

Effect of the pandemic on the presentation and management of patients with acute appendicitis at King Abdulaziz University Hospital in Saudi Arabia

Original Article

Moaz Abulfaraj^a, Jumana Akbar^a, Ashraf A Maghrabi^a, Sara Mozahim^a, Reema Alzahrani^a, Lamiaa Alqahtani^a, Shahad Alahmadi^a, Haneen Rahbini^a, Waad Alalwani^a, Wisam Jamal^b and Omar Iskanderani^c

Department of ^{a,b}Surgery, ^cRadiology, Faculty of Medicine, ^{a,c}King Abdulaziz University, ^bUniversity of Jeddah, Jeddah, Saudi Arabia.

ABSTRACT

Background: The emergence of the coronavirus disease 2019 (COVID-19) pandemic led to significant changes in global healthcare systems, with a particular emphasis on prioritizing COVID-19 patients, even in emergency surgical scenarios. This study aimed to explore the impact of COVID-19 on the presentation and management of acute appendicitis cases in Saudi Arabia.

Patients and Methods: This retrospective study was carried out at King Abdulaziz University Hospital (KAUH) from March 2019 to March 2021, encompassing all patients with appendicitis during this time frame. The data collected included demographic characteristics, clinical symptoms, laboratory findings, time taken before seeking medical help, diagnostic approaches, treatment strategies, postoperative complications, and hospital stay duration.

Results: A total of 238 patients with acute appendicitis were hospitalized during the study, with a predominance of male patients (59.7%). Of these, 72.3% (174) were admitted during the pandemic period. Perforated appendicitis was diagnosed in 25 (10.5%) individuals. There were no significant differences observed between pre- and postpandemic periods concerning the time from presentation to surgery ($P=0.741$), postoperative complications ($P=0.563$), ICU admissions ($P=0.637$), readmissions ($P=0.234$), and overall length of hospital stay ($P=0.228$). However, notable associations were noted in blood loss ($P<0.001$) and postoperative length of stay ($P=0.021$) between the two periods.

Conclusion: Throughout the COVID-19 pandemic, there were no discernible differences in the duration from presentation to surgery, complications, ICU admissions, readmissions, and total length of hospital stay compared with the pre-pandemic period.

Key Words: Abdominal pain, appendectomy, complications, coronavirus disease 2019, hospital length of stay.

Received: 16 March 2024, **Accepted:** 18 March 2024, **Publish:** 7 July 2024

Corresponding Author: Moaz Abulfaraj, MD, Department of Surgery, Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia. **Tel.:** +1 (845)6453870, **E-mail:** mabolafaraj@kau.edu.sa

ISSN: 1110-1121, July 2024, Vol. 43, No. 3: 1077-1082, © The Egyptian Journal of Surgery

INTRODUCTION

Acute appendicitis (AA) stands out as a common cause of acute abdominal pain necessitating prompt medical intervention^[1]. Cardinal symptomatology typically entails pain in the right lower quadrant of the abdomen, often accompanied by localized tenderness and muscle stiffness^[2]. While the precise etiology of AA remains somewhat elusive, several contributing factors have been recognized, encompassing fecal content, viral and bacterial infections, and potential obstruction from tumors^[3]. The lifetime risk of developing AA is estimated to be ~8%, with a noted male predisposition^[4]. Varied age groups exhibit significant diversity in clinical presentations. Despite the availability of nonsurgical alternatives like antibiotic therapy, surgical appendectomy remains the primary treatment modality for AA. Recent studies have pointed to antibiotic therapy as

a viable option for select individuals with radiologically confirmed uncomplicated appendicitis^[5].

The emergence of the novel severe acute respiratory syndrome coronavirus 2 (SARSCoV-2) virus, leading to the COVID-19 disease, was initially reported in China in December 2019. The WHO officially declared the COVID-19 outbreak a global pandemic on March 11, 2020^[6]. The highly contagious nature of the virus prompted a rapid saturation of healthcare facilities, compelling various nations to initiate emergency protocols and enforce mandates for residential confinement. However, concerns regarding potential exposure to the virus among patients visiting emergency departments resulted in a notable decline in emergency department visits^[7]. This decrease in patient footfall might have caused delays in the diagnosis and treatment of several urgent medical conditions. Given

the transmission risks associated with SARS-CoV-2 during surgical procedures, there has been a shift toward nonoperative management strategies amid the ongoing pandemic^[8]. In light of the COVID-19 crisis, the approach to treating AA has pivoted toward a more cautious and conservative stance. Our study seeks to investigate whether there was a delay in the presentation and management of acute appendicitis during the COVID-19 pandemic compared with pre-pandemic periods.

