

# Perforated Appendix - Delay in Presentation Rather than Delay in the Surgical Intervention: Retrospective Database Analysis of 2573 Saudi Arabian Patients in 10 Years

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## Abstract

**Background:** Perforated appendicitis is the result of a delay in treating acute appendicitis either due to patient's related factors, or misdiagnosis and delay of treatment.

**Aim:** The aim of this study to evaluate the effect of time on perforated appendicitis cases to determine whether the delay in presentation or the delay in treatment have a role in the progressing of acute appendicitis to perforation of the appendix.

**Materials and Methods:** A retrospective database analysis of 2573 Saudi Arabian patients treated surgically for acute appendicitis between January 2006 and December 2015 in a public health general hospital in Medina, Saudi Arabia was done. The inclusion criteria included adult patients, diagnosed initially as acute appendicitis, and proven to have had perforated appendix. Diagnostic temperature, complete blood count, ultrasound, operative diagnosis, duration of symptoms, duration of hospitalization, and complications were analyzed.

**Results:** A total of 363 patients (145 females and 218 males) were proven to have had a perforated appendix. The number was higher in males compared to females, and the difference was statistically significant ( $P = 0.033$ ). The mean age of the patients was 29.99 (median 26, range: 14-79). The duration of symptoms was significantly longer ( $68.80 \pm 12.40$  h and  $P < 0.001$ ), and it was statistically significant for both males ( $P = 0.004$ ) and females ( $P = 0.001$ ).

**Conclusion:** To conclude that in our local community, the majority of perforated appendix cases were found to be associated with the delay in presentation rather than the delay in management.

**Key words:** Appendicitis, Complications, Perforated appendix, Peritonitis, Surgery

## INTRODUCTION

Acute appendicitis is the most common acute surgical abdominal emergency occurrence worldwide. It is most common between the ages of 10 and 20 years, but can affect any age. The male to female ratio is 1.4:1, and the lifetime risk is 8.6% for males and 6.7% for females.<sup>1</sup>

A perforated appendix is a complication of untreated or delayed acute appendicitis. Ischemic necrosis of a portion of the appendiceal wall will lead to the perforation. Fecolith was found to be responsible for the perforation in about 90% of cases causing obstruction, increased pressure, and leading to ischemic necrosis. Other causes of luminal obstruction have also been reported such as fruit seeds and vegetables, lymphoid hyperplasia, intestinal worms (*Ascaris*), malignant tissues, and foreign bodies.<sup>2</sup>

Perforation of the appendix is reported to be more common in the elderly patients as a result of the late and atypical presentation, delay in the diagnosis, delay in the decision for surgery, and to the age acquired physiological changes. The mortality and morbidity rates had increased

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Month of Submission : 02-2016  
 Month of Peer Review : 03-2016  
 Month of Acceptance : 04-2016  
 Month of Publishing : 04-2016

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because the perforation could lead to prolonged and difficult treatment, convalescence, and could lead to death.<sup>3</sup>

The most recognized contributing factor in perforation of the appendix is the time factor in which the late presentation of the patients was reported to be a major cause, because when the delay in time between the onset of symptoms and the delivery of treatment increases, the probability of complications increase.<sup>4</sup> The age was proven to be a substantial contributing risk factor, patients under 10 years and more than 40 years are at a significant risk of increased morbidity and mortality.<sup>5</sup> Co-morbid conditions, mainly diabetes mellitus were found to increase the mortality and morbidity in perforated appendix patients. The co-existence of pregnancy and acute appendicitis is reported to increase the morbidity and mortality in both the mother and fetus.<sup>6</sup>

The clinical presentation of appendicitis is influenced by various symptoms and signs with reported variations in about 20-30% of the patients who present with atypical symptoms, signs, or laboratory findings. The patient-related factors are reported in many clinical studies to constitute the main reason for delays although physician-related diagnostic, and management delays have been also reported.<sup>7</sup>

Some clinical studies suggested a close relation between the level of inflammation or perforation and duration of inflammation,<sup>8</sup> however, there have been a lack of evidence-based data on the progress of appendicitis in time, and it is not proven scientifically if the risk of perforation is related to the duration of inflammation or it is because of the patient-related factors.<sup>9</sup>

