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Acute Appendicitis in a Developing Country

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Abstract
Background This prospective audit of appendicitis at a busy regional hospital reviews the spectrum and outcome of acute appendicitis in rural and peri-urban South Africa.
Method We conducted a prospective audit from September 2010 to September 2011 at Edendale Hospital in Pietermaritzburg, South Africa.
Results Over the year under review, a total of 200 patients with a provisional diagnosis of acute appendicitis were operated on at Edendale Hospital. There were 128 males (64 %) in this cohort. The mean duration of illness prior to seeking medical attention was 3.7 days. Surgical access was by a midline laparotomy in 62.5 % and by a Lanz incision in 35.5 %. Two percent of patients underwent a laparoscopic appendicectomy. The operative findings were as follows: macroscopic inflammation of the appendix without perforation in 35.5 % (71/200) and perforation of the appendix in 57 % (114/200). Of the perforated appendices, 44 % (51/114) were associated with localised intra-abdominal contamination and 55 % (63/114) had generalised four-quadrant soiling. Thirty percent (60/200) required temporary abdominal closure (TAC) with planned repeat operation. Major complications included hospital-acquired pneumonia in 12.5 % (25/200), wound dehiscence in 7 % (14/200), and renal failure in 3 % (6/200). Postoperatively 89.5 % (179/200) were admitted directly to the general wards, while 11 % (21/200) required admission to the intensive care unit. The overall mortality rate was 2 % (4/200).
Conclusions The incidence of acute appendicitis amongst African patients seems to be increasing. Although it is still lower than the reported incidence amongst patients in the developed world, it is a common emergency that places a significant burden on the South African health service. The disease presents late and is associated with a high incidence of perforation which translates into significant morbidity and even mortality.

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Introduction

Appendicitis remains the commonest abdominal surgical emergency in the developed world, with an estimated incidence of about 52 cases per 100,000 head of population [1–3]. South African series from the last quarter of the 20th century estimated that 10 % of the white population had undergone appendicectomy, whereas <1 % of the African population required the operation [4–7]. The estimated incidence of appendicitis amongst Africans was on the order of 10 per 100,000 head of population. This difference in incidence is usually ascribed to different dietary habits, with people from the developing world consuming a diet low in fat and high in fibre [8, 9].

In the developed world the management of appendicitis has come to rely heavily on advanced radiological imaging [10]. This has led to earlier diagnosis and a number of reports of the successful nonoperative management of acute appendicitis [11–13]. In the developing world, however, appendicitis remains a surgical disease with late

presentation and delayed definitive care [14]. This translates into major morbidity and even mortality [15]. This prospective audit of appendicitis at a busy regional hospital reviews the spectrum and outcome of acute appendicitis in rural and peri-urban South Africa.

Method

This was a prospective study conducted from September 2010 to September 2011 at Edendale Hospital in Pietermaritzburg, South Africa. All patients who were operated on for suspected acute appendicitis were included in the study. Consent to take part in this audit was obtained from all the patients. Data were collected by patient interview, as well as from hospital records and entered into a spreadsheet. Basic demographic data included the mode of presentation of each patient. There were four modes of presentation, namely, direct self-referral to the hospital emergency department, referral from a general practitioner, referral from the local community health clinic, or referral from one of the four rural district hospitals that feed to Edendale Hospital. Patients were specifically asked about their health-care-seeking behaviour. They were asked about the onset and duration of symptoms prior to seeking contact with the health-care system. The clinical symptoms, physical examination findings, baseline vital signs, and laboratory results were recorded. Clinical details noted included the type of incision, macroscopic appearance of the appendix, the presence of appendiceal perforation, the degree of abdominal contamination, the need for temporary abdomen containment, and the need for repeat operation. The clinical course of each patient was closely followed up until discharge. This included the type and nature of any major complication, the need for repeat operation, and admission to the intensive care unit (ICU). The total length of ICU stay and hospital stay were recorded. The need for repeat operation was classified as planned or unplanned.

Results

Over the year under review, a total of 200 patients with a provisional diagnosis of acute appendicitis were operated on at Edendale Hospital. There were 128 males (64 %) and 72 females (36 %) in this cohort. The mean age of presentation was 21.5 years for males and 22.2 years for females. Most patients, 43.5 % (87/200), were self-referrals who presented directly to the emergency department. A further 19 % (38) were referred from the surrounding primary health-care clinics and 2.5 % (5/200) were referred from local general practitioners. Referrals from the four rural referral hospitals constituted 35 % (70/200) of all admissions.