PATIENTS AND METHODS:

This retrospective study was conducted at a single center, comparing appendicitis patients who presented before the COVID-19 pandemic with those who presented during the pandemic. The analysis focused on demographics, diagnosis, treatment approaches, and complications. Data collection for pandemic-related cases spanned from March 2020 to December 2021.

The study was carried out at King Abdulaziz University Hospital (KAUH), renowned as the largest tertiary hospital in the Western region, boasting a bed capacity of 1,067.

Primary data collection and patient inclusion were facilitated through the hospital's PHOENIX system. Secondary data collection, to supplement missing information, was achieved through necessary phone calls. The gathered data encompassed demographic profiles, presenting symptoms, clinical indicators, and laboratory results. Detailed information on symptom duration and the timing of seeking medical assistance was recorded. Diagnostic modalities and treatment regimens for each patient were also documented. Postoperative data, including complications, duration of hospital stay, and intraoperative blood loss, were meticulously recorded.

Statistical analysis was performed using IBM SPSS Statistics software version 24.0. Quantitative variables were presented as mean \pm SD and ranges, while qualitative variables were expressed as raw values, proportions, and percentages. Associations between categorical variables were assessed using Pearson's χ^2 test, and continuous variables were analyzed using the Student's *t*-test. A *P* value below 0.05 was considered statistically significant.

RESULTS:

The study analyzed a total of 238 patients, with males comprising 59.6% of the cohort. Age distribution revealed that over a third (37.1%) were 18 years old or younger. Smoking was reported in 15.4% of patients, while 16.7% had comorbidities, including diabetes (6.3%), hypertension (2.9%), asthma (2.1%), and other conditions (5.4%). American Society of Anesthesiologists (ASA) scores indicated that 70.6% were class I, 25.6% were class II, 2.9% were class III, and 0.8% were class IV.

Diagnosis methods included computed tomography (81.9%), clinical diagnosis (2.1%), MRI (1.3%), and diagnostic laparoscopy (0.8%). The majority (94.5%) underwent laparoscopy, with 13.9% undergoing ultrasound, 4.2% open laparotomy, and 1.3% transitioning from laparoscopy to open laparotomy. Acute appendicitis was prevalent in 66.4% of patients, while 23.1% had acute noncomplicated cases, and 10.5% had a perforated appendix or appendicular abscess.

Of the cases, 72.5% occurred during the pandemic period. Comparisons between pre-pandemic and pandemic presentations showed similarities in gender distribution, ASA scores, diagnostic methods, treatment approaches, and appendicitis types. However, there was a statistically significant association between age groups and the time of presentation (*P* value=0.039). Refer to (Table 1) for detailed results.

Further analysis of the presentation period (pre-pandemic vs. pandemic) revealed significant associations with blood loss during surgery (*P* value<0.001) and postoperative length of stay (*P* value=0.021). No statistical associations were found for the duration from presentation to surgery, complications, ICU admission, readmission, or total length of stay based on the presentation period. Refer to (Table 2) for comprehensive results.

Comparisons of the duration of pain reported by patients showed that 65.1% sought healthcare within one day or less before the pandemic, compared with 75.5% during the pandemic. Moreover, 6.9% waited for 2–5 days before the pandemic, compared with 13.6% during the pandemic. Detailed insights are illustrated in (Fig. 1).

