ORIGINAL ARTICLE

Acute Appendicitis — The University Hospital Experience

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Summary

A 1 year review of 529 cases of acute appendicitis, treated at the University Hospital in 1990, was performed. Perforation rate was 23.7% and delay in diagnosis was found to be significant. Patients above 50 years of age were particularly at risk. Diagnostic error was 19.3% and it was a problem not only in young women but also in children. Temperature and rectal examinations were not found to be helpful in the diagnosis in contrast to leukocytosis. Waiting time for operation was long (median 7 hours), be it for a perforated or a nonperforated appendicitis.

Key words: Acute appendicitis, diagnostic error, perforation.

Introduction

Acute appendicitis is one of the commonest surgical emergencies. However, the diagnosis is not always easy, often resulting in either an unnecessary operation or a perforated appendicitis.

Urgent appendicectomy is the accepted treatment to prevent perforation, which is the single most important factor in morbidity and mortality[1]. This has markedly reduced the morbidity but has led to an increase in diagnostic error rate.

This paper presents the results of a review of all cases of acute appendicitis treated with appendicectomy at the University Hospital with particular interest in diagnostic error and perforation rates.

Method

Of the total 555 patients subjected to emergency appendicectomy from 1 January 1990 to 31 December 1990, only 529 case notes were available for review. All data were collected into pre-designed data compilation sheets. Information on sex, age, race, duration of abdominal pain prior to presentation, temperature, leukocyte count, per rectal examination, operative findings and time lapse from diagnosis to operation were recorded. Pathological specimens were reviewed by a pathologist. Appendix was reported as normal, acute, suppurative, gangrenous or perforated appendicitis, according to preset criteria. However, where there was an intraoperative finding of a perforated appendicitis or an appendicular abscess, this was the final diagnosis. Diagnostic error refers to the removal of an appendix without any evidence of acute inflammation. Perforated appendicitis in this analysis includes all cases of appendicular abscesses.

Chi square was used for statistical analysis.

Results

A. General

There were 301 males and 228 females. Race and sex distribution is shown in Table I. The ages ranged from 4 to 77 years, with a median of 27 years. Incidence by hospital discharges was 1.4% and it constituted 34% of all general surgical emergency operations.

Table I
Distribution by race and sex

Race	Male	Female	Total	(%)
Malay	120	90	210	(39.7%)
Chinese	123	90	213	(40.2%)
Indian	49	44	93	(17.6%)
Others	9	4	13	(2.5%)
Total	301 (56.9%)	228 (43.1%)	529	(100%)

From the 529 patients operated on for acute appendicitis, 427 were confirmed histologically.

Age distribution for male and female was comparable, as shown in Fig 1. Male to female ratio was 1.7:1 and corrected to the total hospital discharges, the incidence of acute appendicitis in males was significantly higher than that in females ($p<0.001$).

Amongst the 3 major ethnic groups, the highest incidence of acute appendicitis was found amongst the Chinese, followed by Malays and Indians (Table II). The differences observed were all significant ($p<0.025$).

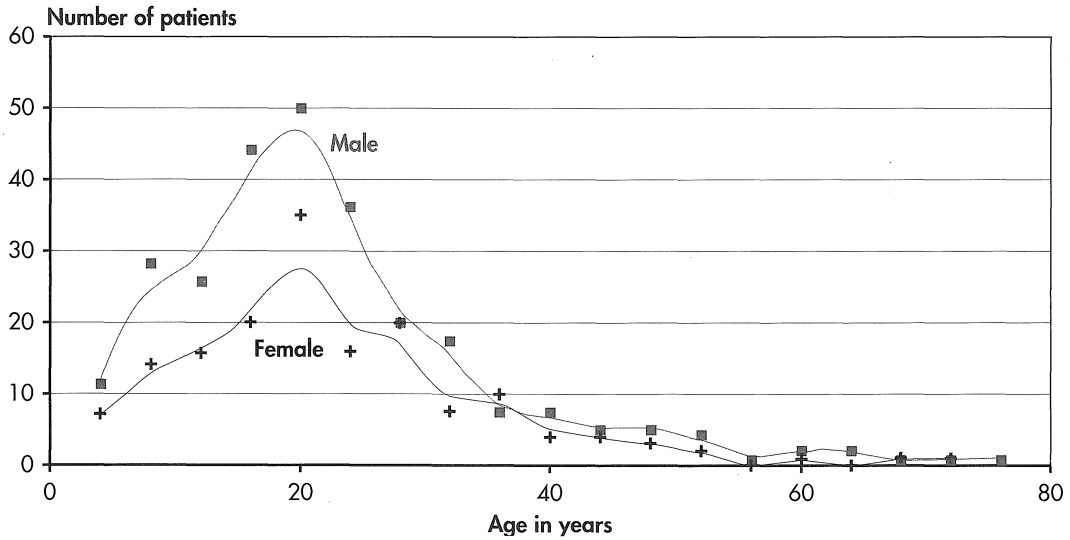


Fig 1: Appendicitis – age distribution.

