The incidence, spectrum and outcome of paediatric trauma managed by the Pietermaritzburg Metropolitan Trauma Service

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ABSTRACT

INTRODUCTION The Pietermaritzburg Metropolitan Trauma Service (PMTS) has run a systematic quality improvement programme since 2006. A key component included the development and implementation of an effective surveillance system in the form of an electronic surgical registry (ESR). This study used data from the ESR to review the incidence, spectrum and outcome of paediatric trauma in Pietermaritzburg, South Africa.

METHODS The ESR was reviewed, and all cases of paediatric trauma managed between 1 January 2012 and 30 July 2014 were retrieved for analysis.

RESULTS During the study period, 1,041 paediatric trauma patients (724 male, 69.5%) were managed by the PMTS, averaging a monthly admission of 36. The mean age was 10.9 years (standard deviation: 5.4 years). The mechanism of injury (MOI) was blunt trauma in 753 patients (72.3%) and penetrating trauma in 170 (16.3%). Pedestrian vehicle collisions accounted for 21% of cases and motor vehicle collisions for a further 11%. Intentional trauma accounted for 282 patients (27.1%) and self-inflicted trauma for 14 cases (1.3%). Ninety patients admitted to the intensive care unit and fifty-one required high dependency unit admission. There were 17 deaths, equating to an in-hospital mortality rate of 1.7%. A total of 172 children died on the scene of an incident. There were 35 road traffic related deaths, 26 suicides by hanging, 27 deaths from blunt assault and 23 deaths from penetrating assault. The overall mortality rate for paediatric trauma was 18.2%.

CONCLUSIONS The ESR has proved to be an effective surveillance system and has enabled the accurate quantification of the burden of paediatric trauma in Pietermaritzburg. This has improved our understanding of the mechanisms and patterns of injury, and has identified a high incidence of intentional and penetrating trauma as well as road traffic collisions. These data can be used to guide strategies to reduce the burden of paediatric trauma in our environment.

KEYWORDS

Paediatric trauma – Injury prevention – Demographics

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The Pietermaritzburg Metropolitan Trauma Service (PMTS) was established in 2006 with the intention of providing comprehensive trauma care to the city of Pietermaritzburg and the whole of the western part of the KwaZulu-Natal (KZN) province.^{1–4} The PMTS aims to provide resources and expertise as well as strategic and political leadership in trauma care to the city of Pietermaritzburg and the western rural health districts of KZN. Pietermaritzburg is the capital of KZN and the largest city in the western part of the province. It has a population of 1,001,000 people and is served by a tertiary hospital (Grey's) and a regional hospital (Edendale). Western KZN is a predominantly rural province with a population of two million. It consists of four health districts. There are two other regional hospitals in western KZN and 19 district hospitals.

For a number of logistical reasons, the PMTS could not adopt the concept of a trauma centre located in a single

hospital and opted to attempt to provide care across the metropolitan complex. Hence, the PMTS is a service and not a centre.

Trauma patients in Pietermaritzburg are directed to one of the two hospitals in the city depending on their geographical location. There is no dedicated children's hospital in Pietermaritzburg and children are cared for in general hospitals by trauma specialists in conjunction with a team of paediatric surgeons. As part of a systematic quality improvement programme, the PMTS implemented an electronic surgical registry (ESR) in January 2012 and updated this system to a comprehensive hybrid electronic medical registry (HEMR) in January 2013 in Grey's Hospital.^{1–4} This study used the data from our prospectively maintained ESR and HEMR to audit the incidence, spectrum and outcome of paediatric trauma managed by the PMTS.

Methods

Data of patients under 18 years of age who had sustained trauma between January 2012 and June 2014 were reviewed by the primary author. Data included demographic details, admission vital signs and the categorisation of anatomical injuries. Injury severity scores were tabulated and collected, as were data pertaining to operative interventions, complications and outcomes. Data were retrieved from the medico-legal mortuary at Fort Napier to identify all children who died following trauma and who were not treated at a health-care institution prior to death. Excel® (Microsoft, Redmond, WA, US) was used for the data analysis.

Results

During the two-and-a-half-year period under review, 1,041 paediatric trauma patients were managed by the PMTS. This equates to approximately 36 paediatric trauma admissions per month. The mean age of the patients was 10.9 years (standard deviation: 5.4 years). The series included 724 male (69.5%) and 317 female (30.5%) patients. The mechanism of injury (MOI) was blunt trauma in 753 patients (72.3%) and penetrating trauma in 170 (16.3%). Table 1 provides an overview of the entire cohort. The remainder of the MOIs are recorded in Tables 2 and 3.

