British Military Experience of Pre-Hospital Paediatric Trauma in Afghanistan

N Walker[1], RJ Russell[2], TJ Hodgetts[3]

[1]Specialist Trainee in Emergency Medicine, [2]Senior Lecturer in Military Emergency Medicine, [3]Defence Professor of Emergency Medicine, all from the Academic Department of Military Emergency Medicine, Royal Centre for Defence Medicine, Birmingham

Abstract

Introduction Trauma is a leading cause of death in children. Life support courses have been developed to reduce the mortality and morbidity of children suffering trauma; differences in anatomy and physiology may produce different injury patterns to adults when children are exposed to trauma, challenging the care providers.

Methods A retrospective analysis of all paediatric patients transported by the helicopter-borne MERT between 01 May 2006 and 31 December 2007 in Helmand Province, Afghanistan.

Results 78 children were brought in over the study period by the MERT team representing 7.3% of MERT casualties and 2.2% of the total seen in the Emergency Department. Breakdown by demographics, triage category, mechanism of injury, and treatment is given.

Conclusion A significant number of paediatric patients are treated by the deployed pre-hospital team. All military pre-hospital care providers should gain training and experience in the care of the seriously injured child prior to deployment.

Introduction

After the age of one, trauma is the leading cause of death in children [1, 2]. Life support courses including Advanced Paediatric Life Support (APLS) [1] and Pre-hospital Paediatric Life Support (PHPLS) [2] have been developed to reduce the high mortality and morbidity from childhood trauma.

Children are not simply little adults. Whilst the same basic assessment of Catastrophic Haemorrhage, Airway, Breathing and Circulation is used, the normal physiological values for each vital sign vary with age and size and the changes in anatomy and physiology require different equipment and techniques [1-3]. This, as well as the emotional stress involved in treating an injured child, can create anxiety and uncertainty in health care professionals when providing paediatric emergency trauma care [1-4].

As well as variation in techniques and equipment, the differences in children's size and anatomy are likely to produce different injury patterns from adults when exposed to the same mechanisms of trauma [1-3]. In this paper we describe the paediatric experiences of the pre-hospital emergency care Medical Emergency Response Team (MERT) on current deployments in Afghanistan. The MERT consists of a Doctor (either a senior trainee or Consultant from Emergency Medicine or Anaesthetics), an Emergency Nurse and two Paramedics. The MERT works from a CH47 (Chinook) helicopter with the aim of reducing the time to the availability of Emergency Department (ED) resuscitation skills and equipment [5] and is primarily equipped and staffed to deal with adult trauma.

Corresponding Author: Lt Col RJ Russell RAMC, Academic Department of Military Emergency Medicine, Royal Centre for Defence Medicine, Birmingham Research Park Vincent Drive, Birmingham B15 2SQ
Tel: 0121 415 8848
Email: SenLecEM.ADMEM@rcdm.bham.ac.uk

Methods

We performed a retrospective analysis of the case notes of all paediatric patients transported by the helicopter-borne MERT between 01 May 2006 and 31 December 2007 and treated in the British Role 2 enhanced field hospital at Camp Bastion in Helmand Province, Afghanistan. A paediatric patient was defined as anyone aged 16 and below at the time of the incident. Patients were identified from two electronic databases maintained at Royal Centre for Defence Medicine (RCDM): the Major Trauma Audit for Clinical Effectiveness (MACE) and the Medical Emergency Response Team (MERT) systems. The MACE database captures details of all patients treated at UK Role 2 Enhanced or Role 3 Field Hospitals that trigger trauma team activation [6]. The MERT database records pre-hospital details including clinical interventions made by the MERT team and continued observations on all patients transported including those taken to non-UK R2E or R3 facilities. The figures do not include interventions made prior to the arrival of the MERT team. Both databases were searched so that full particulars of each case could be retrieved as due to language difficulties and noise some details were not immediately available to the MERT. Results were cross-referenced so that no child was counted twice.

Results

During the 20 month period studied 1068 patients were transported by the MERT and 3594 patients seen in the Field Hospital ED (source: Operational Emergency Department Attendance Register). Seventy eight children were brought in by the MERT team, constituting 7.3% of all MERT patients. No other children were seen in the Field Hospital ED over the study period so MERT paediatric attendances comprised 2.2% of the total ED workload.

Paediatric patients were subdivided into three groups according to age (0-5 years, 6-10 years and 11-16 years) and Figure 1

highlights the number of injured by gender. There were no casualties below the age of one. Details of the mechanism of injury and anatomical sites of the predominant wound in each case are given in Tables 1 and 2; the triage categories generated (Figure 2) and the medical interventions and analgesia administered by the MERT (Tables 3 and 4) are again subdivided by age.