Table II
Incidence by hospital discharges

Malay	1.1%	(166/14,662)
Chinese	1.5%	(182/12,497)
Indian	0.7%	(68/9,153)
Others	2.2%	(11/510)
Male	1.7%	(266/15,383)
Female	0.8%	(161/21,439)

B. Diagnostic error

A total of 102 patients had noninflammed appendices removed, giving a diagnostic error rate of 19.3%. Details of pathological findings in these patients are presented in Tables III and IV. Table V shows that diagnostic error was significantly higher in females compared to males ($p<0.001$) and also in Indians compared to Chinese ($p<0.025$). Differences amongst the others were not significant ($p>0.05$).

Table III
Operative findings in negative cases

No definite pathology	81
Pathology outside the appendix	21
Total	102

Table IV
Diagnosis on discharge in negative cases

No diagnosis	68
Urinary tract infection	6
Acute gastroenteritis	3
Worm infestation	3
Dengue fever	1
Negative operative findings:	81
Gynaecologic in origin	13
Terminal ileitis	1
Meckel's diverticulum	1
Mesenteric adenitis	4
Intestinal obstruction	1
Abdominal wall abscess	1
Findings outside appendix:	21
Total	102

Table V
Diagnostic error by race and sex

Malay	(44)	20.9%
Chinese	(31)	14.6%
Indian	(25)	26.9%
Others	(2)	15.4%
Male	(35)	11.6%
Female	(67)	29.4%

When patients were subdivided into 4 different groups for further analysis as shown in Table VI, error rates were significantly higher amongst children ($p<0.01$) and females around the reproductive age ($p<0.001$) in comparison to male patients 11 to 50 years old. Patients above 50 years also appeared to have a higher diagnostic error but the difference was not significant ($p>0.5$).

Table VI
Diagnostic error by group

Children	<=10 years	(17/70)	24.3%
Male	11 - 50 years	(27/247)	10.9%
Female	11 - 50 years	(55/193)	28.5%
All	>50 years	(3/19)	15.8%

C. Perforated appendicitis

Overall perforation rate was 23.7%. No significant difference was observed amongst the 3 major races (see Table VII, $p>0.05$). Male and female patients had no significant difference ($p>0.5$). In the various age groups, perforation was highest at both extremes (Fig 2).

Table VII
Perforation by race and sex

Malay	(46/166)	27.7%
Chinese	(37/182)	20.3%
Indian	(13/68)	19.1%
Other	(5/11)	45.5%
Male	(65/266)	24.4%
Female	(36/161)	22.4%

Table VIII shows that perforation rates were significantly lower in females around the reproductive age ($p<0.05$) and higher in patients above 50 years ($p<0.05$) when compared to male patients aged 11-50 years. Children appeared to have a higher perforation rate too, but it was not significant ($p>0.25$).

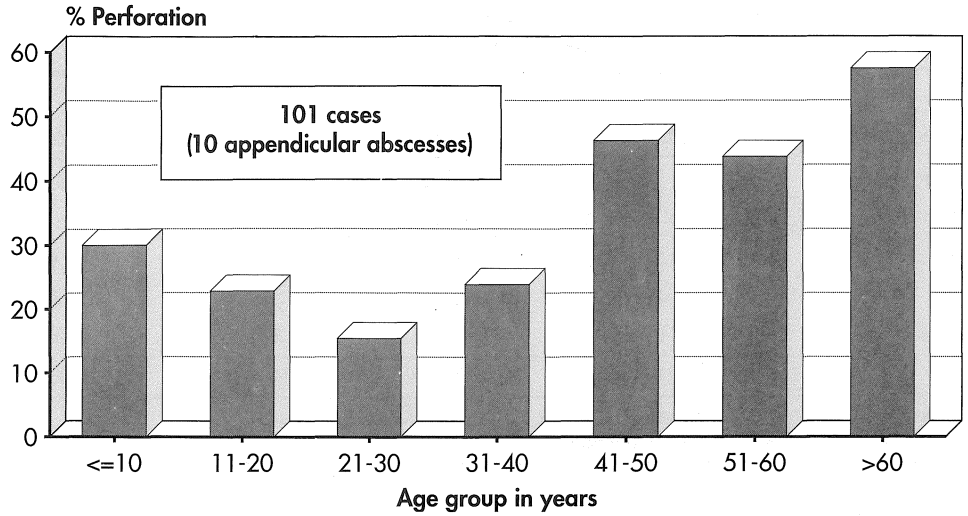


Fig 2: Perforation by age group.