Table 1: Comparison of the baseline, diagnostic, and treatment characteristics between patients presenting before and during the pandemic

Variables	Period			<i>P</i> value
	During pandemic (%)	Before pandemic (%)	Total (%)	
Blood loss during surgery				
Mild	88 (51.2)	15 (22.7)	103 (43.3)	<0.001
Minimal	60 (34.9)	45 (68.2)	105 (44.1)	
Moderate	16 (9.3)	2 (3)	18 (7.6)	
Severe	8 (4.7)	4 (6.1)	12 (5)	

LOS (ER to procedure)				
3 days	9 (5.2)	5 (7.6)	14 (5.9)	0.741
4 or more	9 (5.2)	2 (3)	11 (4.6)	
Next day	17 (9.9)	5 (7.6)	22 (9.2)	
Same day	137 (79.7)	54 (81.8)	191 (80.3)	
Complications				
Yes	9 (5.2)	3 (4.5)	12 (5)	0.563
No	163 (94.8)	63 (95.5)	226 (95)	
ICU admission				
Yes	8 (4.7)	3 (4.5)	11 (4.6)	0.637
No	164 (95.3)	63 (95.5)	227 (95.4)	
Readmission				
Yes	8 (4.7)	1 (1.5)	9 (3.8)	0.234
No	164 (95.3)	65 (98.5)	229 (96.2)	
Follow-up				
Healthy	155 (90.1)	58 (87.9)	213 (89.5)	0.385
Not	17 (9.9)	8 (12.1)	25 (10.5)	
LOS (postoperative)				
One day	77 (44.8)	31 (47)	108 (45.4)	0.021
2–3 days	49 (28.5)	23 (34.8)	72 (30.3)	
4–8 days	32 (18.6)	12 (18.2)	44 (18.5)	
More than 8 days	14 (8.1)	0	14 (5.9)	
LOS (total)				
One day	26 (15.1)	8 (12.1)	34 (14.3)	0.228
2–3 days	72 (41.9)	36 (54.5%)	108 (45.4)	
4–8 days	55 (32)	19 (28.8)	74 (31.1)	
More than 8 days	19 (11)	3 (4.5)	22 (9.2)	

LOS, length of stay.

Table 2: Comparison of hospital length of stay and surgery-related outcomes between patients presenting before and during the pandemic

Variable	Groups	Period			<i>P</i> value
		During pandemic	Before pandemic	Total	
Sex	Male	98 (57)	44 (66.7)	142 (59.7)	0.111
	Female	74 (43)	22 (33.3)	96 (40.3)	
Age group	Lowest throughout 18	70 (40.7)	18 (27.3)	88 (37)	0.039
	18–25 years	32 (18.6)	20 (30.3)	52 (21.8)	
	26–35 years	29 (16.9)	17 (25.8)	46 (19.3)	
	Highest thru 35	41 (23.8)	11 (16.7)	52 (21.8)	
ASA report	I E	119 (69.2)	49 (74.2)	168 (70.6)	0.743
	II E	46 (26.7)	15 (22.7)	61 (25.6)	
	III E	5 (2.9)	2 (3)	7 (2.9)	
	IV E	2 (1.2)	0	2 (0.8)	
Method of diagnosis	Clinical	4 (2.3)	1 (1.5)	5 (2.1)	0.829
	CT	139 (80.8)	56 (84.8)	195 (81.9)	
	Diagnostic laparoscopy	1 (0.6)	1 (1.5)	2 (0.8)	
	MRI	2 (1.2)	1 (1.5)	3 (1.3)	

Treatment modality	Laparoscopic	161 (93.6)	64 (97)	225 (94.5)	0.471
	Laparoscopic to laparotomy	3 (1.7)	0	3 (1.3)	
	Open appendectomy	8 (4.7)	2 (3)	10 (4.2)	
	US	26 (15.1)	7 (10.6)	33 (13.9)	
Type of appendicitis	Acute appendicitis	113 (65.7)	45 (68.2)	158 (66.4)	0.894
	Acute noncomplicated	40 (23.3)	15 (22.7)	55 (23.1)	
	Perforated and abscess	19 (11)	6 (9.1)	25 (10.5)	

