More about...Paediatric trauma

What's new in paediatric trauma resuscitation?

REITZE N RODSETH, ***MB ChB, DCH (SA), DA (SA), FCA (SA)***

Department of Anaesthetics, Nelson R Mandela School of Medicine, University of KwaZulu-Natal, and Inkosi Albert Luthuli Central Hospital, Durban

Correspondence to: Reitze Rodseth (ReitzeRodseth@gmail.com)

Paediatric cardiac arrest

The most recent modifications to the American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care were published in 2006.[1] In this publication the critical role that high-quality and continuous chest compressions play in successful resuscitation has been emphasised. Compressions should be done hard and fast, at a rate of about 100 compressions per minute, allowing time for the chest to fully recoil. Continuity while giving compressions is vital and every effort should be made to minimise interruptions. A compression to ventilation ratio of 30:2 should be used in all patients and each breath should be given over 1 second, producing a visible chest rise. In paediatric patients this ratio should be adjusted to 15:2 for 2-person CPR. Defibrillation should be followed by 5 cycles or 2 minutes of chest compressions before checking for a rhythm.

While a respiratory cause of cardiac arrest carries with it a better prognosis, arrest following blunt trauma has a particularly poor outcome, with survival rates of 1 - 6%, and survivors may have severe neurological deficits.[2] Despite sustaining significant injury, the long-term quality of life in patients with head injury who do not undergo cardiac arrest is high.[3] The use of hypothermic therapy following cardiac arrest in adult populations has shown improved neurological outcomes. Due to differences in the mechanisms of cardiac arrest between adult and paediatric patients therapeutic hypothermia has not been shown to be as effective, and further study in this field has been suggested.[4] In addition, the applicability of this modality of treatment to a trauma population where patients often present with severe hypothermia is uncertain.

Airway management and ventilation

Intubation remains the definitive method of airway management in the trauma patient but presents a greater challenge in the paediatric population than in adults. Prehospital intubation performed by health care providers with little paediatric airway experience has led to unacceptably high complication rates.[5] In these cases airway management should be achieved by means of bag-valve-mask-ventilation. When the practitioner has specific paediatric airway skills, prehospital intubation can be performed safely and successfully.[6]

Intubations should be performed using a rapid sequence induction technique and tracheal intubation confirmed with an exhaled CO_2 detector in both the pre- and intra-hospital setting.[7] The use of the mnemonic LEMON has been suggested as a tool for pre-intubation airway evaluation (Table I).[3] Although useful in drawing attention to the potential difficult airway, the utility of the (e)valuation and (m) allampati components of the mnemonic in the paediatric trauma patient is doubtful. When faced with a difficult airway the gum elastic bougie and the laryngeal mask airway (LMA) may be useful. The use of cuffed endotracheal tubes in the paediatric population is increasing. They provide additional airway protection together with reductions in air leaks and if appropriate sizes are used and cuff pressures are monitored (<20 cm H_2O), are not associated with an increase in tracheal stenosis.[8]

Table I. LEMON mnemonic for the evaluation of a difficult airway

L-ook	For trauma, large incisors, large tongue
E-valuate	Mouth opening, inter-incisor distance
M-allampati	Perform a Mallampati score
O-bstruction	Identify obstructions in the airway
N-eck	Evaluate neck flexion, extension and thickness

Over-ventilation results in alkalosis, increased intrathoracic pressures with subsequent impairment of venous return and reduces the chance of a successful resuscitation. Once the patient is intubated, 8 - 12 breaths should be delivered per minute, which can be increased to between 12 and 20 per minute once a perfusing rhythm as been established.

Fluid and venous access

Hypovolaemic shock in paediatric patients may be difficult to appreciate. Together with a tachycardia the signs of peripheral vasoconstriction – cold, mottled extremities and delayed capillary refill time – assume greater importance than in adults.[9] Normal saline, Ringer's lactate or low substitution hydroxyethyl starches should be used as first-line agents in resuscitation and should be administered in boluses of 10 - 20 ml/kg of crystalloid or 7 - 10 ml/kg of colloids.[10] Care should be taken to avoid over-resuscitation with crystalloids as this may lead to the development of multiple systemic complications, including abdominal compartment syndrome.[11] The use of hypertonic saline may have a role to play in the management of the patient with head trauma but is currently not recommended except within the context of clinical trials. In the hospital setting paediatric patients are at significant risk of developing hyponatraemia due to their retention of water during physiological stress. The use of hypotonic fluids such as half Darrow's dextrose (DD), half normal saline or 5% dextrose in the paediatric trauma population is strongly discouraged.[12]

Fluid resuscitation should be targeted at the restoration of organ perfusion and to this end lactate, base deficit and central venous oxygenation may have clinical utility, particularly in the first 24 hours following injury.[13] When haemorrhage is ongoing fluid administration should be limited and a balance struck between maintaining organ perfusion and avoiding exsanguination, even if this means allowing a lower than normal blood pressure in the patient. Cognisance should be taken that the normal paediatric blood volume is 70 - 80 ml/kg and thus blood loss may often be underestimated. Care should be taken to avoid hypotension in patients who have sustained blunt trauma with associated head injury.[3]

Venous access remains a challenge in the paediatric population. After 3 unsuccessful attempts at percutaneous line placements an intraosseous tibial, femoral or central venous line should be placed immediately. These techniques have largely replaced the use of the saphenous cutdown, which should now be seen as a technique of last resort.[14]

Temperature management

Temperature management is often omitted during paediatric trauma management.[15] The relatively large body surface area of children, ineffective vasoconstriction and cold fluid infusion may combine to rapidly cause hypothermia. Care should be taken to avoid unnecessary exposure, to keep the patient dry and to provide a warm environment during resuscitation. Forced air warmers and in-line fluid warmers are essential in trauma patient management.

