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PAEDIATRIC SURGERY

The spectrum and outcome of paediatric emergency surgical admissions – a regional hospital analysis

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Background: Improving emergency surgical care for children requires information on the causes of admissions and the variables affecting outcome. There is a lack of such data in the South African context.
Methods: This retrospective study was conducted from January 2016 to December 2017. Data was collected on all children (< 12 years of age) requiring admission with emergency surgical conditions. Infrastructure and staffing ratios were determined prior to data collection. Information was sourced from admission and discharge books, patient files and theatre registers. Variables of age, sex, referral source, diagnosis, length of stay, surgical treatment and outcome including death were collected.
Results: Four hundred and thirty-five of the 1 048 children (42%) admitted were in the 0–2-year age group. Trauma (258), sepsis (564) and burns (226) were the main causes. The median hospital stay was 3 days (IQR 2–5), however, for burns patients, the median stay was 4 days (IQR 2–9). Surgery was performed on 279 (27%) admissions. Eight (0.8%) died, six of which were due to burns. Clinical status prior to death was poorly documented. A dedicated high care unit and burns isolation rooms were lacking. Surgeon/population and child/nurse ratios were respectively 1.48/100 000 and 7–12/1.
Conclusion: This study found that the emergency paediatric surgical burden is significant. Sepsis and trauma combined are the leading cause of emergency admissions. Burns had the highest mortality. Although mortality was low, improvements of staff to patient ratios and the institution of an early warning system could reduce mortality.
Keywords: surgery, children, trauma, procedure, system, nursing

Introduction

Maternal and child health remains a priority for many low- and middle-income countries (LMICs), including South Africa. This is despite achieving a 53% decrease in the under-5 mortality rate since the adoption in 2000 of the Millennium Development Goals.[1,2] The United Nations has set a new goal of less than 25 deaths per 1 000 live births by 2030. The attainment of this goal includes environmental, social and economic, as well as healthcare strategies. Recently, there has been a realisation that acute surgical care of the paediatric population plays an important role in improving child health and decreasing preventable deaths and resulted in the establishment of the Global Initiative for Children's Surgery (GICS). This initiative was established in 2016 and aimed at identifying solutions to problems in children's surgical care in LMICs by encouraging LMIC–LMIC and high-income countries (HICs)-LMIC partnerships targeting improvement in infrastructure, service delivery, training and research by using the resources of HICs and leadership and experience of LMICs in an attempt to improve children surgical care.[3]

The majority of routine non-neonatal paediatric surgical conditions in South African state hospitals are dealt with at regional level, by general surgeons as paediatric surgeons are based only at tertiary level hospitals, probably with the exception of oncology cases. There is a lack of studies conducted in Africa in general and in South Africa in particular to describe the spectrum of common surgical paediatric emergencies and their outcome dealt with by general surgeons at a regional hospital.[4]

This information should provide valuable insight on the burden of disease and how effectively it is managed to inform health policy and management algorithms. Against this background a retrospective study was undertaken to review emergency paediatric surgical patients admitted to a regional hospital in KwaZulu-Natal (KZN).

Patients and methods

The study is a retrospective descriptive analysis of children under the age of 12 years admitted as surgical emergencies to Prince Mshiyeni Memorial Hospital (PMMH) over a 2-year period (1 January 2016 to 31 December 2017). PMMH is a level 2 (regional) hospital in KZN, situated on the edge of Umlazi township, south of Durban, that provides surgical care for a population of over 410 000. The general surgical department deals with all general and paediatric surgical pathologies. The department has a general 35-bed paediatric ward with severely ill children being managed in the general adult high care ward. High percentage body surface burns are managed in the side wards in the general paediatric ward.

The patients were managed daily by a consultant-led three medical personnel team. The consultant population ratio

Table I: Age distribution

			Trauma		Sepsis		Burns	
Age	***n***	**%**	***n***	**%**	***n***	**%**	***n***	**%**
0–1	206	19.7	33	12.8	117	20.7	56	24.8
1–2	229	21.9	46	17.8	110	19.5	73	32.3
2–3	111	10.6	23	8.9	50	8.9	38	16.8
3–4	74	7.1	22	8.5	39	6.9	13	5.8
4–5	72	6.9	20	7.8	39	6.9	13	5.8
5–6	66	6.3	22	8.5	32	5.7	12	5.3
6–7	54	5.2	22	8.5	28	5.0	4	1.8
7–8	63	6.0	20	7.8	38	6.7	5	2.2
8–9	62	5.9	22	8.5	34	6.0	6	2.7
9–10	54	5.2	15	5.8	37	6.6	2	0.9
10–11	56	5.3	13	5.0	39	6.9	4	1.8
11–12	1	0.1	0	0.0	1	0.2	0	0.0
Total	1 048	100	258	100	564	100	226	100

