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Epidemiological study of peritonitis among children and factors predicting mortality at a tertiary referral hospital in Rwanda

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Abstract

Background: ***Peritonitis is a commonly encountered paediatric surgical emergency. We conducted this study to identify common causes of peritonitis among Rwandan children and factors affecting morbidity and mortality.***

Methods: ***The study sample consisted of children with peritonitis who underwent surgical treatment at a tertiary referral hospital in Rwanda from 1 September 2015 to 28 February 2016. Collected data included sociodemographic, clinical, paraclinical, management, and outcome information. The analysis included Pearson's chi-square test and multivariate logistic regression to determine factors associated with morbidity and mortality.***

Results: ***Of 63 patients, 28 were female. Ages ranged from 4 months to 15 years, with a mean of 8.8 years. Seventy-three percent of patients presented within the first week of symptom onset. Appendicular perforation (25.4%) and gangrenous intussusception (23.8%) were the most common causes of peritonitis.***

Fourteen patients (22.2%) died. On multivariate analysis, factors associated with mortality included sepsis (odds ratio [OR] = 11.60; 95% confidence interval [CI] = 2.15 to 62.5; P = 0.004) and intensive care unit (ICU) admission (OR = 7.38; 95% CI = 1.20 to 45.3; P = 0.031).

Conclusions: ***Peritonitis among children is common and bears significant morbidity and mortality at our centre. Training of healthcare providers in district hospitals for early recognition of peritonitis, and improved ICU care availability may reduce mortality secondary to peritonitis in children.***

Keywords: epidemiology, peritonitis, paediatric surgery, Rwanda

Introduction

The contamination of the peritoneal cavity can lead to a cascade of infection, sepsis, multisystem organ failure and death if not treated early and efficiently.[3,4] The diagnosis is often delayed or even missed, leading many patients to deteriorate and develop septic shock and organ failure. Successful management of peritonitis requires timely surgical intervention to control or eliminate the source of the intra-abdominal infection and to decrease contamination of the peritoneal cavity, along with appropriate antimicrobial therapy. There are various surgical options to choose from, depending on the source of the infection, the severity of peritoneal contamination and inflammation, the degree of septic deterioration, and the patient's previous state of health.[2] Even with ideal treatment, peritonitis-associated morbidity and mortality (ranging from 10% to 20%) are high.[5,6]

The aetiology of peritonitis in adults in developing countries tends to be different from that in Western countries. Whereas in high-resource settings peritonitis most commonly occurs due to lower gastrointestinal (GI) perforations (such those secondary to diverticulitis), upper GI perforations (especially peptic ulcer perforations) are more common in low-resource areas.[8] On the other hand, it is less clear if the causes of childhood peritonitis differ in high versus low-resource settings. In Rwanda specifically, there is a paucity of data regarding the aetiology of peritonitis in children. We aimed to identify the common causes of peritonitis in children and factors affecting related morbidity and mortality.

Methods

We conducted a prospective observational study at the Department of Surgery at University Teaching Hospital of Kigali (Centre Hospitalier Universitaire de Kigali, CHUK), a teaching and referral hospital in Rwanda, over 6 months (1 September 2015 to 28 February 2016). The study population included all paediatric surgical patients admitted and operated on with a preoperative or postoperative diagnosis of peritonitis during the study period. We attempted to enrol eligible participants within the first 24 hours of the postoperative period. We excluded patients who underwent laparotomy at another hospital.

At the initial visit, the study team documented relevant data, including sociodemographic characteristics, symptoms, investigations and results, preoperative and postoperative diagnoses, intraoperative findings, and definitive surgical procedure. For analysis, age groups were stratified based on Food and Drug Administration (FDA) guidelines. Patients were followed throughout their hospital stay to ascertain whether any complications occurred and whether the patient survived to discharge.

