Pediatric near-drowning and drowning

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ABSTRACT

ماتزال حالات الغرق تمثل مشكلة صحية كبيره بالمجتمع وبالذات لدى الذكور والأطفال الأقل من خمسة أعوام. الهدف من هذا المقال هو تقديم مراجعة حيثة لهذا الموضوع مع التركيز على المعلومات المتاحه من منطقتنا العربية والاستراتيجيات الوقائية. يعد الأطفال الرضع هم عرضه للغرق بالمراحيض وأوعية الغسيل بينما معظم حالات الغرق لدى الأطفال الأكبر سناً تكون فى المسابح. ومن أهم العوامل المؤدية لغرق الأطفال ومن ثم وفاتهم هو عدم مراقبتهم بصورة جيده من قبل المربيين بالذات قليلي الخبرة. بينما تكون الوفيات لدى الأطفال المراهقين أثناء الأنشطه المائية خارج المنزل. ومن المهم بدء الأنعاش والعلاج فوراً عند الأصابه و قبل الوصول للمستشفى لتفادى حدوث أى مضاعفات عصبية. مع العلم أن معظم الأطفال الذين يتم اسعافهم سريعاً يتشافون سريعاً بدون أي مضاعفات عصبية. و من المهم حظر الوصول للمسابح بسهولة و الاهتمام بمراقبتهم أثناء السباحة لتفادى الغرق. مع العلم أن البرامج الوقائية يجب أن توجه للعوائل المعرضة لمثل هذه الحوادث مثل العوائل حديثة الخبرة أو التى تواجه صعوبات ماليه أو اجتماعية.

Childhood water submersion remains a major public health problem. The aim of this article is to present an updated overview of the topic with data from our region and special attention to prevention strategies. Children less than 5 years and males are particularly at risk. Infants are at higher risk of drowning in bathtubs, toilets, or washing machines, while most drowning in older children occurs in swimming pools. Poor supervision by inexperienced caregivers is a common factor and contributes to most deaths. Adolescents drown more often during outdoor water activity. Acute management should start as soon as possible in order to prevent unfavorable neurological outcome. Cardio-pulmonary resuscitation should be started at the scene. Most children who were rescued quickly will recover neurologically intact. Restricting access to water and close adult supervision are paramount in preventing near-drowning and drowning. High-risk groups, such as new or young parents, and lower socioeconomic families, should be targeted by such prevention programs.

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Childhood water submersion remains a major public health problem in many countries with significant morbidity and mortality.[1] Near-drowning occurs when the child recovers from water submersion, whereas, drowning is defined as suffocation and death from such submersion.[2] Many people (estimated at 500,000/year) die from drowning worldwide, with the majority occurring in developing countries.[3] Among all pediatric accidental deaths in the United States, drowning is the second leading cause accounting for more than 1000 deaths annually.[4] However, the estimated annual hospitalizations associated with drowning declined from 4.7/100 000 in 1993 to 2.4/100 000 in 2008.[4] The rates declined for all age groups, and for both males and females. Similar data from developing countries are lacking. However, it is important to note that for every child who drowns, at least 3 receive emergency room care for near-drowning, and more children are never brought to the hospital. The frequency of near-drowning is therefore, much higher because of under-reporting. The aim of this article is to present an updated overview of the topic with data from our region and special attention to prevention strategies.

Risk factors and predisposition. Males are always at higher risk when compared to females. Most drowning occurs in fresh water, particularly residential swimming pools. The use of portable pools also poses a significant risk for younger children.[5] However, children less than 5 years of age often drown in washing containers, up to 55% of cases in one study from Saudi Arabia.[6] Open wells are also a special risk in our region. In general, predisposing circumstances depends on the child's age. Infants are at higher risk of drowning in bathtubs, buckets, toilets, or traditional washing

machines, while most drowning in older children occurs in residential swimming pools. Bathtubs are particularly risky even with few centimeters of water because infants may not be able to lift themselves up once they slipped and submerged. Infant bath seats do not provide full protection and should never replace close adult supervision.[7] Larger buckets and traditional washing machines are a hidden danger to curious young children. Children may be able to pull themselves up into the water container, however, due to their relatively large head, they may not be able to lift themselves out, or tip the water-filled container.[8] Poor supervision by inexperienced caregivers is a common factor and contributes to most deaths in children less than 5 years of age.[9] Brief period of no supervision is usually enough for such a disaster to happen. Child neglect should be suspected in such cases. Many families from our region lacked the necessary general infant and child safety practices.[10] In one Saudi study, up to 87% of the victims were not properly supervised at the time of the event.[11] Children from lower social economic families are exposed more frequently to buckets and laundry tubs making them predisposed to drowning this way.[12] Adolescents drown more often in outdoor water activity such as rivers, lakes, and ponds. In our region, water collections following seasonal heavy rain are a common site for such accidents. In other countries, alcohol or drug use may be involved.[13] Inexperienced male adolescents may engage in risky water behavior and tend to overestimate their swimming abilities.[14] Open lakes and large rain water collection increases the risk of drowning rather than nearly drowning because of lack of close supervision and availability of emergency services.[15] Finally, an important risk factor for drowning is active epilepsy. The risk is even higher if the patient is also mentally retarded. Because of this risk, patients with epilepsy should take showers rather than use bathtubs.[16]