The mean age for the gunshot wound victims was 14 years (range: 5–17 years) and for stab victims it was 15.4 years (range: 14–17 years). Pedestrian vehicle collisions accounted for 21% of cases and motor vehicle collisions for a further 11%. Falling off the back of a moving vehicle refers to falling off a flatbed truck, which accounted for 4% of cases. There were 88 patients who sustained a bite injury (78 snake bites, 7 dog bites and 3 human bites). The injury was intentional in 282 patients (27.1%) and self-inflicted in 14 (1.3%). The known weapons used in the assault cases are documented in Table 4.

Overall, 315 patients required a total of 1,179 operative interventions. This equates to an average of 3.7 operative interventions for each patient who required an operation. The ISS scores were available for 665 patients. The distribution of the available injury severity scores are listed in Table 5. There were 90 patients admitted to the intensive care unit and 51 patients to the high dependency unit. There were 17 deaths, equating to an in-hospital mortality rate of 1.5%. A total of 173 children died on the scene of an incident. The MOI of these deaths is detailed in Table 6. Forty-three per cent of the deaths on the scene were secondary to intentional trauma. By including the mortuary statistics, the overall mortality rate for paediatric trauma in Pietermaritzburg approximated 18%.

Discussion

The demographic profile of developing countries is heavily weighted towards the younger age cohorts and public health initiatives in these countries have focused on programmes directed at this population group. Traditionally, these have concentrated on reducing the morbidity and

Table 1 Overview of the total patient cohort ($n=1,041$)

	Frequency
Male	724 (70%)
Female	317 (30%)
Mean age in years	10.2 (SD: 5.4)
Intensive care unit	90 (1%)
High dependency unit	51 (0.5%)
Non-intentional	745 (72%)
Intentional	282 (27%)
Self-inflicted	14 (1%)
Blunt trauma	753 (72%)
Penetrating trauma	170 (16%)
Bites	88 (8%)
Unknown	13
Electrocution	7
Blunt and penetrating trauma	3
Blunt and thermal trauma	3
Blunt trauma and sexual assault	1
Lightning	1
Near drowning	1
Ingested glass	1
In-hospital mortality	17 (1.6%)
In-hospital + on-scene mortality	189 (18.2%)
SD = standard deviation	

Table 2 Mechanism of penetrating trauma ($n=170$)

Mechanism	<i>n</i>
Stab wounds	107
Gunshot wounds	32
Impalement	24
Iatrogenic	1
Unknown	6

mortality associated with infectious diseases while injury has been regarded as a lesser priority. Over time, this has resulted in underfunding of paediatric trauma care and prevention as well as less research on and social activism around the subject.^{1–5} However, trauma is a leading cause

Table 3 Mechanism of blunt trauma (*n*=753)

Mechanism	<i>n</i>
Pedestrian vehicle collision	219
Assault	136
Motor vehicle collision	113
Fall from height	69
Accidental fall	65
Fall from moving vehicle	45
Building collapse	30
Fall off bicycle	22
Community assault	21
Hanging	14
Animal injury	11
Sports injury	6
Explosion	1
Self-inflicted	1

of childhood death, and it is low and middle income countries that are disproportionally affected by this burden of childhood trauma. Childhood and adolescent trauma is a major public health problem and our data support this contention.

Public health challenges require coordinated systematic responses and the first objective of such a systematic response is surveillance to establish the extent of the problem. This calls for a comprehensive data capture system. Prior to the introduction of the ESR and HEMR in Pietermaritzburg, there was no mechanism in place to capture data about childhood injury in the western half of the KZN province. The implementation of these programmes will hopefully provide an ongoing resource that produces current data on the burden of paediatric injury, thereby forming the basis of a systematic programme to reduce the incidence (and to improve the outcome) of this problem. Such a programme must develop an efficient, well resourced and coordinated system to reduce the burden of trauma and limit the sequelae of injury once it has occurred.¹⁻⁵

It is well established that in-hospital studies in South Africa underestimate mortality rates as many patients die on the scene and never present to hospital. Our study has confirmed this observation. Although 17 patients died of trauma in our service, a further 172 died on the scene, resulting in a high mortality rate of 16%. The MOI associated with the cases of mortality includes a high proportion of intentional trauma, road traffic related trauma and self-inflicted trauma. Reducing mortality from these mechanisms requires comprehensive injury prevention programmes.

Typically, in South Africa, paediatric trauma is due to a blunt MOI, with falls and road traffic collisions (RTCs) predominating as causes, and this appears to be the case also

Table 4 Weapons used during assaults

Weapon	<i>n</i>
Knife	68
Wooden rod	32
Stone	26
Low velocity firearm	21
Sjambok	12
Metal rod	12
Bottle	11
Brick	7
Fists	6
Machete	5
Screwdriver	5
High velocity firearm	4
Air rifle	3
Glass	2
Spear	2
Axe	1
Bicycle spoke	1
Hosepipe	1
knitting needle	1
Knobkerrie	1
Nail	1
Needle	1
Pencil	1
Pliers	1
Pot lid	1
Spade	1
Steel pipe	1

in other sub-Saharan African countries.⁶⁻¹² In keeping with this, ongoing urbanisation and increased levels of motorisation in South Africa are likely to result in growing rates of RTCs. Nevertheless, what continues to distinguish our experience from that of other developing countries is the excessively high incidence of intentional trauma. This high incidence of intentional trauma and penetrating trauma has been reported from other major centres in South Africa, and reflects persistently high levels of interpersonal violence in the country two decades after the advent of democracy.¹³⁻¹⁵