Clinical studies had demonstrated that computed tomography provides a high degree of sensitivity (95%) and specificity (95%) for diagnosing perforation. The reported specific findings on a computed tomography (CT) scan that can lead to identifying a perforated appendix are: The presence of a localized the right iliac fossa abscess or phlegmon, a clear demonstrable defect in the appendiceal wall, an extra luminal air locules or free intraperitoneal air, the presence of appendicolith outside the appendix or within the right iliac fossa abscess, an intraperitoneal leak of rectal contrast, and the presence of multiple appendicoliths in association with thickened appendix, or peri-appendiceal inflammation. Ultrasound is reported to be less reliable than a contrast enhanced CT.<sup>10</sup>

The management of perforated appendicitis is different than that of acute non-perforated disease. The patients who progress to perforated appendicitis will have a longer duration of symptoms, high fever, and a higher white

blood count (WBC). Most of these patients have an established peritonitis and should receive a broad-spectrum intravenous antibiotic therapy, which should start as soon as the diagnosis is established.<sup>11</sup>

Surgical management is through two possible approaches: An open laparotomy or laparoscopy, but controversy regarding the use of laparoscopy in patients with an advanced disease does exist because of the high incidence of postoperative intra-abdominal abscess formation.<sup>12</sup>

We aim in this study to evaluate the effect of time on perforated appendicitis cases to determine whether the delay in presentation or the delay in treatment have a role in the progressing of acute appendicitis to perforation of the appendix.

## MATERIALS AND METHODS

A retrospective database analysis of the treatment outcome of 2573 Saudi Arabian patients treated surgically for acute appendicitis between January 2006 and December 2015 in a public health general hospital in Medina; Saudi Arabia was done.

The inclusion criteria included all adult patients age 12 years and above (according to the age classifications in hospitals of the Saudi Arabian ministry of health), all patients under 12-year-old were excluded due to unavailability of pediatric surgery unit in the hospital.

All patients who were diagnosed initially as acute appendicitis and proven to have had perforated appendix were selected, and random selection in regard to age, gender, and co-morbid conditions was done. All patients had the same diagnostic investigations (complete blood count, blood chemistry, chest X-ray, ultrasound abdomen, and electrocardiogram).

The diagnosis was made by the surgeon, who was on duty in the emergency surgery department, on the basis of the patient's history, clinical findings, laboratory, and radiology investigations. All appendectomy operations were performed as an emergency open procedure. All appendectomy samples were histologically evaluated.

Preoperative WBC count, body temperature, the ultrasound findings, and the diagnosis of a perforated appendix (preoperatively or intraoperatively) were analyzed for characteristics of the diagnosis. Age, gender, duration of symptoms before admission, duration of hospitalization, and mode of patient's referral from other health facilities were recorded and analyzed.

## RESULTS

A total of 2573 Saudi Arabian patients who were treated surgically for acute appendicitis between January 2003 and December 2012 were included, among them, 363 (14.11%) patients were proven to have had perforated appendix, of which 145 (39.9%) were females and 218 (60.1%) were males, male to female ratio of 1.5:1. The incidence rate of the perforated appendix in our study is 14.1%. The number of perforated cases was higher in males compared with females, and the difference was found to be statistically significant ( $P = 0.033$ ). The mean age of the patients was 35.76 years, (median 36.5, range: 14 - 61) (Table 1 and Figure 1).

The duration of symptoms in patients with perforated appendicitis was significantly longer ( $68.80 \pm 12.40$  h and  $P < 0.001$ ). This was found to be statistically significant for both males ( $P = 0.004$ ) and females ( $P = 0.001$ ). Analysis of the data in perforated patients, based on the age and sex, showed that the duration of pre-operative symptoms was very long in females, compared with males. However, this is not statistically significant ( $P = 0.486$  and  $P > 0.05$ ) (Table 2).

Body temperature as part of the vital signs did not show a statistical difference in perforated and non-perforated cases. In the comparison of white blood cells levels of the groups, high levels of WBC levels in patients with appendix perforation were statistically significant ( $P < 0.05$ ) (Table 3 and Figure 2).

It was statistically significant that the time of hospitalization was increasing in accordance with the complicated acute appendicitis (perforated appendix). Comparison of the preoperative ultrasound findings did not reveal a statistically significant difference between the rates of consistency of ultrasound with pathology ( $P > 0.05$ ). However, the highest rate of consistency between ultrasound and pathology was identified in the perforated group (Tables 4 and 5).