was 1.48/100 000. Two of the six surgeons had no formal training in paediatric surgery. Paediatric surgeon advice was available telephonically from a tertiary hospital, Inkosi Albert Luthuli Central Hospital (IALCH), to which patients deemed to require specialised paediatric surgical care were transferred. The number transferred out to IALCH was, however, not recorded. The child/registered nurse ratio was 7–12/1 during the day and 18/1 at night, The child/enrolled nurse ratio was 6–12/1 during the day and 12/1 at night. The child/nurse assistant ratio was 12–35/1 during the day and 18/1 at night.

Data were reviewed for 1 818 emergency surgical admissions over the study period. Seven hundred and seventy patients who had missing information related to age, sex, source of admission and severity of burns were excluded. Variables of age, sex, referral source, diagnosis, length of stay (LOS), surgical treatment and outcome, including death, were collected from the admission and discharge book, the theatre registers and the children's medical records.

Data analysis

The captured variables were entered into a Microsoft Excel spreadsheet. IBM SPSS version 25 (IBM, Armonk, NY) was used to analyse the data. Categorical variables were described using frequencies and percentages, while continuous variables were described using median and interquartile range due to extreme skewness. Categorical variables were compared using chi-square tests or Fisher's exact test as appropriate, and continuous non-normally distributed variables using Mann–Whitney tests in the case of two categories for comparison, or Kruskal–Wallis tests where more than two groups existed.

Results

One thousand and forty-eight patients had a minimal data set for analysis; 413 (39.4%) in 2016 and 635 (60.6%) in 2017. There were 429 (40.9%) females, and 619 (59.1%) males. The age group distribution is shown in Table I. Most were in the 0–1 age group (206; 19.7%), and the 1–2 age group (229; 21.9%). Five hundred and forty-seven patients (52.2%) were admitted from home, 363 patients (34.6%) from clinics, 98 patients (9.4%) from the short stay ward (SSW) and only 22 (2.1%) directly from the emergency unit.

Table II: Surgical procedures

	n	**%**
Incision and drainage	216	77.4
Debridement	35	12.5
Appendicectomy	12	4.3
Laparotomy for appendicectomy	8	2.9
Removal of foreign body	5	1.8
Fasciotomy	1	0.4
Skin graft	1	0.4
Exploratory laparotomy	1	0.4
Total	279	100.0

Trauma was the indication for 258 of the admissions with head injuries accounting for 180 (69.8%). Twenty-four patients had snake bites (9.3%), and 19 had foreign body ingestion (7.4%). There were 564 children admitted with sepsis, of which 343 (60.8%) had an abscess and 169 (30%) cellulitis. Two hundred and sixteen children (63%) with an abscess underwent an incision and drainage in the main theatre, the remaining 127 (37%) had a bedside incision and drainage. Apart from those who had incision and drainage, surgery was performed on 63 patients as detailed in Table II. Two hundred and twenty-six patients had burns, of which 137 patients (60.6%) were mild. Details of the diagnoses are found in Table III. The median LOS was 3 days (IQR 2–5). Median LOS for trauma patients ($n = 258$) was 2 days (IQR 1–5; $p < 0.001$), while the median length of stay for sepsis ($n = 564$) was 3 days (IQR 2–5; $p < 0.001$). Burns patients ($n = 226$) stayed longer with a median LOS of 4 days (IQR 2–9; $p < 0.001$).

Several factors were associated with longer hospital stay: patients admitted from adult high care (implying they were sicker) 4 days (IQR 2–7; $p = 0.019$) and burns victims 4 days (IQR 2–9; $p < 0.001$). It was further noted that burns

Table III: Diagnosis			
		n	%
Sepsis (*n* = 564)			
	Abscess	343	(60.8)
	Cellulitis	169	(30.0)
	Others	52	(9.2)
Burns (*n* = 226) *			
	Mild (< 10% TBSA)	137	(60.6)
	Moderate (10–19% TBSA)	63	(27.9)
	Severe (≥ 20% TBSA)	26	(11.5)
Trauma (*n* = 258)			
	Head injury	180	(69.8)
	Snake bite	24	(9.3)
	Foreign body ingestion	19	(7.4)
	Others	35	(13.5)

TBSA – total burns surface area
*McKerrow N, Allorto N, Den Hollander D, et al. Provincial burns services for children. Dept Health, KwaZulu-Natal (intranet access)

patients who underwent a debridement had a longer average LOS (median 8 days; IQR 3–10) compared to those who did not (4 days; IQR 2–8; $p = 0.010$). Neither age ($p = 0.324$) nor having undergone incision and drainage in main theatre ($p = 0.613$) affected the LOS.

