
ADD ON...PRE HOSPITAL CARE

The Injured Child

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Introduction

There is often anxiety and uncertainty about the management of injured children in both the pre-hospital and hospital environments. The most important factors underpinning this anxiety are lack of training, lack of experience and lack of familiarity with paediatric vital signs and drug doses. The emotional responses evoked by injured children also play a part in causing distress and anxiety amongst rescuers. Seriously injured children are a rare event. Nonetheless, the immediate care practitioner must be able to assess and commence resuscitation in any age of child without making errors or becoming confused.

For most doctors, nurses and paramedics it is unusual to have to manage a seriously injured child. Clinical exposure to these cases is very limited and the confidence that comes with experience takes a long time to develop. To place this in context, emergency ambulance staff in the UK manage, on average, a total of 14 seriously injured patients (adults or children) a year (1). Only approximately 10% of emergency ambulance calls are for children and less than 5% of these children will require resuscitation (2). Thus, in the UK peacetime setting, ambulance personnel are unlikely to have to manage more than one seriously injured child a year (3,4). Of course, ambulance crews see many more children with minor injuries and illness and thus they develop a degree of confidence in handling children and their families. Resuscitation experience is however very limited. Hospital staff may be expected to have more experience of major paediatric injury. However, an analysis of major trauma at one of the largest UK acute hospitals identified only 7 children with major injuries (from 520 patients) over a one year period.(5) The average A&E department will thus see less than one seriously injured child a month. With nurses and doctors on shift patterns, the individual exposure will often be even less. Combat medical technicians and other Army Medical Services personnel are likely to have even less experience of critically injured children. This lack of experience must be managed if injured children are to receive appropriate and timely pre-hospital and hospital care.

The fact that children of different ages have different anatomy and a wide range of physiological norms compared to adults is another cause of anxiety. Accurate selection

of equipment and calculation of drug doses is fraught with difficulty and prone to error. This uncertainty surrounding weight estimations and the use of appropriate drugs and equipment in children has been well documented (6,7). Even the relatively simple action of administration of analgesia can be more complicated than it appears and major drug errors can occur (such as 10-fold overdoses of morphine or lidocaine).

A further factor is the relative paucity of dedicated training for paediatric emergencies in pre-hospital practice (2,5,8). A survey of UK ambulance services revealed that 40% provided paramedics with less than eight hours training in paediatric care and less than half provided an appropriate range of paediatric equipment on ambulances (8). The Joint Royal Colleges Ambulance Liaison Committee (JRCALC) has recognised this and have produced clear guidelines on paediatric care which have now been adopted by all UK ambulance services (9). These are also being incorporated into newer paramedic training syllabuses (2,9,10). Nonetheless, current levels of civilian pre-hospital paediatric training and experience vary widely from area to area.

This article aims to provide some guidance on preparing for and managing injured children in the pre-hospital setting. It does not replace practical experience, directed reading and attendance at an appropriate life support training course. It highlights some key issues for the pre-hospital practitioner. It is assumed that the reader is familiar with standard resuscitation guidelines (11-13) and texts that deal with paediatric emergency care (14-18). Personnel who are required to manage injured children should attend one of the Advanced Paediatric Life Support (APLS) (19-20), Pre-hospital Paediatric Life Support (PHPLS) (19,21,22) or Paediatric Advanced Life Support (PALS) (13) courses in order to further their understanding and increase their confidence.

Preparation

The only way to ensure that the management of the injured child will be efficient and timely is to make adequate preparations in terms of training and equipment. Training opportunities exist and regular re-training and practice is relatively simple to plan. It is perhaps much more difficult to achieve this in pre-hospital practice than in the hospital setting. Whether attendance at the above

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Box 1. Minimum additional paediatric equipment (assuming that adult equipment and an aide memoire is available) (25,26).

<p><i>Airway</i> Oro-pharyngeal airways (range of sizes) Soft suction catheters (range of sizes) Needle cricothyroidotomy kit (assembled for use)</p> <p><i>Breathing</i> Non-rebreathing face mask with reservoir bag Face masks (newborn, infant and child sizes) Bag-valve-mask apparatus with pressure release valve (450-ml bag)</p> <p><i>Circulation</i> Infant (6 – 8 cm) and child (9-10 cm) blood pressure cuffs Intravenous cannula (22 gauge and 24 gauge) Intraosseous needle (with three way tap and 20ml syringe)</p>

mentioned courses is possible or not, basic and continuation training for the pre-hospital provider should include the assessment of infants and children, the use of a length based aide memoire, airway management, monitoring, vascular and intraosseous access, fluid and drug administration, basic and advanced life support and the principles of extrication and triage (23). In terms of equipment, clear guidelines for facilities that receive injured children have been published (including lists of equipment) (24). Pre-hospital practitioners should be familiar with this range of equipment and should produce an appropriate equipment bag to reflect their scope of practice (Box 1) (25). The principles of equipment selection and packing for pre-hospital immediate care have been previously reviewed (26). The key aspects for paediatric care are that equipment should be appropriate for the range of ages and sizes likely to be encountered and that it should be packed in a way that allows all equipment within the same age or size range to be accessed immediately. There is evidence from hospital practice that if paediatric emergency equipment is stored according to weight ranges and used in conjunction with a length/weight based aide memoire then the resuscitation process is more efficient and less mistakes are made (6,27). It is perhaps even more important that equipment is organised in this way when working in the relatively uncontrolled pre-hospital environment. It is often argued that pre-hospital practitioners do not have the luxury of carrying a wide range of sizes of equipment or dedicated paediatric bags. However, if it is likely that injured children will be treated, then dedicated paediatric equipment bags, which are packed according to pre-determined weight ranges, are essential. Although commercially available colour coded bags which match the colours in the Broselow™ tape (see below) are available, an equivalent system can be created by using labels or coloured cards