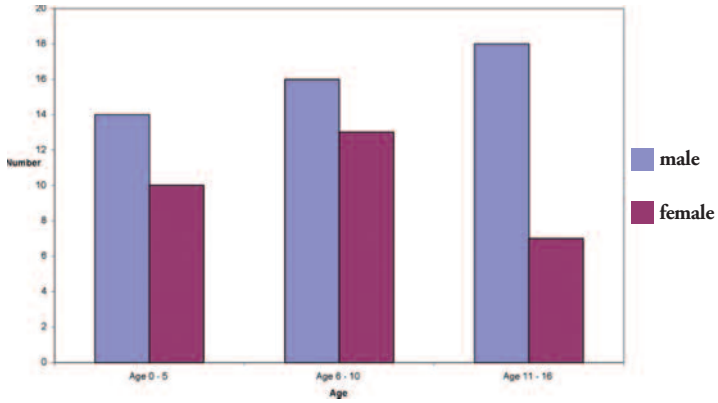

Figure 1. *Distribution of paediatric MERT patients by age and gender.*

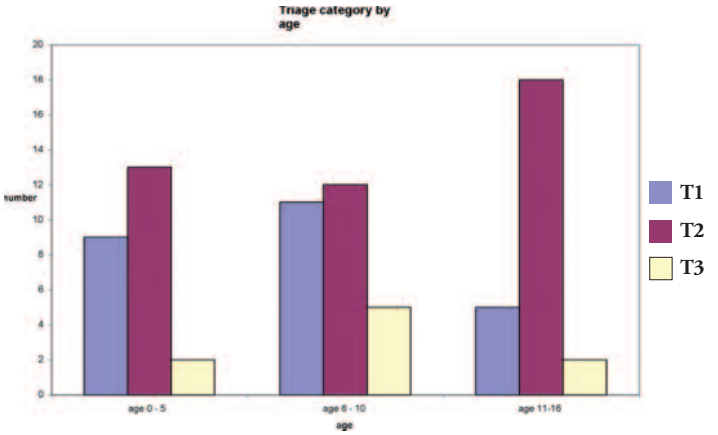

Figure 2. *Distribution of triage category by age.*

Mechanism of Injury	Age 0 – 5	Age 6 – 10	Age 11 - 16
Explosion – hostile action	14	19	12
Explosion - UXO	1	2	2
Burn/thermal	5	2	2
Fall	1	1	1
GSW	1	5	7
RTC	2	0	1
Medical	0	0	0
Total	**24**	**29**	**25**

UXO – Unexploded Ordnance; GSW – Gun Shot Wound; RTC – Road Traffic Collision

Table 1. *Mechanism of injury by age*

Anatomical Location	Age 0 – 5	Age 6 – 10	Age 11 - 16
Head & Neck	4	8	6
Chest	1	2	2
Abdomen	1	3	2
Limb	8	6	9
Spine	0	0	0
Multiple	9	10	6
Total	**24**	**29**	**25**

Table 2. *Anatomical Distribution of Predominant Injury by age.*

Pre-hospital intervention	Age 0 – 5	Age 6 – 10	Age 11 - 16
RSI	2	2	3
Assisted ventilation	0	1	0
Oxygen	17	15	14
IV Cannulation	0	5	7
Intra-osseous access	5	1	3
Haemorrhage control	3	5	4
Fluid resuscitation	8	15	16
Analgesia	10	8	9
Fracture stabilisation	0	1	0
Active re-warming	2	2	0
CPR	0	0	1
Observation only	1	6	2

RSI – Rapid Sequence Induction (intubation); CPR – Cardiopulmonary resuscitation

Table 3. *Pre-hospital interventions performed by the MERT on paediatric patients. An individual patient may have received more than one intervention*

Drug	Age 0 – 5	Age 6 – 10	Age 11 - 16
Morphine	2	4	7
Ketamine	6	2	1
Paracetamol	1	1	0
Fentanyl	1	0	0
Diamorphine	0	0	0
NSAID	0	1	0
Femoral nerve block	0	0	1

Table 4. *Drugs administered for pre-hospital analgesia.*

Discussion

The injury mechanisms and triage categories demonstrate that the MERT team regularly treat seriously injured children with a wide range of pathologies. In most cases, this is in contrast to what individuals would expect during their clinical work whilst not deployed. Even for those who regularly see injured children in the UK, the numbers injured, mechanism, type and severity of injury are very different from their normal experience. A Scottish review of paediatric major trauma cases which is the closest civilian comparator, found that the majority of serious injuries were caused by road traffic incidents [7]. This contrasts with a review from the USA [8] where violence (gunshot, stab or assault) accounted for 46% of cases and traffic incidents for 35%. During this period the MERT (and thus the Field Hospital ED) did not treat any medical paediatric patients which contrast with the data from OP TELIC in 2003 when one in six paediatric patients had medical conditions [9].