Table VIII
Perforation by groups

Children	<=10 years	(16/53)	30.2%
Male	11 - 50 years	(55/220)	25.0%
Female	11 - 50 years	(22/138)	15.9%
All	>50 years	(8/16)	50.0%

D. Per rectal examination (PR)

Rectal examination was performed in 309 out of the 529 cases. Out of the 248 inflamed appendices, 65.7% had tenderness per rectal examination. In the noninflamed appendices, 65.6% also had tenderness on rectal examinations. The false negative rate was 34%.

Table IX
Per rectal examination (PR)

	Appendicitis		Normal	
Positive PR	163	(65.7%)	40	(65.5%)
Negative PR	85	(34.3%)	21	(43.5%)
Total	248	(100%)	61	(100%)

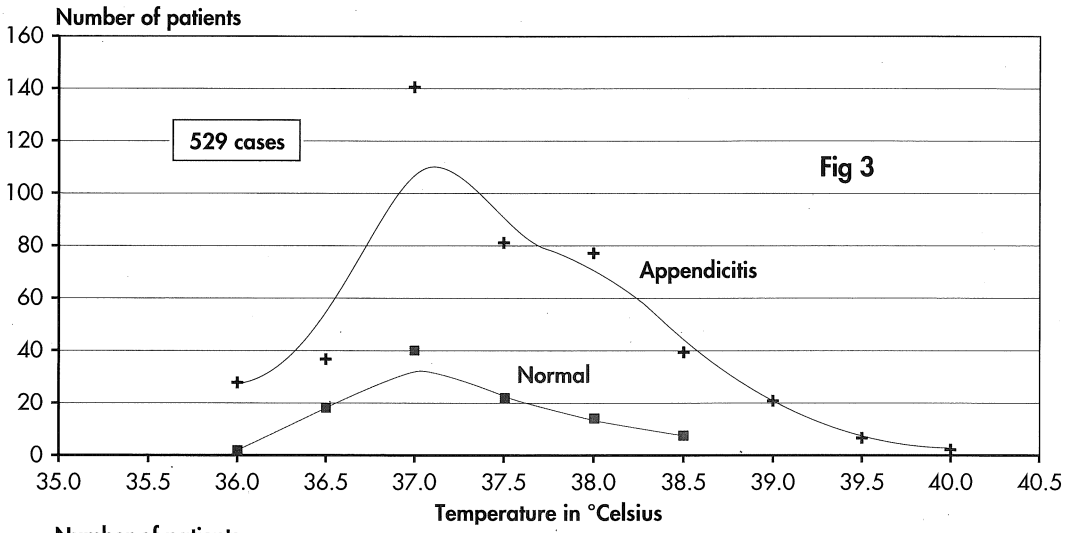
E. Temperature

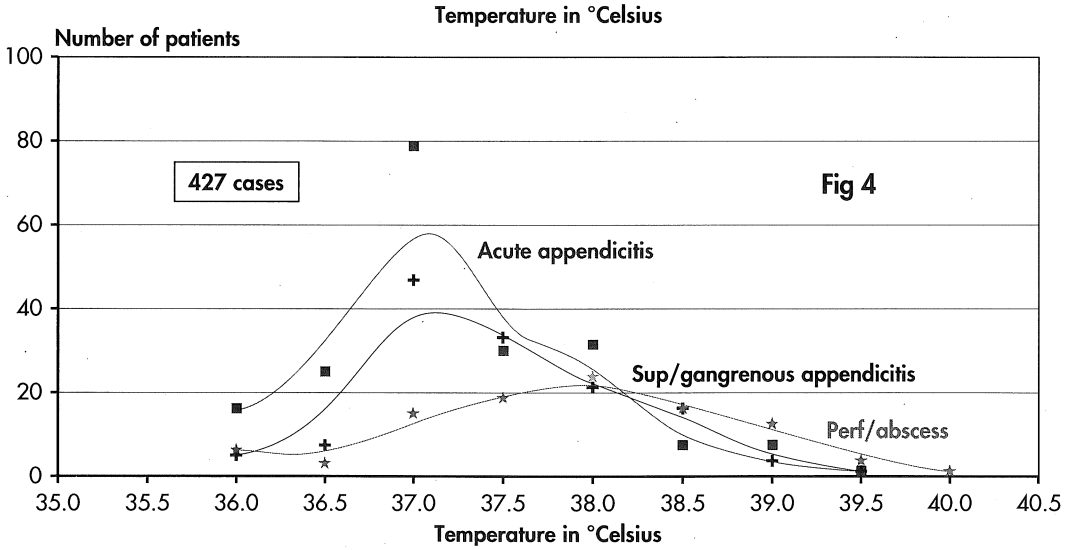
Sixty-eight percent of patients with appendicitis had temperatures of more than 37°C compared to 60% in normal cases and this overlap can be seen in Fig 3. With advancing severity of appendicitis, there was evidence of further increase in temperature as depicted in Fig 4.

