

MANAGEMENT OF ACUTE APPENDICITIS DURING THE EARLY PHASE OF THE COVID-19 PANDEMIC: A SINGLE NHS CENTRE STUDY ONE YEAR FOLLOW UP STUDY.

Medical Science

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ABSTRACT

Introduction: Early during the COVID-19 pandemic, the royal college of surgeons advised to use Non-Operative Treatment of appendicitis (NOTA) or otherwise open surgery for appendicitis. This study has explored the resulted management differences, and the outcome after one year follow up.

Methods: Retrospective study covering Pre-pandemic data over March-May, 2019 & COVID-19 pandemic data over March-May, 2020. We compared the outcome of non-operative treatment approach (NOTA), open and laparoscopic surgical outcome between the 2 groups.

Results: The number of admissions was lower in the COVID compared to the Pre-COVID Group (35 vs 43).

In the COVID group had more CT scanning of the abdomen and pelvis (65.7% vs 42.2%; $p=0.036$). There was no difference in the diagnostic value for these imaging methods between the 2 groups (87.5% vs 86.6%).

During COVID period Significantly fewer patients underwent surgery (77.1 vs 92.8; $p<0.04$). There were significantly more complicated appendicitis cases in the COVID group compared to Pre-COVID group (59.2 vs 28.2; $p:0.021$). There was a reduction in LOS when comparing Laparoscopic to NOTA (1.7 vs 2.6 days; $p:0.03$). There has been a higher complication rate in the open and NOTA treatments compared to Laparoscopic, but this was not statistically significant (24.3% vs 14.8%; $p:0.29$).

In the NOTA group 41% of the patients had emergency or interval appendectomy in after one year follow up period.

Conclusions: There was a tendency towards conservative approach/open surgery during the pandemic. Our study suggests that Laparoscopic surgery should remain the preferred method of management of appendicitis during COVID-19 pandemic considering the more complicated appendicitis. NOTA should be limited to selected high risk patients, accepting the risk of disease recurrence and need for further interval or emergency surgery.

KEYWORDS

Appendicitis, COVID-19, NOTA, Follow up, Conservative, Non-operative.

INTRODUCTION:

Since December 2019, the COVID-19 pandemic has had significant huge impact on clinical medical practice, in many different aspects. Surgical specialties were no exception to this. In the United Kingdom (UK), the first COVID-19 wave saw, all most hospitals cancel elective surgical procedures were cancelled in most hospitals to accommodate the surge in hospital admissions and mitigate for hospital acquired COVID-19 infections [1][2]. This was in preparation for the first peak in the COVID-19 cases in order to optimize hospital capacity for new COVID-19 admissions, to avoid hospital acquired COVID-19 infection, and to prevent hospital staff from unnecessary exposure to COVID-19. [3,4].

The availability of In the early phase in March 2020 there was extremely limited COVID-19 testing available for patients and health care professionals was initially extremely limited in the UK. The practice in some hospitals was, for all new surgical emergency admissions in our hospital were to be treated as assumed COVID-19 patients positive. New precautions were implemented during this period. This included the use of full personal protective equipment (PPE) use intra-operatively, deep theatre cleaning between cases, and preventing the entry of theatre staff into the operating room 15-30 minutes following aerosol generating procedures (AGP) such as intubation. Whilst this protected patients, it added to that - considering intubation to be an aerosol generating procedure (AGP) - no staff could enter theatres for 15-30 min post intubation, this caused huge delays in the running of our emergency theatre list, restricting theatre productivity.

Acute appendicitis is a common surgical pathology seen in emergency surgical units. In light of the additive precautionary measures taken during the COVID-19 pandemic, management Therefore, treatment for appendicitis carried out during early months of COVID-19 had to be viewed through a new lens considering all the above factors. to rationalise resources and minimize in hospital patient transmission of COVID-19.

In the United Kingdom The Royal College of Surgeons of England recommended non-operative treatment of appendicitis (NOTA) to be implemented "where possible and deemed appropriate". "Where...possible and reasonable (such as for early appendicitis), One of the main reasons behind that was the data coming from all the

new studies This was reflective of the significant morbidity and mortality seen in COVID-19 positive patients undergoing major abdominal surgery. is mainly due to the worse outcome of surgical patient with COVID-19 : *"Data are emerging to guide us about postoperative risks. When major surgery is carried out in COVID-positive patients, whether diagnosed peri-operatively or post-operatively, the risks appear to be substantial"* [5,6]

Before the COVID -19 pandemic, the evidence behind the non-operative treatment of appendicitis (NOTA) comes from several randomised controlled trials (RCTs) [7, 8]. Despite some variation in results, the NOTA was proven to be a valid treatment option for certain patients and circumstances [9]. Those patients included high risk patient with significant morbidity, elderly and non-septic patients with early appendicitis. Having said that, Laparoscopic surgical management of surgery, however, remained the standard Golden treatment for acute appendicitis in the UK. This evidence for NOTA was thrown back into focus after COVID 19 pandemic. [10]