Clinical presentation

The mean duration of illness prior to seeking medical attention was 3.7 days. The most common symptoms were nausea and or vomiting (81 %), anorexia (68.5 %), and nonmigratory generalised abdominal pain (68 %). Only 33 % of patients described the classic migratory abdominal pain described in standard textbooks. Diarrhoea was reported in 12 % of patients, constipation in 6 %, and dysuria in 4 %. On presentation, 39 % had tenderness localised to the right iliac fossa, 21 % had localised peritonitis, and 40 % had generalised peritonitis. Mean temperature on admission was 37.5 °C, mean heart rate was 102 beats/min, and mean white cell count was 15.1.

Management and operative findings

Surgical access was by a midline laparotomy in 62.5 % and by a Lanz incision in 35.5 %. Two percent of patients underwent a laparoscopic appendicectomy. The operative findings were as follows: macroscopic inflammation of the appendix without perforation in 35.5 % (71/200) and perforation of the appendix in 57 % (114/200). Of the perforated appendices, 44 % (51/114) were associated with localised intra-abdominal contamination and 55 % (63/114) had generalised four-quadrant soiling. In 7.5 % (15/200), pathologies other appendicitis were identified, including pelvic inflammatory disease (10), perforated Meckel's diverticulum (1), perforated duodenal ulcer (1), perforated gastric ulcer (1), perforated jejunum of unknown aetiology (1), and perforated terminal ileum secondary to tuberculosis (1).

Clinical course

Thirty percent (60/200) required temporary abdominal closure (TAC) with planned repeat operation. Of the 60 patients who required TAC, 58 (96.7 %) underwent the planned repeat operation and 2 died before the surgery. Of the 140 patients who underwent primary abdominal wall closure, 13 (9 %) required an unplanned repeat operation due to on-going sepsis. Major complications included hospital-acquired pneumonia in 12.5 % (25/200), wound dehiscence in 7 % (14/200), and renal failure in 3 % (6/200). One patient developed an enterocutaneous fistula and two patients developed adult respiratory distress syndrome in the ICU. Postoperatively, 89.5 % (179/200) were admitted directly to the general wards, while 11 % (21/200) required admission to the ICU. The overall mortality rate was 2 % (4/200). All four patients who died had four-quadrant intra-abdominal contamination and all required initial ICU admission. Overall mean length of hospital stay for all patients was 6.1 days (median = 5 days).

Subgroup analysis

The 185 patients with confirmed appendicitis were further subdivided into two groups based on the presence or absence of perforation. In those without perforation, the mean duration of illness prior to seeking medical attention was 2.7 days, while the mean duration of illness for those with perforation was 4.4 days. All 21 patients who were admitted to the CU had perforation associated with four-quadrant soiling. Mortality was confined to this group. The mean length of hospital stay was 2.5 days for patients without perforation and 8.5 days for patients with perforation.

Estimations of incidence

Edendale Hospital drains two health districts, namely, the rural Sisonke district and the urban and peri-rural Umgungundlovu district. According to the South Africa census data of 2001, the Sisonke district has 300,000 inhabitants and the Umgungundlovu district has 1,000,000 inhabitants. No other hospitals in our drainage area perform appendicectomy. This allowed an incidence of acute appendicitis per 100,000 of the population to be estimated based on the census data. Using the 2001 census data, we estimate a population incidence of acute appendicitis of 15 per 100,000 of the population in our drainage area.

Discussion

Acute appendicitis remains the commonest general surgical emergency in the developed world [1]. However, in the developing world the incidence is lower [2]. The reported incidence in the UK is 52 cases per 100,00 head of population [2]. The incidence amongst African patients in South Africa was previously reported to be approximately 9 per 100,000 head of population. Walker and Segal [2] stated that appendicitis was rare amongst rural Africans in South Africa. According to them, in 1986 at Murchison Hospital, in southern KwaZulu-Natal (KZN), there were only seven cases of acute appendicitis out of 8,000 admissions and a potential population draining to the hospital of 200,000 people. At the same time, at Baragwanath Hospital in Soweto, a large urban conurbation, there were only 210 patients with appendicitis out of a total of 24,000 surgical admissions [16]. The population of Soweto at the time was estimated to be 2.5 million people. Walker and Segal [2] estimated a rate of 8.2 cases per 100,000 of population in the mid-1980s. By 1994, they estimated the rate of appendicitis in Soweto to be about 9.5 cases per 100,000. This was still one-tenth the rate in Sweden. A study from the Eastern Cape Province of South Africa in 2006 [17] estimated an incidence of 15 cases per 100,000. This is similar to our own estimate and would support the contention that the incidence amongst African patients is increasing. It is now believed that the change in diet of the population is well established and that we will begin to see a much more Western pattern of disease [8, 9].

