in all children at first 3 months (Table 2). Psychological support was provided to all patients in order to eliminate the psychological disorders which may adversely affect the rehabilitation process and delay the healing process.

At joints of hands, wrists, and ankles in which autografts were applied, contractures occurred in time although splints, silicone pressure clothes, and physical treatments were used. Also, post-traumatic stress disorder occurred in all children (Table 2). As a result of irregular application of the exercises which are the most important rehabilitation activity of the patients; at joints of hands, wrists, and ankles in which autografts were applied, contractures occurred in time although splints, silicone pressure clothes, and physical treatments were used.

Table 2: Treatment of the patients

Patient	Intubation time (day)	ICU time (day)	Emergent intervention	Elective intervention	Hospitalization time (day)	Rehabilitation
1	6	15	Left arm, left hand palmar and dorsal areas, left fingers fasciotomy	Debridement with hydrojet + STSG STSG	39	Hand, fingers contacture- sprint, physiotherapy Hypertrohic scar– compression bandage
2	5	7	Debridement wound dressing	Debridement Wound dressing	19	Hypertrohic scar– compression bandage
3	-		Right arm, right hand-palmar and dorsal areas, right fingers fasciotomy	Fasciotomy closing STSG	26	Hand, fingers contacture –sprint, physiotherapy Hypertrohicscar – compression bandage
4	-		Debridement wound dressing		5	Total cure
5	-		Debridement wound dressing		-	Total cure
6	-		Debridement wound dressing		-	Total cure

STSG: split-thickness skin graft, ICU: intensive care unit

In one study; the overall mortality of hospitalized children was 0.7%. These two victims were females, 11 and 17 years-of-age who suffered burns in 90% and 97% of TBSA. In both patients, injuries were caused by flame and were associated with smoke inhalation9, but in our cases, the mortality rate was 0.

Burn injuries in childhood range from minor to severe events and present a significant public

health problem. Apart from causing death, burns often result in disastrous long-term effects that include disabling scars and contractures and have substantial psychological consequences for the affected children[9,10]. Treatment of injuries is expensive and consumes medical resources, as the care of a severe burn patient requires specialized staff and medical technologies. Children are at a higher risk of burn injuries because of their natural curiosity, impulsiveness, the less acute perception of dangerous situations and a limited ability to react promptly and appropriately in hazardous situations[11]. In conclusion, burns, as one of the most devastating injuries in children, require more consideration than that given to other types of trauma.

Teachers and students should implement strict safety controls when laboratory demonstrators are handling hazardous materials. Educational demonstrations involving flammable materials are often performed at schools to engage students and teacher. Main reasons for laboratory fires were reported to be lack of information and overconfidence of the teachers, carelessness, lack of precautions, ignorance of the possibility of an accident, and negative physical conditions[12].

As expected, we found that an increase of the TBSA burned leads to an increased risk of mortality among children, a finding confirmed by other studies[13]. Similarly, with our patients, the head and neck region is the most frequent site where a burn injury occurs. In 4 of our patients there was burn on the neck, and in 3 of them, there was burn on the face. The prevalence of facial burns in children is between 24 and 52%[14]. Especially in these patients who had wounds on neck and face, initial management of the pediatric burn patient requires the evaluation of potential airway compromise, oxygenation, and ventilation.

Predictors of significant inhalation injury and impending respiratory failure including stridor, wheezing, drooling, and hoarseness is indicative of airway swelling and compromise[15]. 2 patients who had burns on the face were transferred to the intensive care unit, and mechanical ventilation was performed for 6 and five days respectively.

It should be kept in mind that conduction of a through hazard review is significant before performing experiments in laboratories with flammable chemicals at schools. Flammability and any other hazards may occur during the demonstration. A safety barrier such as a physical barrier like a clear shield should be maintained between any activity involving flammable chemicals and any bystanders. The person inside the fence performing the demonstration should wear all appropriate personal protective equipment such as gloves, safety glasses with side shields and lab coasts or clothing made of flame-resistant material[16,17].

Unfortunately, children are exposed to burns more often because they are unaware of their danger. Thus, teachers should be aware of the risk factors for pediatric injuries and be more careful in preventing them[18].

In Turkey, Ministry of Education published a guideline named “SECONDARY EDUCATION PROJECT- LABORATORY SERVICES, LABORATORY SAFETY” in 2011 and in this guideline the precaution in school laboratories were explained. This guideline was distributed to all schools[19].

Epidemiological studies of burn injuries have highlighted risk factors that have led to the establishment of effective prevention programs for this significant public health problem. For prevention of this kind of distressful events, health care workers, teachers, school directors, district education officers and parents of the children have essential roles.

Conclusion:

School directors face with legal problems after these kinds of events, and when the parents heard that their children were injured severely in an accident occurred at schools where they thought that they are safe, a significant psychological trauma affects them. Body integrities of the children are deteriorated, and this also affects the children psychologically.

In our country, guidelines of the ministry of education about laboratory safety are present, but other accidents reported in our state show us the deficiencies of practice about this subject.

Additional education directed at raising awareness of the problem and providing resources for reducing the risk is needed to ensure that schools are safe from unnecessary dangers posed by burns.

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