

Appendicitis During the COVID-19 Pandemic: Lessons Learnt From a District General Hospital

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Keywords: Appendicitis, Coronavirus, General Surgery

DOI: <https://doi.org/10.21203/rs.3.rs-141333/v1>

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Abstract

Background

The COVID-19 pandemic dramatically influenced the delivery of healthcare. In line with the UK Royal Colleges' advice the management of acute appendicitis (AA) changed with greater consideration for non-operative management (NOM) or open appendicectomy when operative management (OM) was sought. We describe our experience of the presentation, management and outcomes for these patients to inform care for future viral pandemics.

Methods

This retrospective, cohort study compared patients diagnosed with AA between March and July 2019 with those during the pandemic period of March to July 2020. Medical records were reviewed to obtain demographics, inflammatory markers, imaging, severity, management, histology, length of stay (LOS) and 90-day outcomes.

Results

There were 149 and 125 patients in the 2019 and 2020 cohorts respectively. 14 patients (9.4%) had NOM in 2019 versus 31 (24.8%) in 2020 ($p = 0.001$). In the 2019 operative management (OM) group 125 patients (92.6%) had laparoscopic appendicectomy versus 65 (69.1%) in 2020. 59 patients (39.6%) had a CT in 2019 versus 70 (56%) in 2020. The median LOS was 4 days in 2019 and 3 days in 2020 ($p=0.03$). Two patients in each year who received NOM had treatment failure (14.3% in 2019 and 6.5% in 2020). Three patients in 2019 who received OM had treatment failure (2.2%). Of 95 patients tested for COVID-19 all but one tested negative.

Conclusion

During the COVID-19 pandemic there was no observed increase in severity of AA, patients had a shorter LOS and were more likely to have imaging. NOM proportionally increased with no observed change in outcomes.

What Is Already Known On The Subject

- The COVID-19 pandemic resulted in significant changes to surgical healthcare delivery in emergency and elective settings.
- Laparoscopic appendicectomy has been the main treatment of acute appendicitis in the United Kingdom but the advice published by the Joint Royal Colleges highlighted the new risks associated with laparoscopic surgery in the pandemic and suggested appropriate alternatives, such as non-operative management with antibiotics or open appendicectomy.

- Non-operative versus operative management for acute appendicitis is a controversial area and widely debated in the literature. High quality evidence shows that both non-operative and operative management of uncomplicated appendicitis are safe treatment options.

Main Messages

- Single-centre analysis describing our observations in order to guide care for similar centres during the pandemic and future viral spikes.
- We proportionally increased our management of acute appendicitis to non-operative management and open appendicectomy demonstrating no significant change in 90-day outcomes.
- In future peaks of COVID-19 we would be more open to considering non-operative management in the treatment of appendicitis.

Background

Coronavirus Disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was declared a pandemic by the World Health Organisation on 11th March 2020 (1). During March restrictions were put in place on movement and social gatherings in an attempt to control viral spread. This culminated in United Kingdom (UK) wide 'lock-down' on the 24th March which led to a reduction in all emergency admissions to hospitals across England (2). A report from Italy noted a reduction in presentation of acute appendicitis (AA) and worsening severity on presentation; so far undocumented in the UK (3).

On 26th March the UK Joint Royal Colleges published guidance (4) for surgeons working during the COVID-19 pandemic advising considerable caution for all laparoscopic surgery due to the potential risk associated with aerosol formation on deflation of the pneumoperitoneum. The Colleges also advised non-operative management (NOM) to be used in selected cases and if operative management was necessary, an open appendicectomy should be the method of choice.

Prior to the pandemic the general feeling in our Trust was that laparoscopic appendicectomy was the preferred surgical option over an open approach for the management of AA. Part of the reason for this could be that open appendicectomy has been associated with greater post-operative pain, longer hospital admissions and a slower return to normal physical activity (5). Further to this, in our Trust NOM was previously felt to be reserved for cases where it was the patient's choice or OM was unfeasible in the clinical situation. There is considerable controversy in the literature regarding the role of NOM as the first line treatment for AA (6). NOM for AA at five years compared to a primary appendicectomy shows a significantly lower post-intervention complication rate by avoiding surgical site infection, incisional hernias, post-operative abscesses, post-operative ileus and other complications (7). While conflicting evidence shows there is a non-significantly higher rate of complicated appendicitis with delayed surgery in patients receiving NOM as first-line therapy (7) and of the patients who have NOM for AA there is a 39% risk of recurrence and 27.3% will eventually require an interval appendicectomy (8,9). This highlights some of the controversy that can be found in the literature.