Despite the relatively lower incidence of the disease in South Africa, there is a significant burden on hospitals that deal with the pathology. In Frere Hospital [17] in East London, there are a total of 17 cases of acute appendicitis a month. The average at our institution is also 17 a month. The reported average number of cases a month from KEVIII hospital in Durban [7] was lower at slightly over 10 a month. However, that study was a retrospective review over 5 years and was undertaken more than a decade ago.

Although appendicitis in Africa has a lower incidence than in the developed world, it generally has a far more serious clinical course [15, 18, 19]. The vast majority of patients in this audit waited at least 72 h before seeking any form of medical attention. In an earlier retrospective series from Durban [20], the average delay in presentation was 3.6 ± 5.6 days. This was similar to the audit from East London [17], which also demonstrated long delays. In the developed world the average duration of symptoms prior to presentation to the emergency department is 15 h or less [21]. The reasons for late presentation in our setting are multifactorial and include cultural factors as well as difficulty in accessing health-care services. Our study has also demonstrated a perforation rate of 54 %. Other South African audits report similar rates ranging from 43 to 51 % [3, 7, 17, 20]. Table 1 provides the comparative South African data. Table 2 is adapted from Rogers et al. [17] and shows the equivalent data from the developed world [22–26]. The perforation rate in the developed world is less than half of that in South Africa.

It was thought that the risk of perforation was relatively low during the first 36 h following the onset of symptoms [27] but increased dramatically by 5 % for each 12-h period thereafter [28]. The early administration of

Table 1 The sub-Saharan African experience with acute appendicitis (adapted from [17])

City/Country	Year	Perforation rate (%)	Normal appendicectomy rate (%)	No. per month
Kumasi, Ghana [18]	1996	39	26	NA
Johannesburg [3]	1997	22	21	NA
Durban (KEVIII) [7]	1998	43	9	10
Durban (PMH) [20]	2009	34	17	15
East London [17]	2009	51	21	17
Pietermaritzburg	2012	57	10	17

Table 2 The developed world's experience with acute appendicitis (adapted from [17])

City/Country	Year	Perforation rate (%)	Normal appendicectomy rate (%)
Reading, UK [24]	1993	18	15
Calgary, Canada [26]	1995	16	14
Los Angeles, USA [25]	1997	28	9
Washington, USA [23]	1997	21	13
Wellington, NZ [22]	2006	14	21

intravenous fluid and antibiotic therapy may in select cases avert the need for surgical intervention. It has been shown that children in hospital where operation was deferred for up to 12 h had no increase in adverse outcomes [29]. A similar study from the US demonstrated that in-hospital deferral of appendicectomy between 12 and 24 h after presentation does not significantly affect the clinical outcome [30]. However, other authors have shown that the incidence of perforation may start increasing significantly at even less than 12 h following the onset of symptoms [31]. Generally, most clinicians would be guided by their clinical findings. Early uncomplicated appendicitis may well benefit from a 12–24-h period of medical therapy and repeated observation [32]. Clinical deterioration would prompt surgery but an improvement may allow for successful nonoperative therapy [33]. However, these data cannot easily be extrapolated to our environment. Our patient cohort experienced a cumulative delay far longer than any described in the literature from the developing world, and it is doubtful whether the algorithms from the developed world can be applied to our situation.

Only a small proportion of our patients presented with the classic migratory abdominal pain. The most common symptoms encountered were all nonspecific, with generalised peritonitis frequently present. These findings were similar to those previously reported from Durban [7, 20]. The nonspecific nature of these symptoms has implications for the clinical assessment of African patients. The negative appendicectomy rate of 10 % in our study was comparable to that of other studies from South Africa, as was the incidence of pathology other than appendicitis as a cause for abdominal pain. The majority of these cases were females who had peritonitis associated with severe pelvic inflammatory disease, which were difficult to differentiate from complicated appendicitis. Female patients between the ages of 13–40 tend to have the highest diagnostic error rate [34]. Gynaecological assessment and the appropriate use of imaging may help to define the pathology better and avoid unnecessary surgery. The high incidence of infective diseases such as abdominal tuberculosis, worm infestation, amoebiasis, schistosomiasis, and typhoid that present with nonspecific abdominal pain makes it difficult to establish a firm clinical diagnosis of acute appendicitis. The differential diagnosis of abdominal pain in our environment is much broader than in the developed world [35]. In two patients in our series there was a small bowel perforation due to tuberculosis and one of uncertain aetiology, possibly either tuberculosis or trauma. In some cases of abdominal tuberculosis, operative intervention is unnecessary or even contraindicated, making it even more important to make the distinction [35].

