Paediatric Anaesthesia in Afghanistan: a Review of the Current Experience

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Abstract

This paper describes the author's experience of the paediatric patient load on the UK medical services in Afghanistan. Over a 3 month period there was a mean of 2.9 paediatric trauma admissions per week, mean age was 6.8 years with gunshot wound or explosive injury being the mechanisms of injury in 77% of the trauma admissions. Overall these children represented 10.8% of the surgical workload. Some of the issues of paediatric anaesthesia in this environment are discussed including paediatric equipment, resuscitation for paediatric massive haemorrhage and regional anaesthesia. The need to formally recognise the problem in training and equipping deployed medical personnel to deal with this challenge is examined.

Introduction

United Kingdom medical forces on operations are configured specifically to support the deployed military force in that area. In Afghanistan, as in most conflicts, civilians account for a significant number of the casualties. Present operations take place in close proximity to the local population and consequently UK forces in accordance with the Geneva Conventions will deliver medical support to non-combatants who are injured. Children are a prominent fraction of this group and are regularly placed in the UK medical treatment and evacuation chain where they can impose a significant workload on the hospital in Camp Bastion.

Historical Experience

To appreciate the numbers of children involved it is appropriate to review what information has been published recently. This is predominantly from papers describing paediatric workload to UK and US hospitals in Iraq and Afghanistan over the past decade. Creamer's [1] paper is the largest review and looked at US Combat Support Hospital (CSH) admissions in Iraq and Afghanistan. They reported that 10% of their overall workload was paediatric but these children represented 50% of their civilian admissions. Of those admitted with trauma, penetrating injuries predominated (76.3%), the principal mechanisms of injury being gunshot wound (GSW, 39%) and explosive injury (32%). Just fewer than 6% required mechanical ventilation and mortality was 6.9%, the primary causes of death being head injury and burns. Beitler [2] looked in more detail at their initial admissions in Afghanistan to the 48th Combat Support Hospital and found 28.4% of all trauma victims were paediatric, paediatric admissions a week. Although they didn't look at mechanism of injury in the paediatric population specifically, their overall population had explosive injury (41%) and GSW (20%) as their highest mechanisms of injury. Mean age was 9 years (range 1-16 years) with the paediatric population having a longer length of stay (10 days) compared to adults (8.5 days).

UK data from Iraq in the initial war fighting stage in 2003 from two different hospitals illustrates the work load and differing mechanisms of injury at that time. Gurney's [3] paper was an Emergency Department based review of 34 Field Hospital's admissions over the first month when it was initially positioned in Shaibah, Iraq after the first few days of the conflict. He found paediatric patients comprised 2.9% of all recorded admissions, but accounted for nearly a third of civilian patients. The workload was 13 paediatric admissions per week with burns (77%) and explosive injury (12%) being the most common mechanisms of injury in his trauma subset. Mean age was 7.9 years with a higher proportion being male (65.4%). Heller's [4] review of paediatric patients followed their path through 22 Field Hospital based in Kuwait over the same initial war fighting stage. There were six paediatric admissions per week and again explosive (50%) and burns (42%) were the main mechanisms of injury. Mean age was 6.3 years in their trauma population (range 6 months to 15 years). Their data is highly influenced by the number of transfers from the forward deployed 34 Field Hospital back to 202 Field Hospital in Kuwait.

Local civilians without power were relying on Kerosene lamps for lighting and a high proportion of the injuries were burns secondary to accidents from this method of lighting rather than direct conflict casualties. Nonetheless unexploded ordnance from this and previous conflicts were exposed in this phase of the ground war and injuries secondary to these accounted for a significant part of the remainder.

Present military operations in Afghanistan are producing a greater proportion of explosive and GSW penetrating injuries in the paediatric population in UK facilities. Harris' [5] paper in this journal reviewed the paediatric workload on Critical Care in 2008. In the two months their data was collected they had 15 patients whose mechanism of injury was predominantly penetrating GSW or explosive. Mean age was 6 years (range 6 months to 17 years). This paediatric population was a significant workload for the Critical Care unit leading to children accounting for 30% of all bed occupancy. They reported one death from multi organ failure subsequent a penetrating injury to the chest and abdomen.