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Prevention of childhood injuries

A B (SEBASTIAN) VAN AS, *MBA, FCS (SA), PhD*

Head, Trauma Unit, Division of Paediatric Surgery, Red Cross War Memorial Children's Hospital, School of Child and Adolescent Health, University of Cape Town

Correspondence to: Sebastian van As (Sebastian.vanas@uct.ac.za)

In December 2008 the World Health Organization (WHO) and UNICEF published the World Report on Child Injury Prevention.[1] Approximately 200 participants from over 50 countries worked on this report for a period of 2 years. Childhood injuries and death form a major public health problem requiring urgent attention. Injury and violence are the major killers of children throughout the world, responsible for approximately 1 million deaths of children under the age of 18 (WHO Global Burden of Disease 2004) with accidental injuries accounting for almost 90% of these cases, and the remainder due to violence or maltreatment. The exact ratio of accidental to violence or maltreatment is unknown, but studies of infant deaths suggest the latter are underreported.[2] In addition to these 1 million deaths, tens of millions of children require prolonged hospital care for their injuries, and many of the children are left with a degree of disability, often lifelong. This burden of injuries is severely biased towards low- and middle-income countries; it is estimated that over 95% of all deaths in children due to injury occur in these countries.

The WHO defines violence as the intentional use of physical force or power, threatened or actual, oneself, another person, or against a group or community that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment or deprivation. This definition emphasises intentionality, irrespective of the outcome it produces.[2]

The WHO definitions of child abuse or maltreatment are broader, including all forms of physical and/or emotional ill-treatment, sexual abuse, neglect or negligent treatment or commercial or other exploitation, resulting in actual or potential harm to the child's health, survival, development or dignity in the context of the relationship of responsibility, trust and power.[2] The 4 types of child abuse that have received the most attention are physical abuse, sexual abuse, emotional abuse and neglect. Global estimates of child homicide suggest that infants and very young children are at the greatest risk, with the 0 - 4-year age group having more than double of that of the 5 - 14-year-old group.[1]

Despite the need for urgent attention, child injuries have long been neglected and are largely absent from the present child survival initiatives such as the Millennium Development Goals. Numerous programmes related to child survival have targeted infectious diseases, malnutrition and dehydration. To achieve maximal effects, these programmes need to be supplemented by initiatives that specifically focus on the prevention of accidental as well as interpersonal violence.[3]

The top 3 causes of child mortality from accidental injury are drowning, road traffic accidents and burns.[1] All of these are highly preventable. Factors which predispose to injuries are supervision of particularly small children by a single caregiver in a home with multiple siblings, substance abuse by the caregiver, and large families.[1] Although these risk factors often occur within particular households, the larger context in which they operate cannot be ignored. Child safety is ultimately a matter of crucial concern for all societies. A number of studies have demonstrated the feasibility of interventions to reduce child mortality and morbidity due to accidental injury.[4]

Risk factors for child abuse are young age, gender, caregiver and family characteristics, family structure and resource, family size and household composition, personality and behavioural characteristics and a prior history of abuse and violence in the home. Community factors include poverty and societal factors such as the degree of cohesion and solidarity that exists within communities.[3]

The most vulnerable children are those under the age of 6 years. These little children have not yet developed the capacity to assess dangers in their environment and to avoid them, and are therefore completely dependent on the protection of older caregivers. The high

incidence of child injury and death is a direct result of the low levels of supervision of small children and suboptimal health care. Although children may be mentioned in many discussions around the world, their interests do not form an integral part of societal infrastructural design and activities.

Alcohol and other substance abuse in societies is another important risk factor for many types of trauma, accidental as well as non-accidental. There are numerous well-proven strategies to prevent and diminish the negative effects of substance abuse on children – early intervention is a key component of successful programmes.[5]

Conclusion

There is growing evidence of the extent to which child injury is a major public health problem and of the specific risk factors for such injury. Often such risk factors are easily addressed. Simple improvements to playgrounds may enhance safety, and obvious social adjustments may provide parents with more parenting time. Child injury is less commonly the result of intentional abuse and maltreatment than the consequence of a failure to be aware of child injury, and to appreciate the need for appropriate interventions. Indeed, a range of potential interventions have been shown to be effective and cost efficient in reducing child injury. However, such interventions may require the involvement of many sectors of society, and there is often a lack of political will to make the complex social changes that are needed for reducing injury. There is a need for more research on how optimally to encourage and implement such reforms. Perhaps promoting awareness among adults about the unfortunate plight of so many children may be a more effective strategy to reduce child injuries than strategies aimed at preventing intentional child abuse. Certainly child safety should be higher on the agenda, at home, in the community, and at national and international levels.

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