Table X
Temperature at presentation

Temperature (°Celsius)	Normal appendix*	Type of appendicitis		
		Act	Sup/gr	Per/abs
Median temp	37.2	37.2	37.5	38.0
Temp range	36.2 - 38.8	36 - 39.6	36 - 39.8	36 - 40
Temp<=37°C	40.2%	46.6%	25.9%	12.9%
37.5 - 38.0	49.4%	42.4%	51.1%	46.5%
Temp>38°C	10.4%	11.0%	23.0%	40.6%
Total	100.0%	100.0%	100.0%	100.0%

NB: Act=Acute; Sup/gr=Suppurative/gangrenous; Per/abs=Perforated/abscess.
**excluding 15 cases with other inflammations.*





Figs 3 & 4: Temperature distributions.

F. Clinical acumen

Forty-one out of 66 pre-operative diagnoses of perforated appendicitis were confirmed at operation, giving an accuracy of 62%.

In contrast, 60 perforations were not diagnosed until after the operation, giving a detection rate of only 40%.

There was also disagreement between the surgeon's and the pathologist's reports on the appendix. When the surgeon diagnosed the appendix as normal at operation, 38% were found to be inflamed histologically. On the other hand, when the surgeon diagnosed the appendix as inflamed, 14% turned out to be normal.

G. Acute appendicitis — duration of abdominal pain

Amongst the 3 major races, Malay patients appeared to present at a later stage compared to Chinese and Indians. The 'other' race presented the latest, and most of them were Indonesians (Table XI).

When the duration of abdominal pain was analysed against the outcome as shown in Table XII, patients with perforated appendicitis were found to present later than those with nonperforated appendicitis. The median delay was 48 hours compared to 24 hours.

By 24 hours of abdominal pain, only 37% of the former were in hospital in comparison to 71% ($p<0.01$) in the nonperforative group, as shown in Fig 5. With increasing delay, more perforated appendicitis were clearly seen (Fig 6).

Table XI
Mean duration of pain by race

Malay	42.1 hours
Chinese	31.2 hours
Indian	32.8 hours
Others (mainly Indonesians)	53.2 hours
Overall	36.3 hours

Table XII
Duration of abdominal pain in perforated and nonperforated appendicitis

Pain	Perforated	(%)*	Nonperforated	(%)*
Less than 8 hrs	12	(11.9%)	51	(15.6%)
8 - 16 hrs	5	(16.8%)	69	(26.8%)
16.5 - 24 hrs	20	(36.6%)	111	(70.9%)
24.5 - 48 hrs	30	(66.3%)	68	(91.8%)
48.5 - 72 hrs	14	(80.2%)	15	(96.3%)
72.5 - 96 hrs	6	(94.1%)	3	(7.2%)
More than 96 hrs	14	(100%)	9	(100%)
Median pain (hrs)	48		24	
Range (hrs)	2 - 336		1 - 240	