Methods

In order to obtain a more accurate review of paediatric admissions to the Role 3 hospital at Camp Bastion, data was collected for

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a three month period over Op HERRICK 8b/9a looking at paediatric patients admitted with traumatic injuries. All paediatric surgical admissions medical records were examined retrospectively and the theatre operation log book was examined. Data collected included, age, sex, diagnosis, operations, number of operations, admission to ITU, length of admission.

Results

During the three months, 31 children were admitted for surgical intervention after trauma. There were 18 (58%) male and 13 (42%) female patients with an average age of 6.8 years (range 6 months to 14 years). This is similar to previous experience but of more particular interest was that a quarter of these were aged 2 years or younger (Figure 1).

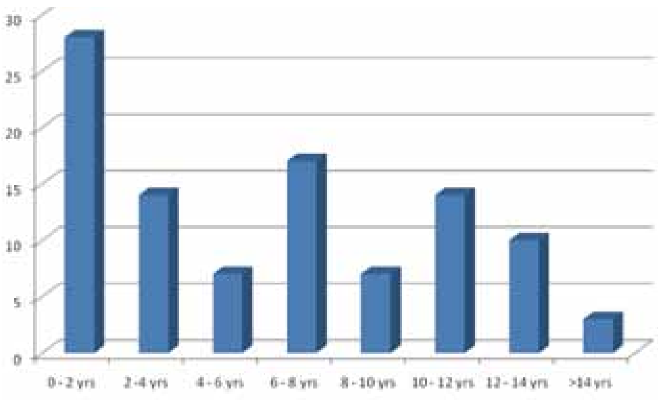

Figure 1: Age distribution of paediatric trauma admissions as a percentage of total paediatric trauma admissions on Op HERRICK 8b/9a.

There were a mean of 2.9 paediatric admissions per week, a smaller number than in the previous papers, however this patient population still presented a significant workload for the surgical and anaesthetic teams. The quantity of surgical operations undertaken on this paediatric population was 10.8% of all operations carried out, with an operation on a child occurring every 1.9 days, each child needing a mean of 1.6 operations (range 1 to 5).

The main mechanisms of injury were fragmentation (45.1%) and GSW (32.3%) and are shown in Figure 2 compared to the previous UK and US experiences in Iraq.

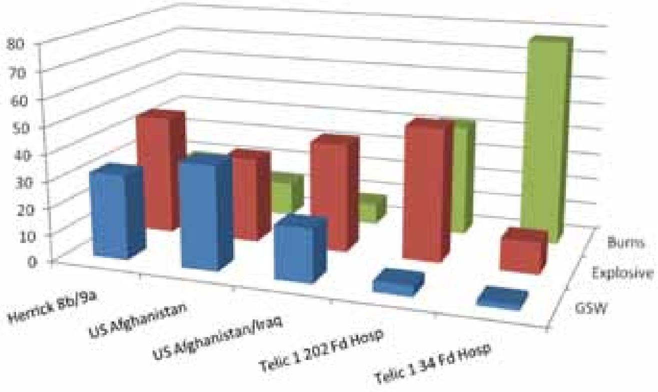

Figure 2: Paediatric patients; mechanism of injury as percentage of total paediatric trauma admissions.

Mean length of stay was 10.5 days (range 1 to 62 days) and 35% of these paediatric patients were admitted to critical care. This was 11.9% of its total admissions over the data collection period. In the critical care sub-group of the most gravely injured children penetrating wounds secondary to GSW or explosive injury accounted for 91% of the injuries. For those admitted to critical care a thoracotomy was needed in 27% of cases, laparotomy in 82% and injuries to the liver, spleen or pancreas were involved in 36%. There was one death from a penetrating explosive injury with multiple wounds to chest and abdomen.