Moreover, Due to 'venturing into unknown' - 'safety-first' approach in the early months of the pandemic, and because of the unknown potential risk of viral transmission, The Royal college of surgeons recommended that laparoscopy only to be considered "in selected cases where...benefit to the patient substantially exceeds the risk of potential viral individual transmission. [6] this was based on few studies about surgical smoke [11, 12] this theoretical risk of virus transmission via surgical smoke exists without enough available evidence to quantify it. Globally we were 'venturing into unknown' and a 'safety-first' approach was adopted. Little was known about the potential risk of viral transmission intraoperatively. Few studies emerged about risk of viral transmission through surgical smoke [11, 12]. The evidence to quantify this risk was, however, lacking.

All the above have reflected and influenced how our hospital practice manages patients admitted with symptoms of acute appendicitis. Considering NOTA was considered for "uncomplicated appendicitis confirmed radiologically. If surgery was required, the "and preference was towards open surgery appendicectomy for surgical management of appendicitis.

Patients And Methods

A retrospective, single centre study that included patients admitted to

the surgical departments at St Peter's Hospital, London.was performed.

For Pre-COVID control group all Ppatients with a diagnosis of appendicitis who were admitted between 15th March 2019 to 15th May 2019 were recruited into the pre-COVID control group. and for the COVID Group all Ppatients with a diagnosis of appendicitis who were admitted between 15th March 2020 to 15th May 2020 were recruited into the COVID group. These two cohorts were compared in demographics, clinicopathological characteristics and surgical aspects of acute appendicitis.

Management decision was taken after considering the cClinical examination, and blood test alone, and/ or after radiological imagingtest US or CT. Only patients who had a diagnosis of acute appendicitis on their discharge documents were included into this study. We excluded Ppatients who were admitted with RIF and found to have different diagnosis through investigations or intra operatively were excluded.

Data wWas collected retrospectively using the followingon electronic data systems: Kainos (Evolve) Electronic Medical Record (EMR) system for epidemiological and clinicaland clinical data, Integrated Clinical Environment (ICE) for laboratory test and Histology, Picture Archiving and Communication Systems (PACS) for Radiology results. a And (Bluesprier) Theatre Management Systems for operations notes. and patients where followed up for one year post admission to identify further admissions or complications.

Appendicitis was graded according to the grading system suggested by Gomes et al[13]. Grade:1 (redness and oedema), 2(fibrin), 3A (segmental necrosis), 3B (base necrosis), 4A (abscess), 4B (regional peritonitis), and 5 (diffuse peritonitis). The dData was collected from both operation notes and histology.

Analysis

Categorical variables are expressed as frequency and were analysed using Fischer's exact test. Continuous variables are expressed as medians or means with 95% confidence intervals and were analysed using the Student's t test or Mann-Whitney U test (as appropriate). Tests were performed using GraphPad Prism 9.0 (GraphPad Software, San Diego, California, USA) and a Pp value of < 0.05 was considered significant.

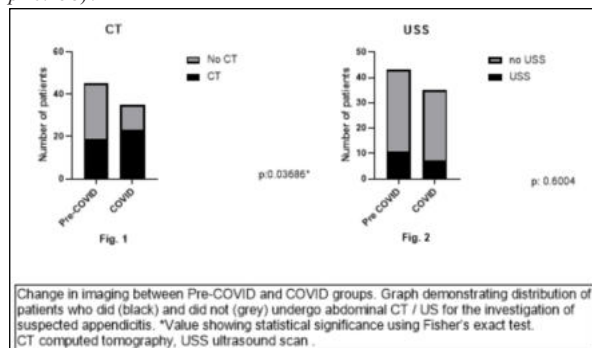
RESULTS

Patients

A tTotal nNumber of 35 patients were admitted between 15 March 2020 and 15 May 2020 in the COVID Cohort. A total of 43 patients were admitted in the same period a year previously in the pPre-COVID group and were analysed as control cohort group. All these patients had diagnosis of appendicitis on the discharge documentation.

The number of admissions was lower in the COVID compared to the pPre-COVID Group (35 vs 43, respectively). There were no significant differences in baseline demographics between the two cohorts.

On admission to hospital, patients in both groups had There was no demonstrable significant difference in white cell count (WCC) ($13.46 \text{ vs } 14.68 \times 10^9/\text{L}$; $p=0.854$), or C-reactive protein (CRP) ($75 \text{ vs } 51 \text{ mg/L}$; $p=0.158$).