**Cumulative %*

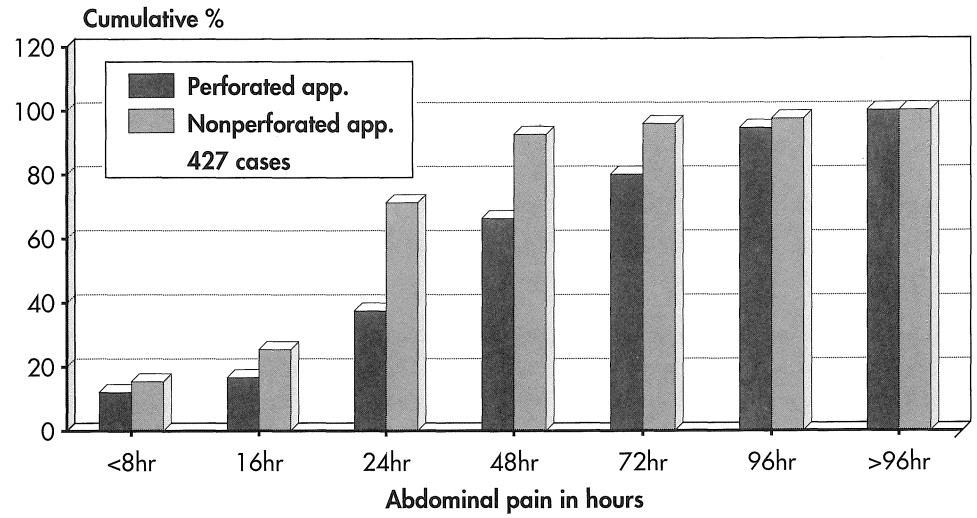


Fig 5: Proportion of patients presented at the Casualty Unit by duration of pain.

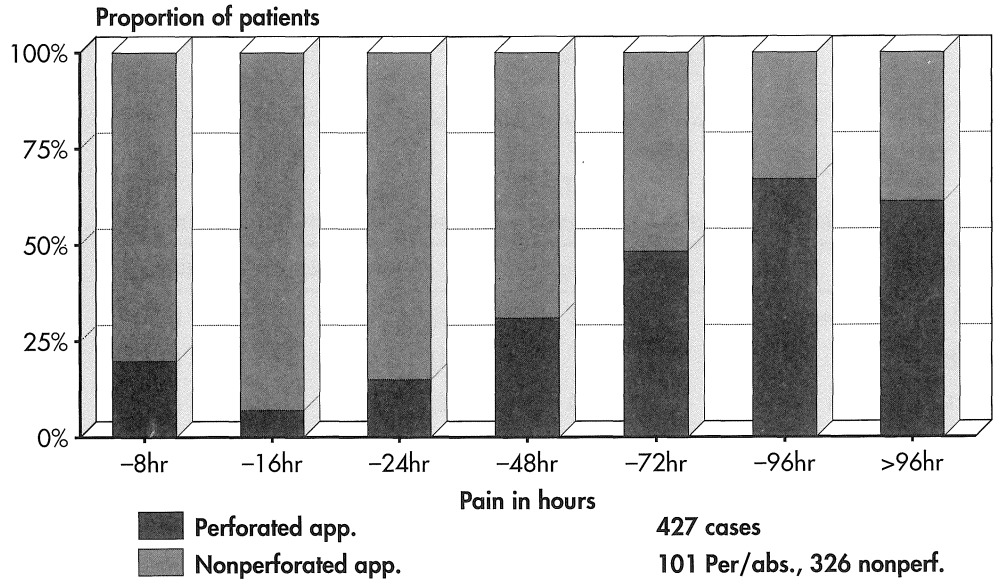


Fig 6: Duration of abdominal pain and appendicitis.

H Time lapse from diagnosis to operation

Table XIII shows that both the perforated and nonperforated appendicitis were made to wait equally long before being operated on. The median time lapse in both the groups was 7 hours. In general, about 80% of the patients were operated on within 12 hours.

Table XIII
Time lapse from diagnosis to operation

Time lapse	Perforated	(%)*	Nonperforated	(%)*
Less than 2 hrs	8	(7.9%)	24	(7.4%)
2.5 - 4 hrs	20	(27.7%)	72	(29.4%)
4.5 - 6 hrs	20	(47.5%)	54	(46.0%)
6.5 - 8 hrs	18	(65.3%)	43	(59.2%)
8.5 - 10 hrs	7	(72.3%)	46	(73.3%)
10.5 - 12 hrs	8	(80.2%)	27	(81.6%)
12.5 - 14 hrs	6	(86.1%)	18	(87.1%)
14.5 - 20 hrs	7	(93.1%)	35	(97.9%)
More than 20 hrs	7	(100%)	7	(100%)
Median time (hrs)	7.0		7.0	
Range (hrs)	1 - 37.5		1 - 33	

**Cumulative %*

I. Leukocyte count (LC)

Table XIV shows that leukocyte count was significantly higher in appendicitis compared to those with normal appendix ($p<0.001$). For appendicitis, the count was highest in perforative-type followed by the suppurative/gangrenous and acute types respectively. The differences observed were all significant ($p<0.01$) except between the suppurative and perforative types ($p>0.05$).