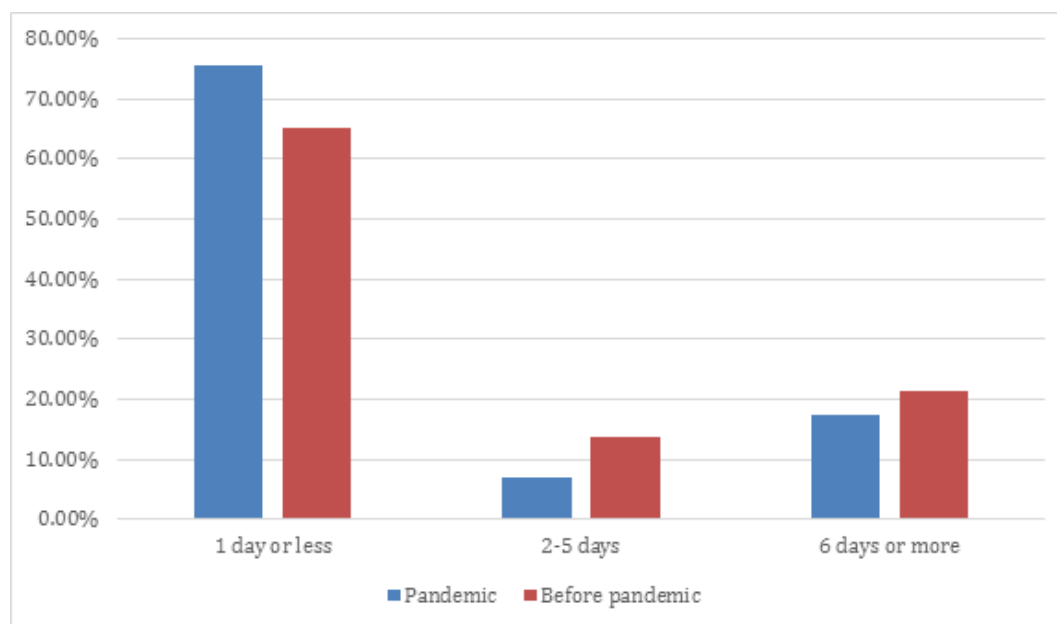


Fig. 1: Comparison of the duration of pain before hospital presentation between patients presenting before and during the pandemic, P value=0.05.

DISCUSSION

The impact of the COVID-19 pandemic on clinical practices has been profound, necessitating significant adaptations to address infection transmission concerns, self-isolation protocols, and workforce limitations^[9,10]. This global health crisis has placed immense strain on healthcare infrastructure, directly influencing the delivery of patient care both in visible and unseen ways^[11]. Our study aimed to evaluate the repercussions of the pandemic on AA presentation, management, and complications within Saudi Arabia. Despite the scarcity of data on AA management during the pandemic in the region, some evidence points to the continuation of AA procedures amid these challenging times.

In a specific institution-based study by Alsaigh *et al.*, nearly two-thirds of patients undergoing surgical interventions were diagnosed with AA^[12]. Interestingly, while delays in non-COVID-19-related diagnoses have been widely documented^[13], a decline in AA cases during the pandemic, as seen in other studies^[14,15], was not observed in our investigation. Traditionally, AA is

classified into uncomplicated and complicated forms, with the latter encompassing severe conditions such as perforation, abscess formation, and peritonitis, often requiring prompt intervention due to increased risks associated with prolonged symptoms^[16].

Contrary to certain reports, our study did not find a significant correlation between the pandemic period and metrics like the duration of hospital stay and postoperative complications. However, contrasting results from Passoni *et al.* highlighted a substantial rise in complicated AA cases during the COVID-19 peak, along with extended onset-to-admission times^[17]. Furthermore, other researchers like Burgard *et al.* noted delays in symptom presentation during the initial pandemic stages, with a subsequent increase in complex appendicitis cases postpandemic^[18].

Various imaging tools like CT play a crucial role in AA diagnosis, with our study predominantly employing this modality. Similarly, other researchers have shown no significant association between the pandemic period and duration of hospital stay and

postoperative outcomes. The findings are in alignment with previous studies, suggesting consistency in certain outcome measures when comparing pre- and post-pandemic eras^[19,20].

Notably, the studies of Aharoni *et al.*, Poget *et al.*, and Bickel *et al.* reinforce the notion that the COVID-19 pandemic did not substantially alter the manifestation, progression, or therapeutic approaches for individuals with AA^[21–23]. While minor shifts in the prevalence of complicated appendicitis were noted, the overall management and outcomes of AA remained largely stable during the pandemic period, reflecting the resilience and adaptability of healthcare systems in navigating unprecedented challenges.