During the early stages of the COVID-19 pandemic, surgical practice changed for patients with AA as units gave greater consideration to the option of NOM and open appendicectomy where OM was sought. We describe the changes to the management of AA in our Trust in response to advice by the Royal Colleges, to explore the impact these changes had on short-term outcomes and to provide insight on some of the lessons we have learned as we face the second wave.

Methods

We undertook a single-centre retrospective cohort analysis to compare the management of AA both before and during the COVID-19 pandemic. The Royal Devon and Exeter Hospital is a University-affiliated NHS Foundation Trust with 800 beds offering secondary care specialist services to a population of 460,000 people.

Data were obtained for all patients with a coded discharge diagnosis of AA from the 1st of March to the 31st of July 2019 and the equivalent five-month period in 2020. The 2019 cohort served as a control for comparison. Electronic health records (EHR) were interrogated to obtain baseline demographics, patient comorbidities as represented by the American Society of Anaesthesiologists (ASA) physical status classification (10), admission blood tests (C-reactive protein (CRP), White Cell Count (WCC) and platelets), imaging investigations (ultrasound scan (USS) or computed tomography (CT) with or without contrast enhancement) and outcome data. Management strategy was defined as one of the following: non-operative management (NOM) with antibiotics; operative management (OM) (with laparoscopic appendicectomy or open appendicectomy).

Operation notes were analysed to grade the severity of intra-operative findings in AA according to a nationally recognised system shown in Table 1 (11). Other information extracted from the EHR included: hospital length of stay (LOS); post-operative complications; re-attendance to hospital within 90 days from the initial presentation. Symptoms were reviewed daily by medical staff and patients were classified as being symptomatic or asymptomatic. COVID-19 tests (for SARS-CoV-2 RNA) were taken by trained Health Care Assistants and Nurses; the tests had a sensitivity of 71-98% (12)

Histology was reported on all operatively managed cases of AA and classified as 'normal appendix, 'acute inflammation', 'tumour' or 'other findings'.

Data on demographics, blood results and imaging modalities used are summarised for the 2019 and 2020 cohorts. The management of AA (NOM or OM) was compared between cohorts using a Chi-squared test, and blood results were compared using two sample t-tests and Mann Whitney tests. Within OM patients, surgical approaches and histology outcomes are summarised and compared between cohorts. Re-attendances are summarised and their management approaches were compared between cohorts. Length of stay was compared between cohorts using a Mann Whitney test.

Ethical approval was not required due to the retrospective and anonymised nature of the study. The project was registered locally and approved by the clinical audit department (reference number 20-4591).

Result

A total of 274 patients were included in this study (149 in 2019; 125 in 2020). Baseline characteristics, admission blood results and imaging modalities are reported in Table 2. A smaller proportion of patients were treated with NOM in the 2019 cohort than in the 2020 cohort (14/149 (9.4%) v (29/125 (23.2%)). Two patients in the 2020 cohort were transferred to a tertiary centre specialising in paediatric surgery for their ongoing care and were excluded from the analysis.

Operative Management (OM)

Table 3 shows surgical technique, intraoperative findings and the histology results for the OM patients. There was a statistically significant difference between the cohorts in terms of the proportion receiving NOM or OM ($p = 0.001$) and having laparoscopic or open surgery ($p < 0.001$).

Morbidity and Outcomes

The median length of stay (LOS) in 2019 was 4 days (interquartile range (IQR) 3 to 6 days), versus 3 days (IQR 2 to 5 days) in 2020 ($p = 0.03$). The patients who had NOM had a median LOS of 5.5 days (IQR 5 to 7 days) in the 2019 cohort compared to 3 days (IQR 2 to 6 days) in the 2020 cohort. The OM group had a median LOS of 4 days (IQR 3 to 5 days) in the 2019 cohort and 3 days (IQR 2 to 4.8 days) in the 2020 cohort.

In the 2019 cohort, there were two re-attendances (14.3%) in the first 90 days in the NOM group – one for an appendiceal abscess requiring interventional radiological (IR) drainage and the other for further intravenous antibiotics. Out of 135 patients in the OM group there were three reattendances (2.2%) – two patients had a post-operative collection and one had a superficial wound dehiscence.

In the 2020 cohort, two patients (6.5%) in the NOM group reattended and required a different management strategy – one had an open appendicectomy and the other received intravenous antibiotics for an appendiceal abscess confirmed on CT. In the 2020 OM group there were no reattendances requiring intervention.