Eighty-three percent of all cases with appendicitis showed leukocytosis (>10000/μl) compared to 54% in normal appendices ($p<0.001$).

Table XIV
Leukocyte count (LC)

Appendix type	Median LC (1,000/μl)	Range
Appendicitis	14.7	3.1 - 51.0
Normal appendix* ($p<0.001$)	10.2	2.4 - 27.1
Acute appendicitis	13.4	3.1 - 38.6
Sup/gangrenous	15.2	6.3 - 27.1
Per/abscess	16.5	4.5 - 51.0

*NB: *excluded 15 cases with other inflammations.*

Table XV
Leukocyte count per μl

Appendix	LC<=10000	LC>10000	Total
Normal cases*	37 (46.2%)	43 (53.8%)	80 (100%)
Appendicitis	68 (17.0%)	333 (83.0%)	401 (100%)

*NB: 33 patients had no leukocyte count. *15 cases with other inflammations excluded.*

Discussion

These results confirm previous reports[2-7] that acute appendicitis is more common in men than women and occurs mostly in the first 3 decades of life.

Since the classic paper by Fitz in 1886, care for acute appendicitis has improved tremendously[9]. Mortality, in general, ranges from 0-1%[4,5,8,10,11]. In this series, there was no mortality recorded. This has been attributed to the timely and appropriate treatment of the disease. Appendicectomy is considered timely if it is done before perforation and appropriate only if the diagnosis is correct.

The diagnostic error in this hospital was 19.3%, comparable to other reported series ranging from 13.2% to 30.7%[4,6,10-14]. Hussein reported an error rate of only 4.8% in 1972, but no mention of histological confirmation was made[8]. Ahmed reported a 9.6% error rate in Khartoum and he had only 7% of the appendices examined histologically[3]. At operation, we found surgeon diagnosed appendix as inflamed in excess of 14% despite the fact that 38% of proven appendicitis were diagnosed as normal. This clearly indicates the need for histological examination of all appendicectomy specimens.

Diagnostic error has been reported to be a problem mainly in female patients[4,12-16]. The same was found in this study. In addition, children were also found to have a higher diagnostic error rate.

Despite the fear of infertility following a perforated appendicitis in young women[17] and confusion with gynaecological conditions[16], indiscriminate appendicectomy is not without risks and cost. Repeated examinations could possibly help us to avoid many of these negative appendicectomies and it has been shown to be safe and effective[18].

Our perforation rate of 23.7% is on the high side compared to several reported series which ranged from 3.6% to 28.5%[5,6,10,11,21]. Looking at the duration of abdominal pain in our series we found that patient delay was an important factor, similar to the findings of others[13,22,23].

However, it was disappointing to find that perforated appendicitis were not operated earlier when compared to nonperforated cases — both had a median time lapse of 7 hours. This could have been due to poor detection of perforation pre-operatively (40%) or to the indifferent attitude towards perforated appendicitis. In comparison, in a critical review of 1,000 cases by Lewis[7], the median time lapse from diagnosis to operation for perforated appendicitis was 4 hours, compared to 7 hours for those without perforation.

Our results show that patients at the extreme of ages were more at risk of perforation, similar to those reported in other studies[1,10,11,19,24]. In older patients, Burns[1] found that there was a sharp rise in the incidence of perforation in the 40 to 50 decades and we observed the same, as depicted in Fig 2.

Although appendicitis is more common in males and most of the perforations are seen in males, we found that the incidence of perforation was actually the same for both sexes, as was similarly reported by Isto[12] and Scher[23].

Like other studies[2,3], we found temperature and per rectal examination of little help in the diagnosis. Leukocytosis appeared to be more specific and the median leukocyte count in appendicitis was significantly higher than in normal cases. However, in cases where the clinical findings are at variance with the leukocyte count, the latter should be ignored[25].

Conclusion

We found that besides young women, children also posed a diagnostic problem in the management of acute appendicitis. Bearing in mind the diagnostic difficulty inherent to this group of patients, we still believe that the diagnostic error rate could be reduced if repeated examinations were performed until more definitive signs were obtained before proceeding to do the operation.

Patients above 50 years are most at risk of perforation and public and also medical health education is necessary to reduce patient delay. As perforation is associated with morbidity and mortality, special attention should be given to this group of patients.

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