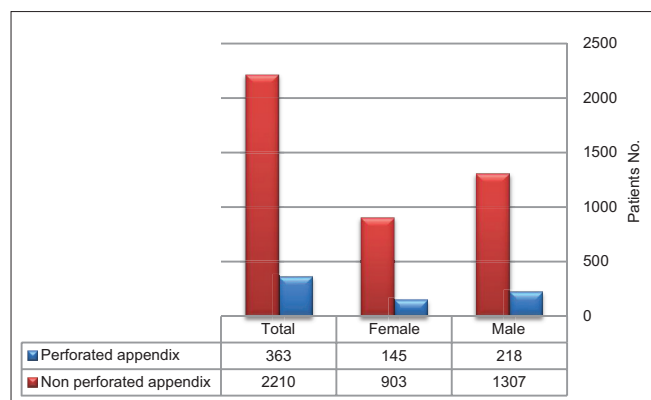


Figure 1: Patients gender of perforated and non-perforated appendix

The mortality rate was (0%) in all acute appendicitis patients including perforated and non-perforated appendix. The rates of postoperative morbidities were found as 2.5% in total of the non-perforated group (56 patients of 2210), and 17% in the perforated group (62 patients of 363) (Table 6).

Table 1: Demographic characteristics of the patients with perforated appendix

Age group (years)	Male (%)	Female (%)	Total (%)
12-19	51 (63.0)	30 (37.0)	81 (100.0)
20-49	143 (58.1)	103 (41.9)	246 (100.0)
≥ 50	24 (66.7)	12 (33.3)	36 (100.0)
Total	218 (60.1)	145 (39.9)	363 (100.0)

Table 2: Distribution of age, gender-stratified mean, duration of pre-admission symptom according to level of inflammation (perforated/non-perforated)

Age group (years)	Non-perforated appendix		Perforated appendix	
	Male (h)	Female (h)	Male (h)	Female (h)
12-19	32.0 (12)	35.2 (15)	160.0 (3)	74.6 (9)
20-49	32.8 (46)	39.5 (48)	87.0 (8)	46.6 (18)
≥ 50	36.0 (6)	33.6 (5)	56.0 (3)	60.0 (4)
Total	33.0 (64)	38.1 (68)	56.5 (31)	96.0 (14)

Table 3: WBC count in perforated and non-perforated appendix

WBC	Non-perforated (%)	Perforated (%)
10-15	899 (40.7)	0 (0)
15-20	847 (38.3)	85 (23.4)
20-25	437 (19.8)	185 (50.9)
25-30	27 (1.2)	93 (25.6)
WBC (±SD) $P < 0.05$	11.54 (±3.28)	15.49 (±3.75)

WBC: White blood cells, SD: Standard deviation

Table 4: Distribution of mean duration of hospitalization according to the perforated and non-perforated

Appendicitis	Average ± SD
Non-perforated	1.85 ± 1.03
Perforated	4.24 ± 2.39

SD: Standard deviation

Table 5: Distribution of pathology and ultrasound findings in perforated and non-perforated appendix

Ultrasound finding	Non-perforated (%)	Perforated (%)
Appendicitis (+)	44.7	57.8
Appendicitis (-)	55.3	42.2
P value	0.715	

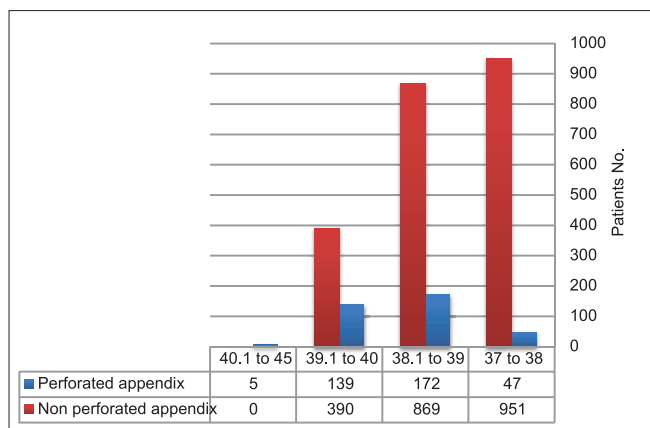


Figure 2: Body temperature in perforated and non-perforated

Table 6: Postoperative complications in perforated and non-perforated appendicitis patients

Data	Non-perforated appendix group	Perforated appendix group
Complications patients no	56	62
Total no of patients	2210	363
Paralytic ileus	17	30
Urinary tract infection	12	13
Wound infection	3	6
Fever (atelectasis)	16	10
Chest infection	9	3