The incidence of complicated acute appendicitis (including suppurative appendicitis, gangrenous appendicitis, and peri-appendicular abscess) surged notably during the pandemic period compared with the control group, resulting in an extended average hospital stay^[23]. Laparoscopic appendectomy has emerged as a superior choice over open appendectomy, showcasing benefits in postoperative pain management, reduced wound infection rates, shorter hospital stays (often within 1–3 days postoperatively), and quicker recovery times. This aligns with similar observations in studies conducted in Istanbul, Turkey, and South Korea, highlighting a consistent readmission rate within 30 days^[24,25]. The preference for laparoscopic appendectomy stems from its ability to minimize scarring, diminish postoperative discomfort, and expedite recovery, with most patients undergoing the procedure on the same day as their emergency room presentation.

However, certain limitations warrant consideration in our study. First, a potential selection bias could have influenced the outcomes due to the retrospective nature of the study, predominantly involving individuals diagnosed at a single hospital with uncomplicated appendicitis. Second, differences in healthcare systems and pandemic contexts across countries raise challenges in generalizing our findings to diverse populations. Moreover, long-term follow-up data is necessary to track the recurrence of appendicitis in conservatively managed patients. Notably, no apparent disparities in the complications of acute appendicitis were observed at King Abdulaziz University Hospital (KAUH) before and during the COVID-19 pandemic, underscoring the stability in managing this condition across varying time frames.

CONCLUSION

In conclusion, the global healthcare landscape has been significantly impacted by the COVID-19 pandemic, introducing challenges in patient care delivery. Nonetheless,

our study indicates that within Saudi Arabia, the pandemic did not notably alter the presentation, management, or complications of acute appendicitis. CT scans retained their prominence as the primary diagnostic tool, while laparoscopic appendectomy continued to be the favored treatment modality. The stability in factors such as hospital stay durations, readmission rates, and symptom durations pre-ER presentation suggests that the healthcare system at King Abdulaziz University Hospital (KAUH) effectively navigated acute appendicitis cases during the pandemic, demonstrating a capacity to uphold care standards and minimize transmission risks.

Moving forward, future investigations are imperative to unveil the enduring repercussions of the pandemic on acute appendicitis and broader healthcare dynamics. Understanding the enduring effects on medical conditions and healthcare systems at a national and global scale will be vital for sustaining quality patient care and adapting to evolving healthcare challenges.

CONFLICT OF INTEREST

There are no conflicts of interest.

REFERENCES

1. Baird DL, Simillis C, Kontovounisios C, Rasheed S, Tekkis PP. Acute Appendicitis. *BMJ* 2017; 357:j1703.
2. Moris D, Paulson EK, Pappas TN. Diagnosis and Management of Acute Appendicitis in Adults: A Review. *JAMA* 2021; 326:2299–2311.
3. Stringer MD. Acute Appendicitis. *J Paediatr Child Health* 2017; 53:1071–1076.
4. Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A, *et al.* Diagnosis and Treatment of Acute Appendicitis: 2020 update of the Wses Jerusalem guidelines. *World J Emerg Surg* 2020; 15:27.
5. Podda M, Gerardi C, Cillara N, Fearnhead N, Gomes CA, Birindelli A, *et al.* Antibiotic treatment and appendectomy for uncomplicated acute appendicitis in adults and children: A Systematic Review and Meta-Analysis. *Ann Surg* 2019; 270:1028–1040.
6. Ciotti M, Ciccozzi M, Terrinoni A, Jiang W-C, Wang C-B, Bernardini S. The Covid-19 Pandemic. *Crit Rev Clin Lab Sci* 2020; 57:365–388.
7. Conlon C, McDonnell T, Barrett M, Cummins F, Deasy C, Hensey C, *et al.* The Impact of the Covid-19 Pandemic on Child Health and the