Although Madiba et al. [7] did not feel that delay was associated with perforation, our findings suggest the opposite. We found that long delay to definitive therapy is associated with perforation, which is in turn associated with the need for reoperation and for ICU admission. Four-quadrant soiling was associated with mortality. Patients with perforation had a significantly longer hospital stay than those without perforation.

Surgical access was predominantly via a midline laparotomy, whereas only 2 % of patients underwent laparoscopic appendicectomy. Table 3 summarizes the South African data. The use of midline laparotomy reflects the fact that these patients presented with established diffuse peritonitis. Temporary abdominal containment (TAC) is seldom required in series from the developed world. However, in our experience TAC was necessary in just under one third of our patients. We find that the use of a plastic fluid bag sutured to the skin is the most reliable method of TAC as the bowel is often grossly distended [36]. The sutureless approach of the so-called "Opsite sandwich" preserves the skin edges but cannot contain the grossly distended bowel and needs to be replaced within 48 h. All of the patients in the TAC group were subjected to planned repeat operation. Of the group that underwent primary abdominal closure, 6 % required one or more unplanned repeat operations, which tends to support our aggressive approach with planned repeat operation. However, evidence supporting planned repeat operation or "on-demand" repeat operation remains conflicting. A previous meta-analysis [37] suggested a reduction in mortality in the on-demand laparotomy group, but a recent meta-analysis [38] demonstrated no difference in mortality. The only difference appeared to be related only to the reduced

Table 3 Comparative data for surgical access in South Africa

Study	Year	Lanz	Laparotomy	Laparoscopy
KEVIII [7]	1998	NA	NA	NA
Frere [17]	2006	82 %	18 %	Nil
PMH [20]	2009	NA	47 %	Nil
Edendale	2012	36 %	60 %	2.7 %

Table 4 Comparative data between the US Department of Defense [23] and the current study

Comparative data	US Department of Defense	Edendale
Year	1997	2010–2011
Patients	4950	200
Centres	197	1
Number per centre per year	25	200
Mortality	0.08 %	2 %
ICU	NA	11 %
Reoperation rate	27(0.5 %)	29 %
Temporary abdominal containment	NA	30 %

number of relaparotomies required and the associated health-care cost.

Our approach to the management of abdominal sepsis can be summarised by the adage that we have a low threshold for surgical re-exploration. We tend to invert the thinking process surrounding this decision by saying that the patient needs to earn the right not to have a repeat operation rather than earn the right to have one. Four-quadrant soiling, extensive faecal soiling, ischaemic bowel, and TAC remain our major indications for planned repeat operation. In all other patients we would be prepared to observe the patient and have a low threshold for a return to theatre. TAC, reoperation, and ICU admission must be considered major morbidity in the management of acute appendicitis. Table 4 compares our data with pooled data from the US Department of Defense [23] from a decade earlier. Reoperation, ICU admission, and the use of TAC is uncommon in the developed world and reflects the fact that our patients experience long delays in definitive treatment.

There is a growing realization that surgical care is an integral part of primary health care, and a variety of tools have been developed with the intention of improving surgical care in developing countries. Many of these tools measure inputs into the health-care system but do not measure outputs. There is a need to develop tools to monitor system outputs. Maternal and child health-care services use crude statistics to assess the quality of output of a system. Acute appendicitis is a disease that may allow for the development of a qualitative measure of output of a surgical system. It is a common disease that is treatable by a relatively straightforward surgical intervention and definitive treatment is curative. A number of outcomes of acute appendicitis may be useful as markers of quality of surgical care. These potential metrics include delay to definitive treatment, perforation rates, laparotomy rates, reoperation rates, ICU admission rates, and open abdomen rates. The routine collection of data on acute appendicitis may be a useful measure of the quality of surgical care across a rural health district.

Conclusion

The incidence of acute appendicitis amongst African patients seems to be increasing. Although it is still lower than the reported incidence amongst patients in the developed world, it is a common emergency that places a significant burden on the South African health-care service. The disease presents late and is associated with a high incidence of perforation which translates into significant morbidity and even mortality. Identifying and addressing the reasons for these long delays may help reduce the burden of preventable morbidity that is currently associated with acute appendicitis in South Africa. We suggest that the routine collection of basic data about acute appendicitis may well provide managers with a tool to measure the output of a surgical system.

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