A summative review of the above data predicts that any anaesthetist deploying to Afghanistan would be expected to deal with two to four paediatric admissions per week. These patients will have an average age of seven and a quarter of them may be less than two years of age. Each child will need around two operations and have an average length of stay of 10 days.

Discussion

This significant paediatric challenge means military anaesthetists need to be prepared to treat not just the injured paediatric patient but one that has had significant ballistic trauma and is suffering from the major haemorrhage and coagulopathy that can result from it, a rare occurrence in UK civilian practice. Military consultants and trainees need to be prepared to deal with this patient group by being adequately trained and equipped to provide the appropriate care.

Critical Care

Over a third of paediatric patients who had suffered trauma were admitted to critical care which seems a large proportion. It places a significant workload on the critical care staff who do not necessarily have the necessary paediatric experience. There is probably a combination of factors influencing this admission rate; significant penetrating injuries not normally seen in the UK, staff with little paediatric experience and the lack of local paediatric critical care provision are probably all of some significance. This is discussed in more detail in Harris' paper [5].

Equipment

The design and choice of breathing systems is determined by the child's weight and age. The commonest being the Mapleson F and the circle system which comes in adult and paediatric sizes. The differences and advantages of these systems can be found in any paediatric anaesthesia text [6]. In summary the Mapleson F is in most common use and its advantages are: no valves, low resistance, Continuous Positive Airway Pressure (CPAP) and Positive End Expiratory Pressure (PEEP) can be applied and it can be used for spontaneous and controlled ventilation. It is of particular use in smaller children but its disadvantage is the need for high fresh gas flows. The main disadvantages of circle systems are the resistance from unidirectional valves and their higher compliance reducing tactile feedback when hand ventilating. This reduces its ability to be used in smaller children (less than 10kg).

Until recently in the military environment the Triservice anaesthetic apparatus (TSAA) has predominated. It has been studied in children in its original format previously by Bell [7]. His team studied children weighing down to 10kg, comparing work of breathing between the Mapleson F breathing system and the TSAA. They found there was no significant difference in work of breathing between the two breathing systems proving the TSAA is suitable to be used in children over that weight. Despite this endorsement the TSAA has a number of problems when being used to anaesthetise children. When manually ventilating children it also provides poor tactile feedback back from the bag and an inability to accurately measure and set the inspiratory pressure. In spontaneous ventilation it is difficult to visually monitor the tidal volume and respiratory rate in addition to being unable to easily provide PEEP or CPAP.

This has prompted some users to use the TSAA in different formats when anaesthetising children. The Oxford Miniature Vaporisers (OMVs) can be added to the fresh gas flow arm of the Mapleson F. This will require a high flow of gas through the vaporisers (in excess of 6 litres per minute) to prevent rebreathing. Further upstream from the OMVs is the oxygen inlet and the cage mount connector of the TSAA. This end has traditionally been occluded to minimise air entrainment and this occlusion is not an ideal solution for patient safety. Birt [8] describes the use of a short piece of extension tubing and a disposable Intavent adjustable pressure limiting (APL) valve at this end allowing pressure relief to occur when the circuit pressure exceeds a set level. This set up can be used for both spontaneous and manual ventilation in most paediatric weight groups.

For children under 10kg, intubation and positive pressure ventilation is the norm. Manual ventilation compared to mechanical ventilation is useful as it provides constant feedback of airway resistance but it does not enable the anaesthetist to do concurrent tasks that are essential in resuscitation of the severely injured child. Ralph et al [9] addressed this issue recently and devised a method for ventilating children under 10kg using the TSAA in conjunction with the Pneupac ComPAC 200 ventilator. The ComPAC 200 ventilator is a flow generator which is inadequate for paediatric use. Children have significantly smaller tidal volumes and are at higher risk of barotrauma so they should be preferentially ventilated using a predetermined inspiratory pressure rather than volume. Ralph's group described a series of six children under 10kg who were successfully ventilated using the TSAA and ComPAC 200. In a similar move to the conversion of a Penlon Nuffield 200 ventilator from flow to a pressure generator by the addition of a Newton Paediatric valve they added an Intavent APL valve between the ventilator and the OMVs thus converting the ComPAC 200 to a pressure generating ventilator.