COVID-19 swab tests became mandatory for all inpatients on 10th April 2020, this equated to 95 patients (76%) in the 2020 cohort who were tested. One patient tested positive (1.1%) and the remaining 94 (98.9%) who were tested were negative. The swab-positive patient was originally treated with NOM as their acute appendicitis symptoms coincided with their mild COVID-19 symptoms. The patient then reattended 14 days later and had a laparoscopic appendicectomy which showed acute inflammation on histology.

Discussion

The COVID-19 pandemic brought unprecedented challenges to the National Health Service and drove widespread changes in healthcare delivery. The UK had the benefit of witnessing the experiences in other

countries before a surge in UK COVID-19 cases, allowing our surgical services some time to prepare (13,14). The UK Intercollegiate guidance (4) encouraged a move towards NOM of AA where appropriate. Two recent trials support this approach despite the optimum treatment of AA remaining controversial (7,15–17). During the pandemic other General Surgery departments across the UK were having similar quandaries as us in decision-making processes as a result of the Royal Colleges' advice. (16) Our study adds to the literature by providing an insight into the workings behind a single-centre, aiding other similar sized centres in their decision-making for future viral spikes.

Following nationwide 'lock-down' in March 2020 fewer patients attended with AA (149 in 2019 vs 125 in 2020). NOM was used more frequently (9.4% in 2019 vs 24.8% in 2020) although the majority of patients still received OM. Patient selection for NOM appears to be in keeping with the advice provided by a recent AA update which advises NOM in patients with uncomplicated AA confirmed on imaging (15). The observed reduction in laparoscopic appendicectomy (92.6% of OM in 2019 vs 69.1% of OM in 2020; $p < 0.001$) reflects our Trust's iteration of the intercollegiate advice (4).

The current pandemic presents unquantified risks to patients. Some early collaborative trials showed there was an increased risk of morbidity and mortality in COVID-19 positive patients undergoing surgery (18). For surgeons this translates to new challenges in consent and shared decision-making. As the COVID-19 outbreak progressed our consent process changed to counsel patients on the risks associated with contracting the virus during the perioperative period. In 2019, 59 patients (39.5%) had a CT compared to 70 patients (56%) in 2020. This was to improve diagnostics and to guide appropriate management reducing unnecessary operating. Recent published guidance pushes towards imaging rather than diagnostic laparoscopy (19) and we had a lower negative appendicectomy rate in both cohorts (3.7% in 2019 and 3.2% in 2020) when compared with the literature (20,21). There is evidence that COVID-19 infection can clinically mimic AA in atypical cases (22) but none of the patients with a negative appendicectomy had COVID-19 confirmed on swab.

Patients presenting with AA during the COVID-19 pandemic had shorter hospital stays. This was the case for patients following an operation (median of 4 days in 2019 vs 3 days in 2020) despite evidence showing that open appendicectomies result in longer hospital admissions (5). These findings suggest that under normal circumstances we may be able to safely discharge patients earlier who are recovering from AA. This is supported by recent evidence demonstrating that OM of AA can be conducted as a day case in 25% of patients (23).

In this study, there are several limitations. It is a retrospective study and captures a small cohort of patients from a single-centre. However, it represents data from a large district general hospital and other studies have reported similar findings

(16,17) We cannot comment if patients re-attended out of area though this seems unlikely with Government advice to avoid non-essential travel (24).

In one sense the pandemic has presented an opportunity to put alternative approaches to the test. Easing of the preventive measures has demonstrated an evolving second peak of the virus and pressure on the health services may be worse than the first (25). This study has demonstrated few complications following NOM and subsequently our Trust is open to NOM in uncomplicated AA. Along with the strengthening body of evidence in support of this management strategy we are more equipped to counsel patients to make informed decisions about their care.

Conclusions

During the early months of the COVID-19 pandemic, we saw no increase in the severity of acute appendicitis presentations. In our department, more patients were managed without surgery, and spent less time in hospital. Consistent with other studies, we saw no significant difference in outcomes. We recognise the need for further studies to assess longer-term outcomes, but this study adds to the case for a non-operative first line approach to acute appendicitis.

Abbreviations

AA = acute appendicitis

NOM = non-operative management

OM = operative management

LOS = Length of Stay

COVID-19 = Coronavirus Disease 2019

SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2

UK = United Kingdom

HER = electronic health records

ASA = American Society of Anaesthesiologists

CRP = C-reactive protein

WCC = White Cell Count

USS = Ultrasound Scan

CT = Computed Tomography

IQR = interquartile range

IR = interventional radiological

Declarations

Ethics approval and consent to participate: Ethical approval was not required due to the retrospective and anonymised nature of the study. The project was registered locally and approved by the clinical audit department at the Royal Devon and Exeter Hospital NHS Trust (reference number 20-4591).