Data were recorded using EpiData software and analysed using SPSS version 16.0. We extracted descriptive demographic data tables and cross-tabulations directly from SPSS; charts and figures were obtained using SPSS. Variables with significant associations were compared with outcome variables, including mortality and complications, to draw their correlation with mortality and morbidity using Pearson's chi-square test. We conducted a bivariate analysis to determine variables associated with increased mortality risk. Factors with P-values < 0.10 on bivariate analysis were included in a multivariate logistic regression model. P-values < 0.05 on multivariate analysis were considered statistically significant.

Table 1: Patient characteristics

		n	%
Age	1 month - 2 years	10	16
	2-12 years	33	52
	12-15 years	20	32
Gender	Male	35	56
	Female	28	44
Symptom duration	> 7 days	18	29
	≤ 7 days	45	71
Symptoms	Fever	40	63
	Abdominal pain		
	Abdominal distension	23	37
	Nausea/vomiting	44	67
	Stool and gas arrest	24	38
	Diarrhoea	23	37
Diagnosis	Appendiceal perforation	16	25.4
	Gangrenous intussusception	15	23.8
	Typhoid ileal perforation	11	17.5
	Perforation of gangrenous ileal obstruction	6	9.5
	Traumatic ileal perforation	6	9.5
	Primary peritonitis	4	6.3
	Pelvic inflammatory disease	3	4.8
	Liver/biliary empyema	2	3.2
Primary surgeon	Resident	50	79
	Faculty	13	21
Complications	Malnutrition	14	22
	Sepsis	13	21
	Intra-abdominal abscess	7	11
	Surgical site infection	5	8
	Respiratory distress	4	6
	Fascial dehiscence	4	6
Reoperation		8	13
Intensive care unit admission		13	21
Mortality		14	22

Results

From 1 September 2015 to 28 February 2016, 64 children were treated surgically for peritonitis at CHUK. We excluded 1 patient who was not discharged by the end of the study period. Tables 1A and 1B show the patients' characteristics and outcomes of management. Of 63 patients, 28 were female, with a male-to-female ratio of 1.25:1 (Table 1). Their ages ranged from 4 months to 15 years, with a mean of 8.8 years (standard deviation [SD] = 5.2 years) and a median of 10 years (interquartile range [IQR] = 4, 14). The majority of patients (84%) were between 2 and 15 years old. Seventy-three percent of patients presented within the first week of symptom onset.

Appendicular perforation (n = 16; 25.4%) and gangrenous intussusception (n = 15; 23.8%) were found to be the most common causes of peritonitis in among study patients, followed by typhoid

Table 2: Comparison of patients with and without complications

		No complications n (%)	Complications n (%)	P-value
Age	1 month-2 years	6 (19)	4 (13)	0.813
	2-12 years	16 (50)	17 (55)	
	12-15 years	10 (31)	10 (32)	
Gender	Male	16 (50)	19 (61)	0.367
	Female	16 (50)	12 (39)	
Symptom duration	> 7 days	27 (84)	18 (58)	0.021
	≤ 7 days	5 (16)	13 (42)	
Symptoms	Fever	20 (63)	20 (65)	0.868
	Abdominal pain	29 (91)	30 (97)	0.513
	Abdominal distension	11 (34)	12 (39)	0.721
	Nausea/vomiting	26 (81)	18 (58)	0.045
	Stool and gas arrest	10 (31)	14 (45)	0.256
	Diarrhoea	11 (34)	12 (39)	0.721
Diagnosis	Appendiceal perforation	11 (34)	5 (16)	0.046
	Gangrenous intussusception	7 (22)	8 (26)	
	Typhoid ileal perforation	1 (3)	10 (32)	
	Perforation of gangrenous ileal obstruction	4 (13)	2 (6)	
	Traumatic ileal perforation	2 (6)	4 (13)	
	Primary peritonitis	3 (9)	1 (3)	
	Pelvic inflammatory disease	2 (6)	1 (3)	
	Liver/biliary empyema	2 (6)	0	
Primary surgeon	Resident	21 (66)	29 (94)	0.006
	Faculty	11 (34)	2 (6)	
Reoperation		0	8 (26)	0.002
Intensive care unit admission		1 (3)	12 (39)	< 0.001
In-hospital mortality		2 (6)	12 (39)	0.002

ileal perforation (n = 11; 17.5%) and perforated traumatic or obstructed ileum (n = 6; 9.5%). The least common cause of peritonitis was that of liver or biliary origin (n = 2; 3.2%). Length of hospital stay varied between 1 and 28 days, with a mean of 12.1 ± 5.7 days. For nearly half of the patients (44.4%), hospital stay was between 8 and 14 days; 34.9% of patients were admitted for > 15 days, while 20.6% stayed between 1 and 7 days.

