Proportion of Perforated Appendix among Patients Operated for Acute Appendicitis at a Tertiary Hospital: A Prospective Cross-Sectional Study with Focus on seasonal variations

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Imran Ullah[1], Danish Ramazan[2], Muhammad Anees[3], Muhammad Kamil[4] Nasir Kakar[5], Abdullah Khan[6]

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[1] Sandeman Provincial Hospital, Quetta, Pakistan

[2] Sandeman Provincial Hospital, Quetta, Pakistan

[3] Sandeman Provincial Hospital, Quetta, Pakistan

[4] Sandeman Provincial Hospital, Quetta, Pakistan

[5] Sandeman Provincial Hospital, Quetta, Pakistan

[6]Sandeman Provincial Hospital, Quetta, Pakistan

Corresponding Author:

Dr. Imran Ullah, Sandeman Provincial Hospital, Quetta, Pakistan

imran.hotak@gmail.com

ABSTRACT

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Background: Acute appendicitis is a prevalent surgical emergency globally and constitutes a major source of morbidity when complicated by appendiceal perforation. Although seasonal fluctuations in the incidence of acute appendicitis have been extensively documented, there is a paucity of localized data concerning seasonal patterns in appendiceal perforation.

Objective: To ascertain the prevalence of appendiceal perforation in patients undergoing appendectomy for acute appendicitis and to assess its correlation with seasonal variation.

Methods: This prospective cross-sectional study was carried out in the Department of General Surgery at Sandeman Provincial Hospital, Quetta, over a one-year duration from August 2024 to July 2025. A total of 426 patients over the age of 15 who had appendectomies for clinically and/or histopathologically confirmed acute appendicitis were included. We wrote down the demographic information, the results of the surgery, and the month of the surgery. Appendiceal perforation was detected during the operation. The seasons were divided into four groups: winter, spring, summer, and fall. We used SPSS version 26 to look at the data. We used the chi-square test, and a p-value of 0.05 or less was considered statistically significant.

Results: Out of 426 patients, 57 (13.38%) had perforated appendicitis. Perforation occurred significantly more frequently in males than in females (22.1% vs 3.5%; $p = 0.008$). There was a strong link between age group and appendiceal perforation ($p < 0.001$), with the highest percentage (37.5%) of patients being between the ages of 41 and 60. Seasonal analysis indicated the highest incidence of perforation in spring (20.65%), demonstrating a statistically significant correlation between season and perforation ($p = 0.032$).

Conclusion: Appendiceal perforation was significantly correlated with male gender, advancing age, and seasonal fluctuations, exhibiting a peak incidence in the spring months. Early diagnosis and prompt surgical intervention, especially during high-risk periods, may mitigate perforation-related morbidity.

Keywords: Appendectomy, appendiceal perforation, acute appendicitis, seasonal variation

Introduction

Acute appendicitis is still a common reason for emergency abdominal surgery around the world, and it continues to be a big problem for healthcare systems, especially in low- and middle-income countries. New estimates from around the world say that there are 90 to 120 new cases of this disease every year for every 100,000 people. The lifetime risk is about 7–9%. There are always more cases in men than in women (1,2). Appendiceal perforation continues to be a major cause of illness, longer hospital stays, complications after surgery, and higher healthcare costs, even though diagnostic imaging and perioperative care have gotten better. The pathophysiology of acute appendicitis primarily results from the obstruction of the appendiceal lumen, causing elevated intraluminal pressure, ischemia, bacterial proliferation, and ultimately necrosis. Appendicoliths, lymphoid hyperplasia, parasitic infestation, and, less frequently, neoplasms are common causes of obstruction (3). In 20–30% of cases, complicated appendicitis, including gangrenous and perforated variants, has been observed, particularly in patients who delayed seeking medical attention or could not access surgical intervention promptly (4). Appendiceal perforation is associated with elevated incidences of peritonitis, sepsis, and postoperative infections, underscoring the necessity of early identification of at-risk populations.

People have been more interested in the epidemiological patterns of appendicitis in the last few years, such as how they change over time and by season. A lot of recent studies have shown that appendicitis cases go up steadily in the spring and summer, when the weather is warmer. This may be due to environmental, dietary, infectious, and behavioral factors (5–7). There is considerable evidence demonstrating that the occurrence of acute appendicitis fluctuates with the seasons; however, evidence corroborating a similar pattern for appendiceal perforation, especially among South Asian populations, is less compelling.