Consent for publication: Written consent was not obtained from study participants.

Availability of data and material: All data generated or analysed during this study are included in this published article [and its supplementary information files].

Competing interests: There are no competing interests to declare

Funding: There was no funding received for this study

Authors' contributions: All authors (HP, UD, MB, EW, GF, SN, SB and RMB) have read and approved the manuscript.

Acknowledgements: Not Applicable.

Disclaimer: Susan Ball is supported by the National Institute for Health Research (NIHR) Applied Research Collaboration (ARC) South West Peninsula. The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care.

PERMISSION TO COLLECT DATA

The project was registered locally and approved by the clinical audit department at the Royal Devon and Exeter Hospital NHS Trust (reference number 20-4591).

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Tables

Table 1 Intraoperative appearances of acute appendicitis (11)

Non-complicated Acute Appendicitis
Grade 0 – Normal looking appendix (Endoappendicitis/Periappendicitis)
Grade 1 – Inflamed appendix (Hyperemia, oedema ± fibrin without or little pericolic fluid)
Complicated Acute Appendicitis
Grade 2 – Necrosis Grade 2A – Segmental necrosis (without or little pericolic fluid) Grade 2B – Base necrosis (without or little pericolic fluid)
Grade 3 – Inflammatory Tumour Grade 3A – Flegmom Grade 3B – Abscess <5cm without peritoneal free air Grade 3C – Abscess >5cm without peritoneal free air
Grade 4 – Perforated – diffuse peritonitis with or without peritoneal free air

Table 2 Baseline demographics, blood results and imaging modality used

	2019	2020
Number of patients	149	125
Age, in years, mean (SD)	37.2 (21.2)	38.1 (21.0)
Sex, n (%)		
Male	80 (53.7)	67 (53.6)
Female	69 (46.3)	58 (46.4)
ASA score, n (%)		
I	109 (73.2)	76 (60.8)
II	27 (18.1)	44 (35.2)
III	12 (8.1)	5 (4.0)
IV	1 (0.7)	0 (0)
Admission blood test results		
CRP (mg/L) median (range) [‡]	44 (0-494)	37 (0-447)
WCC (1 x 10 ⁹ /L) mean (SD) [¥]	13.3 (4.2)	12.3 (3.5)
Platelets (1 x 10 ⁹ /L) mean (SD) [×]	253.3 (68.1)	252.4 (68.5)
Imaging modality, n (%)		
None	58 (38.9)	24 (19.2)
Ultrasound scan (USS)	32 (21.5)	31 (24.8)
Computed tomography (CT) [¥]	57 (38.3)	64 (51.2)
USS and CT	2 (1.3)	6 (4.8)
Imaging findings, n (%)		
None	58 (38.9)	24 (19.2)
Normal/inconclusive	16 (10.7)	8 (6.4)
Uncomplicated AA	58 (38.9)	70 (56.0)
Complicated AA	16 (10.7)	23 (18.4)
Other	1 (1.0) [*]	0 (0.0)
COVID-19	N/A	
Not tested, n (%)	149 (100)	30 (24.0)
Tested, n (%)	0 (0)	95 (76.0)

Positive	1 (1.1)
Negative	94 (98.9)

≠ ($p = 0.75$)

¥ ($p = 0.03$)

× ($p = 0.92$)

* Ovarian cyst

Table 3 Acute appendicitis management and outcomes among patients treated with Operative Management

Operative Management	2019 (N = 135)	2020 (N = 94)
Laparoscopic Surgery, n (%)	125 (92.6)	65 (69.1)
Open	10 (7.4) [±]	28 (29.7) [≠]
Unknown	0 (0.0)	1 (2.1)*
Intraoperative findings, n (%)		
Grade 0	5 (3.7)	3 (3.2)
Grade 1	72 (53.3)	55 (58.5)
Grade 2a	9 (6.7)	7 (7.4)
Grade 2b	2 (1.5)	3 (3.2)
Grade 3a	10 (7.4)	5 (5.3)
Grade 3b	18 (13.3)	7 (7.4)
Grade 3c	2 (1.5)	1 (1.1)
Grade 4	17 (12.6)	10 (10.7)
Histology, n (%)		
Acute inflammation	122 (90.4)	88 (93.4)
Tumour	1 (0.7) adenocarcinoma 3 (2.2) mucinous neoplasm 1 (0.7) neuroendocrine	0
Other	5 (3.7) normal appendix 1 (2.1) chronic inflammation	3 (3.2) normal appendix

[±] Two began as laparoscopic and were converted to open

[≠] Four began as laparoscopic and were converted to open

*Operation note unrecoverable in electronic medical records