- Provision of Care in Paediatric Emergency Departments: A Qualitative Study of Frontline Emergency Care Staff. *BMC Health Serv Res* 2021; 21:1–11.
8. Bogani G, Ditto A, De Cecco L, Lopez S, Guerrisi R, Piccioni F, *et al.* Transmission of Sars-Cov-2 in surgical smoke during laparoscopy: a prospective, proof-of-concept study. *J Minim Invasive Gynecol* 2021; 28:1519–1525.
 9. Quah GS, Eslick GD, Cox MR. Laparoscopic Appendectomy Is Superior to Open Surgery for Complicated Appendicitis. *Surg Endosc* 2019; 33:2072–2082.
 10. Köhler F, Acar L, van den Berg A, Flemming S, Kastner C, Müller S, *et al.* Impact of the Covid-19 pandemic on appendicitis treatment in Germany—a population-based analysis. *Langenbecks Arch Surg* 2021; 406:377–383.
 11. Schneider M, Altersberger M, Binder C, Hengstenberg C, Binder T. The Covid-19 Burden for Health Care Professionals: Results of a Global Survey. *Eur J Intern Med* 2021; 83:96–98.
 12. Alsaigh S, Harisi M, Almuhaymidi R, Al-Hojailan AA, Alharbi AZ, Alolayan SS, *et al.* Impacts of Covid-19 on patients with common surgical emergencies at the King Fahad Specialist Hospital in Buraidah, Saudi Arabia. *Cureus* 2022; 14:e31868.
 13. Solis E, Hameed A, Brown K, Pleass H, Johnston E. Delayed emergency surgical presentation: impact of corona virus disease (Covid-19) on non-covid patients. *ANZ J Surg* 2020; 90:1482–1483..
 14. Bosak Veršić A, Šestan M, Čepić I, Nikolić H, Bukvić N, Sršen Medančić S, *et al.* Characteristics of acute appendicitis before and during the Covid-19 pandemic: single center experience. *Emerg Med Int* 2022; 2022:4541748.
 15. Tankel J, Keinan A, Blich O, Koussa M, Helou B, Shay S, *et al.* The decreasing incidence of acute appendicitis during covid-19: a retrospective multi-centre study. *World J Surg* 2020; 44: 2458–2463.
 16. Bom WJ, Scheijmans JC, Salminen P, Boermeester MA. Diagnosis of uncomplicated and complicated appendicitis in adults. *Scandinavian J Surg* 2021; 110:170–179.
 17. Passoni S, Giuliani M, Arigoni M. Increased incidence of complicated acute appendicitis after the first Covid-19 pandemic peak: have patients a different attitude towards Covid-hospitals? *Br J Surg* 2021; 108(Supplement_4):znab202.046.
 18. Burgard M, Cherbanyk F, Nassiopoulos K, Malekzadeh S, Pugin F, Egger B. An effect of the Covid-19 pandemic: significantly more complicated appendicitis due to delayed presentation of patients! *PLoS ONE* 2021; 16:e0249171.
 19. Monsonis B, Mandoul C, Millet I, Taourel P. Imaging of appendicitis: tips and tricks. *Eur J Radiol* 2020; 130:109165.
 20. Romero J, Valencia S, Guerrero A. Acute appendicitis during coronavirus disease 2019 (Covid-19): changes in clinical presentation and Ct findings. *J Am Coll Radiol* 2020; 17:1011–1013.
 21. Aharoni M, Barash Y, Zager Y, Anteby R, Khalilieh S, Amiel I, *et al.* Management of acute appendicitis during the covid-19 pandemic: a single tertiary center experience. *Isr Med Assoc J* 2021; 23:269–273.
 22. Poget M, Chautems R, Kohler R, Diana M, Saadi A. Impact of the covid-19 pandemic on the severity and management of acute appendicitis. *Front Surg* 2022; 9:981885.
 23. Bickel A, Ganam S, Abu Shakra I, Farkash I, Francis R, Karra N, *et al.* Delayed diagnosis and subsequently increased severity of acute appendicitis (compatible with clinical-pathologic grounds) during the Covid-19 pandemic: an observational case-control study. *BMC Gastroenterol* 2022; 22:19.
 24. Fersahoglu MM, Çiyiltepe H, Fersahoğlu AT, Bulut NE, Ergin A, Tasdelen İ, *et al.* A comparison of patients who have appendectomy during the covid-19 pandemic period with the period before the pandemic. *Ulus Travma Acil Cerrahi Derg* 2022; 28:170–174.
 25. Choi YS, Yi JW, Chung CTY, Shin WY, Choi SK, Heo YS. Clinical experience of emergency appendectomy under the covid-19 pandemic in a single institution in South Korea. *Medicina* 2022; 58:783.