Clinical manifestations. Multiple body systems are affected in varying severity by near-drowning and the associated hypoxic ischemic injury. During the submersion, the child initially will hold breath; try to surface, panic, followed by water aspiration. The patient then becomes hypoxic, loses consciousness, and stops breathing. Silent drowning occurs in less than 10% of cases when laryngospasm is triggered by initial water aspiration resulting in dry rather than wet lungs. Water inhalation is usually associated with bronchospasm and atelectasis with subsequent intrapulmonary shunting of blood through poorly ventilated tissues. This further reduces ventilation and oxygenation. If the patient is rescued, one should watch for later development of pulmonary edema and adult respiratory distress syndrome.[17] Neurological manifestations occur in up to 10% of near-drowning patients depending on the duration and severity of the initial hypoxic-ischemic insult. These patients should be monitored for brain edema during the first 3 days post injury. Other manifestations and complications include cardiac dysfunction, arrhythmias, acidosis, electrolyte imbalance, hypotension, and hypothermia. Hypothermia may result in significant hypovolemia as a result of peripheral vasoconstriction. Differences in the osmolarity of fresh and salt water may result in specific fluid and electrolyte abnormalities. Fresh water is hypotonic relative to plasma causing hypervolemia and dilutional hyponatremia, while salt water is hypertonic causing hypovolemia and hypernatremia. However, such significant changes in fluids or electrolytes are less common in clinical practice.[18] In fact, metabolic acidosis is more common than electrolyte disturbances.[19] Patients with more severe near-drowning may develop shock with associated anemia, acute tubular necrosis and disseminated intravascular coagulation.[20]

Acute management. Acute management should start as soon as possible in order to prevent unfavorable neurological outcome.[21] Cardio-pulmonary resuscitation (CPR) should be started at the scene. Due to lack of training, families rarely try to perform such resuscitation. Cervical spine immobilization should be performed if a high impact event is suspected, such as diving or falls.[22] The airway, breathing, and circulation should be assessed. However, maneuvers to remove fluid from the lungs, such as chest or abdominal compressions, are no longer recommended because of lack of efficacy. As well, these compressions may delay CPR, and increase the risk of vomiting and aspiration.[23] The CPR can be performed with fluid in the lungs as long as there is no airway obstruction.[24]

Once in the hospital, the cervical spine needs to be examined and x-rayed for possible injuries or fracture. This is uncommon in young children and should not delay or interfere with acute management. Complete blood count, electrolytes, blood gas, and chest x-ray should be obtained promptly. Respiratory support and management of bronchospasm or pulmonary edema is critical.[25] Nebulized beta agonist and furosemide are used for this purpose. Antibiotics and steroids should not be used routinely unless the water is contaminated. In such cases, bronchoscopy and bronchial lavage may be needed to remove aspirated particulate matter. Finally, surfactant and extracorporeal membrane oxygenation can be utilized in severe cases.[26] Treatment of other manifestations and complications, such as hypotension, seizures, and renal dysfunction is needed. Cerebral

edema should be promptly treated in order to improve the neurological outcome. Hypothermia is common in children because of their relative large surface area and tends to improve quickly by rewarming.

Outcome and neurological morbidity. Most patients improve quickly with acute management. If the child does not improve or deteriorates, other etiologies or complications should be considered, including head injury, blood loss, alcohol, or drug ingestion. Children generally either survive with no neurological sequelae, or die following water submersion. Most children who are rescued quickly will recover neurologically intact.[27] Most deaths occurred in young children (<5 years) who were unsupervised, or in older children who swam in open water. As mentioned earlier in the introductory segment, there is some recent evidence that pediatric hospitalization rates for drowning, as well as fatal drowning have decreased over the past 16 years.[4] Only 5-10% develops severe neurological sequale.[28] Factors that correlated with neurological morbidity included submersion or CPR for more than 25 minutes.[29] Hyperglycemia (glucose ≥10 mmol/L) correlated with bad outcome in one Saudi study.[30] In another study, hypothermia was the only independent predictor of poor neurological outcome.[31] Few other published reports described a relatively better neurologic outcome following submersion in very cold water.[32]

Prevention strategies. Restricting access to water and close adult supervision once in the water are paramount in preventing near-drowning and drowning.[33] Children must always be supervised, regardless whether they can swim well, or not. In a Saudi report, no adults were watching the children when the accidents occurred in all mortality cases.[6] Most young children drown in their own pool, or in family or friend's pool because of easy access and lack of strict supervision.[34] Such pools should be fenced or completely isolated from the yard in order to reduce the risk of submersion.[35] It is preferred if the fence is at least 1.4 meters tall, and have a self-closing gate.[36] Safety accessories and equipment are not always provided in residential swimming pools, particularly in lower socioeconomic families.

In our region, most of the private swimming pools do not meet the required safety regulations.[11,30] In addition, all public or commercial pool facilities should have a telephone and a monitoring system. Pool covers could add further security when the pool is not used or closed. The CPR training of parents and pool owners will ensure early and more effective rescue, and therefore improves the outcome of such incidents. Pediatricians should encourage parents to take CPR courses, and teach their children how to swim well.

In our community, CPR knowledge or training is virtually nonexistent.[11,30] Educating the general public regarding drowning prevention is also essential. The media, as well as government authorities should play a major role in increasing public awareness to minimize such incidents. No single strategy will prevent all submersion deaths and injuries; therefore a strong and pervasive education campaign is needed to make the public aware of these dangers. High-risk groups, such as new or young parents, lower socioeconomic families, and families with prior child protective services referrals, should be targeted with drowning prevention programs. Such increased awareness and safety campaigns can be successful in reducing near-drowning and saving precious young lives.

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