Thirty-one patients had a complication (Table 2). Malnutrition and electrolyte imbalance was the most registered complication (n = 14; 22%); followed by sepsis and septic shock (n = 13; 21%); surgical site infection (n = 5; 8%); respiratory complications (n = 4; 6%); and fascia dehiscence (n = 4; 6%).

On multivariate analysis, factors associated with complications were resident serving as the primary surgeon (odds ratio [OR] = 29.49; 95% confidence interval [CI] = 1.28 to 680.53; P = 0.035) and intensive care unit (ICU) admission (OR = 15.21; 95% CI = 1.40 to 165.33; P = 0.025) (Table 3).

Table 3: Multivariate analysis of factors associated with complications

	Adjusted odds ratio	95% confidence interval	P-value
Symptoms > 7 days	2.44	0.44 to 13.50	0.306
Nausea/vomiting	0.71	0.14 to 3.70	0.686
Diagnosis	1.28	0.98 to 1.68	0.071
Resident surgeon	29.49	1.28 to 680.53	0.035
ICU admission	15.21	1.40 to 165.33	0.025

Table 4: Multivariate analysis of factors associated with mortality

	Adjusted odds ratio	95% confidence interval	P-value
Nausea/vomiting	0.60	0.11 to 3.28	0.55
Sepsis	11.60	2.15 to 62.50	0.004
ICU admission	7.38	1.20 to 45.30	0.031

On multivariate analysis, factors associated with mortality were sepsis (OR = 11.60; 95% CI = 2.15 to 62.5; P = 0.004) and ICU admission (OR = 7.38; 95% CI = 1.20 to 45.3; P = 0.031) (Table 4).

There were 14 deaths (22.2%) (Table 5). Eight patients (57.1%) died in the ICU. Trauma was implicated in 28.6% of all deaths; 66.7% of trauma patients died. All study patients operated on by surgical trainees died. Mortality was 64% among patients diagnosed with sepsis at admission, 57% among children who required ICU admission postoperatively, 43% among children admitted 7 or more days after symptom onset, and 43% among those presenting with intractable nausea and vomiting.

Table 5: Comparison of survivors and non-survivors

		Survivors n (%)	Non-survivors n (%)	P-value
Age	1 month-2 years	8 (16)	2 (14)	0.571
	2-12 years	24 (49)	9 (64)	
	12-15 years	17 (35)	3 (21)	
Gender	Male	29 (59)	6 (43)	0.278
	Female	20 (41)	8 (57)	
Symptom duration	> 7 days	12 (24)	6 (43)	0.180
	≤ 7 days	37 (76)	8 (57)	
Symptoms	Fever	30 (61)	10 (71)	0.484
	Abdominal pain	47 (96)	12 (86)	0.147
	Abdominal distension	19 (39)	4 (29)	0.484
	Nausea/vomiting	38 (76)	6 (43)	0.013
	Stool and gas arrest	18 (37)	6 (43)	0.677
	Diarrhoea	19 (39)	4 (29)	0.484
Diagnosis	Appendiceal perforation	14 (29)	2 (14)	0.219
	Gangrenous intussusception	13 (27)	2 (14)	
	Typhoid ileal perforation	8 (16)	3 (21)	
	Perforation of gangrenous ileal obstruction	5 (10)	1 (7)	
	Traumatic ileal perforation	2 (4)	4 (29)	
	Primary peritonitis	3 (6)	1 (7)	
	Pelvic inflammatory disease	2 (4)	1 (7)	
	Liver/biliary empyema	2 (4)	0	
Primary surgeon	Resident	36 (73)	14 (100)	0.031
	Faculty	13 (27)	0	
Complications	Malnutrition	12 (24)	2 (14)	0.418
	Sepsis	4 (8)	9 (64)	< 0.001
	Intra-abdominal abscess	6 (12)	1 (7)	0.592
	Surgical site infection	4 (8)	1 (7)	0.901
	Respiratory distress	3 (6)	1 (7)	0.890
	Fascial dehiscence	3 (6)	1 (7)	0.890
Reoperation		7 (14)	1 (7)	0.479
Intensive care unit admission		5 (10)	8 (57)	< 0.001