This study aimed to ascertain the proportion of perforated appendices among patients undergoing appendectomy at a tertiary care hospital and to assess the existence of seasonal fluctuations in perforation rates over a one-year duration, due to the lack of regional data. If doctors knew these patterns, they might be able to make better early diagnoses, choose the best time for surgery, and plan public health campaigns to lower the risk of complications that could have been avoided

Materials and Methods

This prospective cross-sectional descriptive-analytical study was carried out in the Department of General Surgery at Sandeman Provincial Hospital, Quetta, over a one-year duration from August 2024 to July 2025. The study encompassed all patients over the age of 15 who underwent emergency

or elective appendectomy for clinically suspected and/or histopathologically confirmed acute appendicitis during the study period. Individuals of both sexes were recruited through a consecutive sampling method. To reduce confounding factors, we did not include patients who had a history of abdominal trauma, gastrointestinal cancer, inflammatory bowel disease, appendicitis caused by foreign bodies, pregnancy, immuno-compromised states, a negative appendectomy, or incomplete medical records.

Data was collected in advance using a structured proforma. The recorded variables encompassed demographic characteristics (age and gender), symptom duration, month of surgery, operative findings (perforated or non-perforated appendix), and postoperative outcomes. The diagnosis of appendiceal perforation was established based on intraoperative observations, corroborated by histopathological validation when necessary. To evaluate seasonal variation, months were classified into four seasons: winter, spring, summer, and autumn, based on regional climatic trends.

We used Statistical Package for Social Sciences (SPSS) version 26 to enter and analyze the data. Continuous variables were represented as mean ± standard deviation, whereas categorical variables were delineated as frequencies and percentages. The Chi-square test or Fisher's exact test was used to look for links between appendiceal perforation and categorical variables like age group, gender, and season. A p-value of ≤ 0.05 was deemed statistically significant.

The Institutional Review Board of Sandeman Provincial Hospital gave the study ethical approval. All participants or their legal guardians provided written

informed consent prior to their inclusion in the study, and patient confidentiality was rigorously upheld throughout the research process.

Results:

A total of 426 patients who underwent appendectomy for acute appendicitis during the study period were included in the analysis (Table 1). The mean age of the study population was 22.94 ± 12.72 years. There were 226 males (53.1%) and 200 females (46.9%), with a male-to-female ratio of 1.13:1.

Appendiceal perforation was identified in 57 patients, resulting in an overall perforation rate of 13.38%, while 369 patients (86.62%) had non-perforated appendicitis (Table 2). Perforation was significantly more frequent among male patients, with 50 of 226 males (22.1%) affected compared to 7 of 200 females (3.5%). This association between gender and perforation status was statistically significant ($p = 0.008$).

Age-wise analysis demonstrated a significant association between age group and appendiceal perforation ($p < 0.001$, Table 2). In the 15–25-year age group, 33 of 318 patients (10.4%) had perforation. In the 26–40-year group, perforation was observed in 18 of 90 patients (20.0%). The highest proportion of perforation was seen in the 41–60-year age group, with 6 of 16 patients (37.5%) affected. No perforation was observed among patients aged over 60 years.

Monthly distribution showed noticeable variation in perforation rates throughout the year (Table 3). The highest proportions of perforated appendicitis were observed in March (25%), followed by June (21%), April (19%), and July (16%). When grouped seasonally, the spring season demonstrated the highest

frequency of appendiceal perforation (20.65%). Statistical analysis revealed a significant association between season and appendiceal perforation (p = 0.032). The seasonal distribution of perforated appendicitis is illustrated in Figure 1.

Overall, appendiceal perforation was significantly associated with male gender, increasing age, and seasonal variation, with a peak occurrence during the spring months.

Table 1: Demographic Characteristics of Study Population

Variable	Value
Total patients (n)	426
Mean age (years ± SD)	22.94 ± 12.72
Gender (Male/Female)	226 (53.1%) / 200 (46.9%)

Table 2: Association of Gender and Age with Appendiceal Perforation

Variable	Total	Perforated	Non-Perforated	p-value
Male	226	50	176	0.008
Female	200	7	193	
15–25 years	318	33	285	<0.001
26–40 years	90	18	72	
41–60 years	16	6	10	
>60 years	2	0	2	

Table 3: Monthly and Seasonal Distribution of Appendiceal Perforation

Month	Total Cases	Perforated	Percentage
March	36	9	25%
April	32	6	19%
June	42	9	21%
July	43	7	16%