## DISCUSSION

The delay in the diagnosis and management of acute appendicitis is proved to occur in a group of patients who present with the atypical clinical picture including those who had received narcotics or other strong analgesic medications. The fact that despite recent advances in laboratory and radiographic diagnostic tools, a high rate of complicated, gangrenous, or perforated appendicitis is still encountered necessitated the review of cases of appendicitis in regard to the time events starting from the initial presentation to the definitive treatment. Several clinical studies proved that the high rate of complicated acute appendicitis and the increased morbidity and mortality rates were primarily the direct results of the patient delay.<sup>13-15</sup>

Several clinical studies pointed to the preadmission delay on the part of the patient and the post admission delay on the part of the surgeon.<sup>15-17</sup> The major finding of our study was that the time between the onset of symptoms and the presentation to the emergency department was significantly longer in patients with a perforated appendix in comparison to patients with non-perforated acute appendicitis. Perforation of the appendix was proven in some clinical studies to increase the risk of complications up to 39%, and if there is no perforation

during the operation, this rate is about 8%.<sup>12,18</sup> That was in accordance with our study results where the complication rates were 17% and 2.5% in the groups with and without perforation, respectively. The duration of postoperative hospitalization in patients who had perforated appendix was significantly higher compared with the non-perforated.

In the last years, there have been ongoing debates on whether the delay of diagnosis is patient-related or surgeon-related factors. Our findings were consistent with the results of many studies which concluded that perforation of the appendix has mainly depended on the duration of the preadmission factors.<sup>10,19-21</sup> On the other hand, some studies had emphasized the role of the surgeon-related delay of diagnosis and treatment as a cause of complicated appendicitis.<sup>8</sup> The main factor was the diagnostic uncertainty for doubtful presentations of appendicitis patients. To overcome this dilemma, many surgeons adopted the policy that it is possible to avoid perforation by an earlier operation.<sup>20,21</sup>

Many clinical studies outlined the role of preoperative radiological investigations in confirming the diagnosis either by ultrasound or CT.<sup>22,23</sup> In our study, the results of ultrasound investigations showed that the association between the ultrasound findings and the pathology was highest in the perforated appendix group, but statistically no significant difference was found. We interpreted this finding to the usefulness of ultrasound as the second important preoperative factor to the clinical examination, which we believe is the first.

An article published in 2003, a prospective randomized clinical study compared the value of the clinical examination compared to CT scan in the diagnosis of acute appendicitis concluded that CT scan did not increase the accuracy of the diagnosis.<sup>24</sup> In our study, we did not rely on the CT scan method because most of the cases with perforation presented in the preadmission period, and the clinical diagnosis was most important factor in the decision-making to admit and operate.

Some clinical studies<sup>10,25-27</sup> reported that perforated appendicitis presented with high incidence in patients over 50 years of age, but in our study, the duration of appendicitis before presentation in comparison to the age factor was not found to cause a delay in admission, and no statistically significant difference was found in the mean duration of pain before the presentation when we compared the patients under and over 50-year-old. The duration of symptoms was relatively long in female patients who had perforated appendix compared to male patients, but it was not found to be statistically significant.



According to our results, the delay of presentation is the major factor leading to acute appendicitis complications in general and perforation in particular. The clinical picture of appendix perforation is not affected by age or gender in our local society. One of the limitations of this study was the exclusion of patients under the age of 12 years as they could not be operated due to the absence of pediatric surgery in the hospital where the study was conducted. Another limitation was the referral system between hospitals at night hours with all possible causes of delay in transferring the patients for available surgical service.

Diagnosis of perforated appendicitis may be a difficult task and remains a clinical challenge in the emergency departments. Despite technologic advances, the diagnosis is still based primarily on the patient's history and the physical examination, thus, on the surgeon's clinical judgment. Careful attention to the patient's history, a thorough physical examination, and early clinical review will minimize the possibility of a delay in diagnosis of acute appendicitis and its complications including perforation.

The observation of the late presentation due to the limitations of the referral system should be strongly addressed as it had affected the progression of acute appendicitis to a perforated appendix, especially in patients referred from other faraway medical centers.

## CONCLUSIONS

We conclude that in our local community, the majority of perforated appendix cases were found to be associated with the delay in presentation rather than the delay in management.

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**How to cite this article:** Shirah BH, Shirah HA, Alhaidari WA. Perforated Appendix - Delay in Presentation Rather Than Delay in the Surgical Intervention: Retrospective Database Analysis of 2573 Saudi Arabian Patients in 10 Years. *Int J Sci Stud* 2016;4(1):32-36.

**Source of Support:** Nil, **Conflict of Interest:** None declared.