The overall number of children treated in the ED as a proportion of the total (2.2%) is consistent with that seen during the early phases of Op TELIC in 2003 [9, 10]. Comparable pre-hospital paediatric data is limited but Seidel et al suggest that paediatric pre-hospital calls constitute 10% of all emergency medical services activity [8], which ostensibly correlates well with our figure of 7.3%, but ignores the impact of the trauma workload which constitutes the whole of the MERT, but only a small proportion of the civilian activity.

The increase in injury rates with increasing age is probably due to the increase in mobility and independence, which places the child at greater risk of injury from Improvised Explosive Devices (IED) or mine strike and being caught up in crossfire [11]. It has been suggested that the gender differences in injury rates in the older age group might be due to the adoption of more formal roles within the family where boys continue to gain independence whilst taking on tasks outside the home including farming. Girls, in contrast, stay predominantly within the home undertaking domestic tasks. The lack of patients below the age of one reflects difficulties in defining the child's' exact age on presentation to the

MERT team when communication is often difficult, once at the Field Hospital more time and local interpreters were usually available for communication with relatives so more accurate ages could usually be determined.

The distribution of triage categories, with 88% being T1 or T2 patients, reflects high energy transfer mechanisms of injury. Local medical services are limited and only capable of treating relatively minor injuries. As a result help will preferentially be requested for serious cases; there may also be a degree of over-triage by the MERT team as the standard adult triage sieve [12] over-triages children as it uses adult values. The paediatric triage tape (Figure 3) [13] is part of the MERT equipment but the patient report forms currently employed do not allow its use to be documented.

Figure 3. *Paediatric Triage Tape*

The mechanism of injury has further been divided to show the type of incident by age group as well to see if there were any patterns that occurred with differing age groups. This shows that within the two younger age groups there is a similar distribution of T1 and T2 patients. The older group have considerably less T1 patients and a greater number of T2 patients. This may again reflect MERT members' relative inexperience in triaging severely injured younger patients and because adult triage parameters have been applied to the patient resulting in over-triage. An alternative explanation may be that this is related to the relative size of the younger age group causing more body systems to be impacted by the wounding mechanism.

Hostile action was the commonest cause of injury. The origin of the hostile action (i.e. Afghan/Coalition or Taliban) is not always clear as civilians, including children, are frequently caught in crossfire. The predominance of hostile action is to be expected in the circumstances and given the paucity of motorised transport within Afghanistan compared with Western countries. The incidence of gunshot wounds increases with age, which is again explained by male children maturing, gaining more independence and possibly acquiring a weapon of their own.

The anatomical distribution of injuries (Table 2) demonstrates that the majority of patients, 25 (63%), sustained their most serious injuries to the limbs or in multiple sites. This reflects the high incidence of explosive injuries. There were no spinal injuries, which is probably also due to the prevailing mechanism of injury.

The treatment strategy adopted by the MERT is usually that of "scoop and play on the way" due to a largely non-permissive environment. Seven patients (9%) underwent Rapid Sequence Induction in transit to the hospital which is a higher proportion than might be expected but is explained by the high percentage of T1 patients seen and the mechanisms of injury. Vascular access in children, particularly infants, is a specialised skill that requires practise. The procedure becomes harder when the child is severely injured and hypotensive and further complicated in the back of a helicopter in flight. Intra-osseous (IO) access is a well established alternative in children under six years of age but the advent of new intra-osseous techniques has made this a viable alternative for older children and adults [14]. The frequency of intravenous cannulation compared to IO access increased with increasing age (Table 3), but we were unable to determine whether IO access was the initial route chosen or followed unsuccessful intravenous attempts. Table 3 also demonstrates the wide range of management techniques and knowledge required to manage the severely injured child.

Only 27 (35%) children were given analgesia. All children were transported , where possible, accompanied by an adult they knew to provide reassurance; nevertheless MERT transfer would likely increase stress levels and coupled with high energy transfer mechanisms of injury, the provision of adequate analgesia would be beneficial. Closer analysis of the raw data demonstrates that all children in whom IV or IO access was secured received analgesia suggesting that failure of access rather than restriction of analgesia is the critical issue. This may be alleviated as alternative methods of administering strong analgesia (e.g. intranasal morphine) are becoming more established in civilian practice and are now available to the MERT team.