The changes described above give the military anaesthetist all options needed when anaesthetising a child using the TSAA. In recent months the new Dräger Fabius Tiro has been in place in Camp Bastion. This enables conventional methods of providing anaesthesia using the breathing systems discussed above that are well known in UK hospitals.

Analgesia and Regional Anaesthesia

Adequate pain relief is an essential part of any anaesthetic technique and this is true for children of any age. Pain management in children presents additional challenges not seen in adults; in particular the difficulty of assessment of pain. Anticipation of pain and pre-emptive treatment should be the norm. The use of regional anaesthesia is common in children and if given at induction has the advantage of providing good intra-operative analgesia where its effect can be assessed as to its subsequent post-operative effect. Blocks are virtually all performed under general anaesthesia. Virtually any block performed on adults can be used in children. The equipment does not have to be significantly different except for peripheral blocks in much smaller children and central blocks under a certain size. Paediatric regional anaesthesia though should only be carried out by an experienced practitioner who has the prior knowledge and skills to undertake them. It is not in the scope of this article to discuss the equipment requirements in detail nor the different local anaesthetic doses, volumes or infusion rates.

Massive Haemorrhage

Adult management of massive haemorrhage has been well described and there is formal guidance for all deployed physicians in its management [10]. The Paediatric Anaesthesia and Critical Care Specialist Interest Group (PACCSIG) has written a paediatric guide per weight that will enable anaesthetists to guide paediatric patient resuscitation and this is detailed further in the article by Bree et al [11].

Training

It is imperative that military anaesthetists have adequate training to deal with this paediatric challenge. It is the author's opinion that trainees should have at least 6 months paediatric training in their final 3 years of training, preferably at a tertiary paediatric hospital. Ideally this hospital should have a dedicated paediatric ED department and have a military anaesthetic consultant working there. For consultants there should be one consultant with a regular paediatric exposure in the UK deployed to Herrick at any one time. The other consultants should have refresher training in a tertiary paediatric centre before deploying.

US experience

The Americans have dealt with over 3,500 infants and children in Afghanistan and Iraq. Their combat support hospitals are 'doctrinally' not staffed or equipped to provide care for this population. The US has recognised this and made changes to respond to this challenge [12]. Paediatric specific education including a web based education platform, modified paediatric equipment and a 24 hour paediatric critical care 'teleconsultation' service have been designed to improve pre-deployment training and in theatre care of the injured child.

Paediatric Anaesthesia and Critical Care Specialist Interest Group (PACCSIG).

This group has been commissioned by the Defence Consultant Adviser in Anaesthetics and meets bi-annually to address some of the issues raised in this article. At present it is working on equipment concerns, massive haemorrhage, audit and training. As part of its work improved Role 1 Paediatric training has occurred for HERRICK 12 and 13. Consultant anaesthetists deploying to HERRICK 13 have had clinical refresher sessions at Birmingham Children's Hospital and guidelines for paediatric massive haemorrhage are published in this journal.

Conclusions

The current spectrum of operations imposes a tough challenge on deployed Defence Medical Services (DMS) personnel to manage and treat civilian children. The data collected for this paper illustrates that children with considerable ballistic and penetrating injuries are a significant part of this challenge and military anaesthetists need to be prepared for this. As such, the DMS has a duty to train and equip its personnel to the required standard in order to provide appropriate care to this population group. The PACCSIG is addressing some of the issues described in this article and is working towards a more formal recognition of the training and equipment needs in addition to guidelines for best practice in paediatric anaesthesia and resuscitation in the deployed environment.

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