The diagnosis was affected by some factors: male patients and those admitted from adult high care were more likely to suffer from trauma ($p < 0.004$) and females from burns ($p < 0.004$), burns occurred in younger age groups (0–1 and 1–2 years) ($p < 0.001$) and trauma in older patients. During the study period, eight deaths (0.8%) were recorded of which six occurred in burns patients. There was insufficient information to establish the direct cause of death, but these children were found either in a very critical condition or unresponsive with no previous recording of their vital signs to determine deterioration. Burns were associated with a higher mortality rate, six of 226 burns cases (2.7%; $p < 0.001$). However, this finding was not statistically significant when compared to other deaths due to trauma, OR 3.491 (95% CI 0.697–17.472; $p = 0.128$; $n = 484$).

Discussion

Advances in the management of tuberculosis, HIV infection and malaria by well-funded targeted interventions constitute the main reason for the reduction in number of children under five dying.[3,5] However, much less attention has been paid to trauma and non-trauma surgical emergencies in children to determine the causes and reduce avoidable deaths. This study found that the paediatric emergency surgical burden is significant, that infections, trauma and burns are the leading causes of admissions, and that mortality was very low.

Paediatric-specific infrastructure, service delivery, training and research proposed by the GICS is still lacking in third-world countries.[3,5,6] In line with the GICS objectives, we found that during the study period, the paediatric unit of PMMH appeared to have sufficient beds to accommodate the paediatric surgical burden. The equipment available in the unit seemed to be adequate based on the National Core Standards.

However, during the conduct of this study certain challenges were noted with regard to infrastructure and personnel. The lack of a dedicated paediatric high care ward and the lack of suitable resources to manage the highest surface area burns in dedicated rooms was apparent. The child nursing ratios that pertained during the study period are half that recommended by HICs and are even worse during night shifts. While a global recommendation on the optimal patient to nurse ratio is lacking, a high patient to nurse ratio has been shown to result in burnout and poorer outcomes for the children.[7]

Similarly, with a ratio of 1.48 surgeons/100 000 population, PMMH hospital has a quarter the number of surgeons recommended per capita in HIC.[8,9] The PMMH ratio is twice the reported national average in South African state hospitals and thrice the average for Burundi, Ethiopia, Kenya, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe.[10,11] Dell et al. quantified paediatric surgeon to population ratio in South Africa as 2.6 per million population under 14 years of age. These reports highlight the dire shortage of general and paediatric surgeons in South Africa and Africa in particular.[12]

The finding of this study in regard to male gender bias and the 0–2 age range accounting for almost half of the children admitted is in keeping with several other studies.[4-6,13,14] Bickler and Sanno-Duanda in their 29-month prospective study in a government hospital in Gambia demonstrated, as we did, that patients who suffered trauma, especially burns, had a longer hospital stay.[4] There appears to be a great need to introduce burns management practices, such as early burn wound excision and grafting, that have been shown to reduce hospital stay in other settings.[15]

Burns were not only a significant cause of increased hospital stay but were responsible for six of the eight deaths in this study and again echo the findings of Bickler and Sanno-Duanda.[4]

The overall mortality of 0.8%, though low, remains a cause for concern as several other studies have reported no deaths.[4,13,14,16] This discrepancy may be due to these reports emanating from better-resourced hospitals and therefore not strictly comparable to our setting.[4,6]

A notable absence from our management policy was the use of the paediatric early warning score (PEWS). A modified easy to use PEWS system based on six clinical variables has been shown, in Rwanda, to rapidly and accurately identify deteriorating children and greatly improve their outcomes.[17] Implementation thereof in PMMH has the potential to reduce mortality.

Several limitations related to retrospective data collection, particularly information relating to establishing the circumstances of death, hamper more effective interpretation. Despite these deficiencies, this study quantifies the large burden of paediatric surgical emergencies predominantly due to infections, trauma and burns. These can be effectively managed in a regional hospital with less than ideal infrastructure and staffing ratios, with a very low, yet potentially improvable mortality. Implementation of a modified PEWS system and addressing deficiencies in burn care have the potential to reduce the death rate.

Conflict of interest

The authors declare no conflict of interest.

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Ethical approval

The study was approved by the University of KwaZulu-Natal Bioethics Committee (BE 419/18).

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