Familiarity with treating seriously injured children can only be gained and maintained by appropriate training and continued medical practice. In addition to APLS and PHPLS, the Battlefield Advanced Life Support (BATLS) course [15] delivers a "master class" in paediatric trauma management but BATLS should act as a refresher rather than a primary course. Given the different challenges faced by the military, there is also a potential opportunity for the development of a bespoke military paediatric trauma course. This is currently under discussion with the Advanced Life Support Group.

Whilst deployed, DMS personnel will develop their paediatric skills and confidence in their ability to manage the seriously injured child. The experience of managing seriously injured children due to blast injury and GSW is difficult to consistently replicate within the UK. The increasing specialisation of paediatric trauma centres makes clinical experience and confidence in these situations hard to acquire in both Ambulance Trusts and Acute Hospitals [7, 16]. The average Emergency Department will see less than one seriously injured child a month [16] and combined with the full shift rota systems instituted across most specialties, individuals exposure will undoubtedly be even less. However, with a continued increase in gun and knife crime combined with the increased terrorist threat in the UK currently, the know-how gained on operations may be highly beneficial both to those personnel and the hospitals and other organisations they work in on return.

These factors emphasise the importance of all military pre-hospital emergency health care providers gaining training and exposure to the care of the seriously injured paediatric patient wherever possible. Whilst specific paediatric pre-hospital care attachments are not possible as such services do not exist, attachments to Paediatric Emergency Departments should be considered. Training abroad has also been a solution in the past but the number of children seen does not justify the cost of this. Simulation Centres using high-fidelity models are being used increasingly, particularly in anaesthetics for critical incident training, and it is possible that a similar paediatric simulation model could be developed, although this may focus more on the technical skills as recreating the conditions in the back of a moving CH47 would be difficult.

Conclusion

It is clear that on current deployments a sizeable number of paediatric patients are being cared for by the pre-hospital team. With this in mind it is important that all DMS pre-hospital emergency care providers have appropriate training and experience in paediatrics. The increasing specialisation of paediatric EDs in the UK combined with the fact that an average ED sees less than one seriously injured paediatric patient a month, means that gaining the appropriate competencies is going to become increasingly difficult for those who do not work within these specialist paediatric trauma units. Paediatric Life Support courses are available but consideration should be given to attachments to Children's Emergency Departments prior to deployment.

References

1. Advanced Life Support Group. Advanced Paediatric Life Support: The Practical Approach (4th edition). London, BMJ Books 2005.
2. Advanced Life Support Group. Pre-Hospital Paediatric Life Support (2nd edition). London, BMJ Books 2005.
3. Battlefield Advanced Trauma Life Support manual 2008. Joint Services Publication 570, 2008.
4. Mackenzie R, Sutcliffe R. The injured child. JR Army Med Corps 2004; 150: 33-43.
5. Hodgetts TJ, Davis S, Russell R, McLeod J. Benchmarking UK military trauma system. JR Army Med Corps 2008; 153(4): 237-8
6. Clinical Guidelines for Operations. Joint Doctrine Publication, Development, Doctrine and Concepts Centre 2008.
7. Gaffney P, Johnson G. Paediatric pre-hospital trauma care. Trauma 1999; 1: 279-84.
8. Seidel J, Henderson D, Ward P. Pediatric pre-hospital care in urban and rural areas. Pediatrics 1991; 88: 681-690.
9. Gurney I. Paediatric casualties during Op Telic. J R Army Med Corps 2004; 150: 270-272.
10. Heller D. Child patients in a field hospital during the 2003 Gulf conflict. J R Army Med Corps 2004; 151: 41-43.
11. Sugerman DE, Hyder AA, Nasir K. Child and young adult injuries amongst long-term Afghan refugees. Int J Inj Cont Saf Promot 2005; 12(3): 177-82.
12. Advanced Life Support Group. Major Incident Medical Management and Support: The Practical Approach (2nd edition). London, BMJ Books 2003.
13. Hodgetts TJ, Hall J, Maconochie I, Smart C. Paediatric Triage Tape. Pre-Hosp Immed Care 1998; 2: 155-9
14. Cooper BR, Mahoney PF, Hodgetts TJ, Mellor A. Intra-osseous access (EZ-IO) for resuscitation: UK military combat experience. J R Army Med Corps 2007;153(4): 314-6
15. Battlefield Advanced Life Support (JSP 570). Edition 4.1. January 2009.
16. Nicholl J, Hughes S. The costs and benefits of paramedic skills in pre-hospital trauma care. Health Technol Assess 1998; 2: 17.