Box 2. Vital signs in children (20,21)

Age	Respiratory rate	Pulse rate	Blood pressure
< 1	30-40	110-160	70-90
1-2	25-35	100-150	80-95
2-5	25-30	95-140	80-100
5-12	20-25	80-120	90-110
>12	15-20	60-100	100-120

within the clear plastic pockets of standard bags.

Aide memoire

A paediatric aide memoire should ideally incorporate vital signs, basic equipment requirements and relevant drug doses. Observations such as pulse rate, respiratory rate and blood pressure must always be related to the age of the child. Relatively subtle changes in respiratory or pulse rate can be important in the assessment of injured children so a list of the normal vital signs must be immediately available. The most widely used range of physiological norms are those produced by the Advanced Life Support Group (Box 2) (20,21). These divide children into five age groups which can generally be described as infants (below the age of 1 year), toddlers (aged 1 to 2 years), pre-school children (aged 2 to 5 years), school children (aged 5 to 12 years) and adolescents (12 years and over). There are different ranges of age specific norms published in different sources (14-18,28). Whichever is used, the practitioner must have a system that does not rely on memory alone.

The most widely used aide memoire for drug doses in hospital practice is the single page Oakley chart or an adaptation thereof. This was originally designed for use in cardiorespiratory arrests in children in the hospital setting (6). Following changes in resuscitation practice and publication of variations on the chart, updated versions have been produced (29,30). An alternative to the single page aide memoire is the colour coded tape (Figure 1). The best known version of this is the Broselow™ tape (31). It involves using a colour coded tape which relates height to weight (based on the fiftieth centile on growth charts). The tape itself provides detailed information on drug dosages and equipment requirements for children from birth (3 kg) to adolescence (34kg). The tape provides weight specific drug doses in kilogram increments and is also divided into seven colour coded zones which give equipment sizes for age/weight ranges. These colour codes can be related to colour coded bags or equipment drawers. The system is based on the fact that in the 1 to 10 year old child, length is essentially proportional to age and weight in the normal population. The concept of relating length to drug dose is the same as for the single page

Fig 1. The Broselow Pediatric Emergency Tape. The tape is placed alongside the child and the closest weight section to the foot is used as an estimation of weight in kilograms. Each weight box contains a wide range of emergency drugs. In addition there are seven colour coded weight range bands which indicate the appropriate equipment for use in a child of that size (e.g. tracheal tube, laryngoscope blade, suction catheter, blood pressure cuff, intravenous cannula and nasogastric tube).

chart based systems but the clear advantage of a Broselow™ type system is the rapid allocation of children to colour coded weight bands. The disadvantages of the tape are that it includes a very wide range of drugs and that it is inconsistent in terms of whether doses (in milligrams) or volumes (in millilitres) are given. Some ambulance services have developed similar but simpler colour coded aide memoire tapes that are specific to their practice. The Broselow™ tape colour scheme has also been developed as a central colour theme for organisation of all paediatric equipment and drug doses (e.g. colour coded charts to simplify assessment of vital signs, colour coded mattresses in resuscitation rooms and pre-packed colour coded kits for critical interventions). Variations on this theme can easily and inexpensively be achieved.

In assessment of the use of an aide

memoire, it has been shown that mistakes are made when doses are stated as milligrams rather than actual volumes for injection (millilitres) of prepared solution, when more than one concentration of drug is quoted and when more than one option is given (29,30). The point of the aide memoire is to make the immediate care of the injured child quicker and safer. It should therefore be simple to use and specific to the scope of practice of the individual practitioner or organisation. A combination of a single sheet aide memoire and a tape that relates length to colour coded weight ranges is probably the most effective system. An example of an aide memoire used regularly for the rapid treatment of seriously injured children in a UK setting is reproduced at Figure 2. Key elements of this aide memoire are that it includes vital signs and essential drug doses in volume of prepared solution. The original aide memoire was coloured to reflect the colour codes in the Broselow™ tape. It was designed to fit in the clear plastic thigh pocket of a flight suit and the BASICS specification overalls.

Having undergone training and prepared equipment and an easy to use aide memoire, it is essential to practice use of the aide memoire and immediate medical care with simulated paediatric resuscitations.

Do not rely on memory or perform calculations – use a length based aide memoire

Immediate medical care

In providing immediate medical care for injured children, the principles of the primary and secondary survey with assessment and resuscitation according to the conventional ABCDE approach should be followed (20,21,32). There are, however, some specific problems and caveats associated with injured children.

Airway management

Maintenance of adequate oxygenation in the injured child is of paramount importance. Hypoxia secondary to airway obstruction will rapidly result in bradycardia and hypoxic cardiac arrest. Pre-hospital practitioners