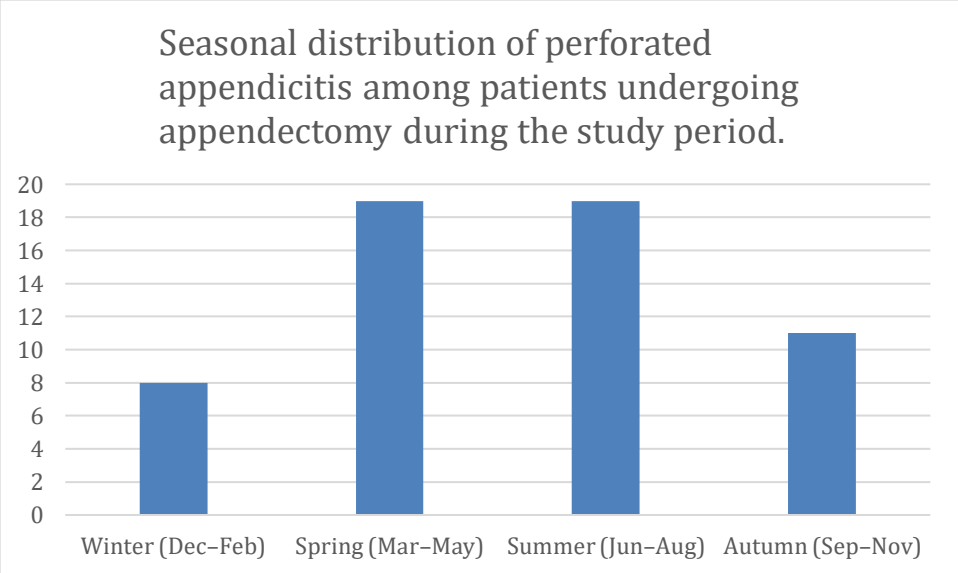

Figure 1. Seasonal distribution of perforated appendicitis among patients undergoing appendectomy during the study period.

Discussion

The current study found that 13.38% of patients who had appendectomies for acute appendicitis had an appendiceal perforation. This is similar to what has been found in recent international and regional studies. Recent studies show that perforation rates range from 12% to 30%. The differences are mostly due to differences in healthcare access, delays in diagnosis, and patient-related factors (8–10). Our group had a lower perforation rate, which may be due to better clinical

recognition and timely surgical management in a tertiary care setting.

This study found that being male was strongly linked to appendiceal perforation. Recent population-based studies have yielded analogous results, indicating that males may seek medical attention later in the disease progression or possess elevated thresholds for doing so, consequently heightening the risk of complicated appendicitis (11–13). Age was significantly correlated with perforation, with elevated proportions noted in older patients. Recent studies have shown that this trend is true. Unusual clinical presentations, comorbidities, and diagnostic difficulties all make it harder to get help quickly and raise the risk of perforation (14–16).

One of the most important things this study found was that appendiceal perforation changes a lot with the seasons, with the most cases happening in the spring. Seasonal variation in the incidence of acute appendicitis has been consistently documented; however, evidence concerning seasonal trends in perforation is still scarce. Recent research indicates that fluctuations in environmental temperature, dehydration, modified dietary habits, and seasonal infections may affect disease severity and progression, potentially elevating the risk of perforation during warmer or transitional seasons (17–20). Our results support new evidence that seasonal factors may affect not only the number of cases of appendicitis but also the types of complications that occur.

The fact that this study was designed ahead of time and included a full year cycle are two of its best features. Nevertheless, limitations encompass its single-center design and the absence of comprehensive evaluation of symptom duration and socioeconomic factors,

which recent studies have demonstrated to affect perforation risk (21–24).

Overall, these results show how important it is to diagnose acute appendicitis early, do surgery quickly, and be more careful during times of high risk to avoid complications that could have been avoided.

Conclusion

This research paper has shown that appendiceal perforation is a significant complication in patients who have appendectomy due to acute appendicitis with the overall perforation rate of 13.38. Perforation was very much related to male gender, age and seasonal difference where the highest frequency was recorded during spring months. These results point out the role of demographic and time factors on disease severity. Perforation-related morbidity could be lowered by identifying the symptoms early, undertaking surgery in a timely fashion as well as enhanced clinical awareness during seasons considered to be at risk. These findings are suggested to be supported by further multicenter studies to establish their validity and investigate mechanisms.

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