Discussion

Peritonitis is a commonly encountered paediatric surgical emergency in Rwanda, as it is in other developing countries.[9] In most cases, patients with well-established peritonitis present late to hospital. Thus, purulent and faecal contamination leads to varying degrees of abdominal sepsis, with typical signs and symptoms making it possible to make a clinical diagnosis of peritonitis for almost all patients.

In our study, the principal causes of peritonitis in paediatric patients were appendicular perforation, gangrenous intussusception, and typhoid ileal perforation. Prior studies in Rwanda found ileal perforation to be a common cause of peritonitis.[9] Perforated appendix has been reported as the most common cause of peritonitis in children in Nigeria.[10,11] In contrast, the prevalence of perforated appendix among paediatric peritonitis cases has been as low as 11.6% in West Africa[7] and 9% in Pakistan.[2] Our results are similar to findings in the study carried out in Pakistan,[2] where typhoid ileal perforation was found to cause peritonitis in 17% of cases. Surgical management, which included bowel resection and anastomosis, stoma creation, and closure of perforations, was dependent on the intraoperative findings and to the surgeon's judgment, and the options adopted were similar to those reported in other studies.[1,7,10]

The rate of mortality found in our study (22.2%), was comparable to results found in other studies in Africa, as it was found to be 20% in studies done in Nigeria.[10,11] Contrary to results of other studies done in children,[10,11] younger age was not associated with mortality in our sample. Mortality in trauma was 66.7%, but this was not statistically significant; however, other studies in developing countries found lower figures, ranging from 10% to 20%.[7,8]

Postoperative ICU admission and sepsis were associated with mortality on multivariate analysis, possibly related to illness severity and dehydration with electrolyte derangements contributing to mortality.[8] Future research should consider focusing on trauma-related peritonitis in children and causes of mortality among (paediatric) peritonitis patients, including in the ICU setting.

Sepsis and delayed presentation were associated with mortality, similar to findings from elsewhere.[2,8] Reinforcement of training of healthcare providers in district hospitals for early recognition of peritonitis (especially in trauma) could help reduce paediatric mortality secondary to peritonitis. The massive surgical training programme and reinforcement of health facility infrastructure and human resource capacity throughout the country provide hope for improved outcomes for children with peritonitis.

Study limitations

This study had several limitations. This was an observational study; we assumed that patients entered in the study received reasonably standard care based on their diagnosis. However, system-related problems may have led to inadequate management, thus contributing negatively to outcomes. We could not histologically confirm the causes of ileal perforation in our study, but clinically they looked like typhoid perforation. Also, constraints of study period limited us to reporting short-term outcomes.

Conclusions

Peritonitis among paediatric patients at CHUK is one of the most common causes of admission to the surgical department, and it causes significant morbidity and mortality. Challenges and factors

associated with increased morbidity and mortality were delayed transfer of patients from district hospitals, delayed surgery, inadequate skills of operators, postoperative sepsis, and severe illness requiring ICU postoperatively. Other factors, such as tachycardia, the cause of peritonitis, nausea and vomiting, economic status, and malnutrition were significantly associated with increased morbidity and prolonged length of hospital stay; these could be regarded as also influencing the overall outcome. However, a multi-institutional study covering the country's other surgical centres and more patients would further validate our findings.

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