The operative workload for paediatric trauma in the PMTS is significant. With the increased use of non-operative techniques to manage blunt trauma, the operative load for trauma in the developed world has decreased significantly. In our environment, however, penetrating trauma

Table 5 Breakdown of injury severity scores

Score	n
0–5	371
6–20	260
21+	34

Table 6 On-scene deaths according to mechanism of injury

	Mechanism	n
Intentional (n=76)	Hanging	26
	Head injury due to assault	12
	Stab to chest (great vessel, lung parenchyma)	10
	Assault	7
	Gunshot wound (2 head, 2 chest, 1 neck)	5
	Head injury due to stab	4
	Stab to heart	4
	Strangulation	4
	Aggravated sexual assault	2
	Poisoning	2
Non-intentional (n=96)	MVA/PVA	35
	Burns	26
	Aspiration/food, blood or foreign body	12
	Electrocution	11
	Drowning	10
	Head injury due to fall	1
	Snake bite	1

cases account for a large proportion of surgery and a third of patients in this study required operative intervention. If surgery is indicated, then multiple procedures are usually necessary.

One of the key components in the systematic approach to trauma care is the development of dedicated paediatric trauma centres.¹⁵ There is an increasing body of evidence to suggest that injured children treated at such a centre have better outcomes than those who are treated at general hospitals. Currently, there is no such institution in the western half of KZN province and this has presented a major organisational challenge to our service.

Our solution has been to develop the concept of a trauma service, which manages trauma across the entire

metropolis through the development and implementation of management protocols. Our outcomes are acceptable within the constraints of our present resources as evidenced by an in-hospital mortality rate of 1.7%. Although not ideal, our trauma service does seem to be effective in delivering the best care possible in our environment. The issue of prehospital care is an important one and it would appear that many deaths occur in the prehospital environment. This suggests that our prehospital retrieval systems are less than optimal and that we should be focusing our attention on improving this component of our system.

There has been much interest in the identification of specific risk factors for paediatric injury in the hope of developing targeted injury prevention programmes. It would seem that the three areas that need to be addressed are RTCs, intentional trauma and self-inflicted trauma. The three primary interventions to prevent and reduce RTCs are safety engineering, education and legislation.^{5,16} Some risk factors can be addressed by improving playground, sports and vehicle safety as well as by the introduction of traffic calming zones around schools and public places. Although education is important, it has been demonstrated repeatedly that enforced legislation is more effective than education alone in improving changes in behaviour. The introduction of legislation to enforce the use of seatbelts and motorcycle helmets was effective in reducing morbidity and mortality associated with RTCs. Preventing the transportation of children on the back of flatbed trucks is another potential intervention.

Dealing with the issue of intentional trauma in children is more challenging but equally pressing as intentional trauma is more likely to be fatal than non-intentional trauma. Further work is required to identify risk factors for intentional trauma in children. There were 40 children in the current study who attempted or were successful in committing suicide by hanging. This translates into one serious suicide attempt every twenty three days, which is cause for concern.¹⁵ More detailed work needs to be undertaken to identify the causes for this high rate of suicide so that interventions can be developed to identify those at risk and to prevent them from acting on suicidal thoughts.

The ESR and HEMR have proved to be reliable mechanisms for capturing hospital-based data on paediatric injury in our environment. We have recognised the major limitation that they cannot provide information on prehospital deaths and have attempted to develop a means of capturing these data. Using these two systems has allowed us to produce a detailed overview of the problem and the outcome of trauma in children in Pietermaritzburg. It is hoped that this programme can be extended, and that it will be able to integrate with pre-existing surveillance and injury programmes such as the Childsafe programme (<http://www.childsafe.org.za/>), which is currently based in the Western Cape province of South Africa and records data from the Red Cross Children's Hospital. These data are in turn fed back to the Safe Kids Worldwide programme (<http://www.safekids.org/>), which attempts to provide a global overview of the problem.

Conclusions

The ESR and HEMR have proved to be effective surveillance tools, which have enabled us to accurately quantify the extent and outcome of paediatric trauma in Pietermaritzburg. The burden of disease is significant, and there is a high incidence of intentional trauma and penetrating trauma in our environment. RTCs and suicide are also major contributors to this burden. Injury prevention programmes are required as a matter of urgency and the city of Pietermaritzburg warrants a dedicated paediatric trauma centre. Furthermore, attention must be given to improving prehospital services.

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