Imaging

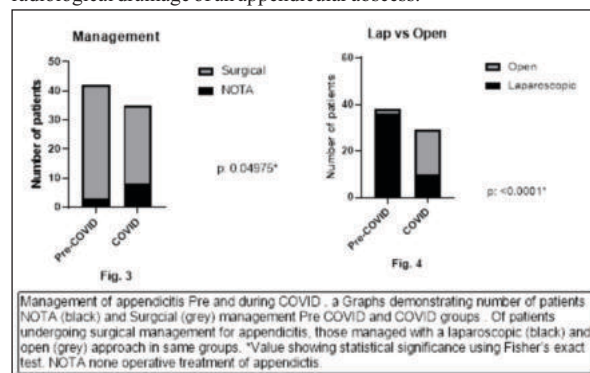
In the COVID group, significantly more patients with possible appendicitis underwent CT scanning of the abdomen and pelvis

(65.7% vs 42.2%; $Pp=0.036$) (Fig. 1). Concurrently, there was a no significant decrease in the use of ultrasound examinations (20 vs 25.5%; $Pp=0.6$) (Figure. 2). There was no difference in the diagnostic value for these imaging methods between the 2 groups (87.5% vs 86.6%)

Management Of Appendicitis

During the COVID period, s Significantly fewer patients underwent surgery (77.1 vs 92.8; $p<0.04$) (Figure. 3).

Nonoperative treatment of appendicitis NOTA was mainly done with intravenous or oral aAntibiotics. ; Oone patient require CT guided radiological drainage of an appendicular abscess."



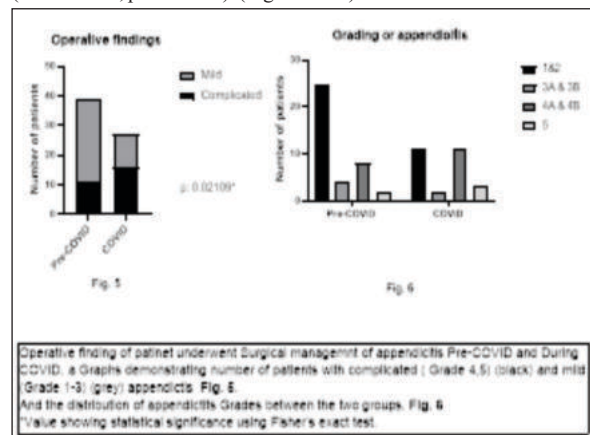
Operative Findings

we used a simple grading system suggested by Gomes et al [13] described in table 1

Grade	Laparoscopic findings
Grade 0	Normal looking appendix
Grade 1	Hyperemia and edema
Grade 2	Fibinous exudate
Grade 3A	Segmental necrosis
Grade 3B	Base necrosis
Grade 4A	Abscess
Grade 4B	Regional Peritonitis
Grade 5	Diffuse Peritonitis

Table 1: Laparoscopic Grading system of acute appendicitis (From Gomes et al. 2015)

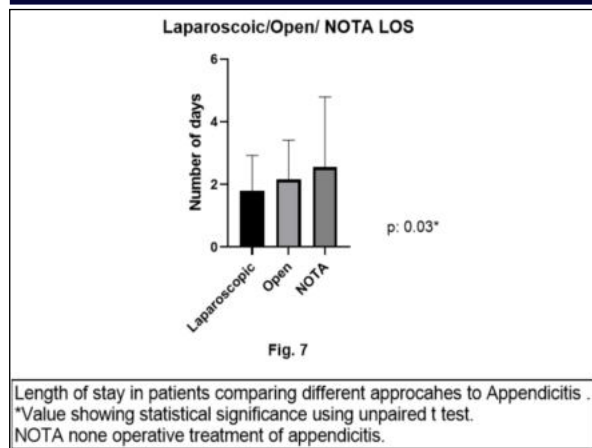
There were significantly more complicated appendicitis cases (Grade 4A and above) in the COVID group compared to Pre-COVID group ($59.2 \text{ vs } 28.2$; $p P= 0.021$). (Figure 5 & 6)



Length Of Stay (LOS)

The LOS was longer in patients admitted during COVID compare to pPre-COVID., Tthis differencet was not statistically significant (2.1 days vs 1.69 days; $P=0.142$)

The LOS for management of appendicitis for lLaparoscopically, oOpen, and using NOTA measures was (1.7, 2.1 and, 2.6 days) respectively. However, there was in reduction LOS when comparing Laparoscopic to NOTA ($p:0.03$)



Complications And Readmission

There have been more complications in the COVID group compared to the Pre COVID (27 % vs 8.7%; $P=0.03$). The list of complications is listed in (Table 2).

There was no significant difference in the readmission rate in the first 3 months between the two groups.

There has been higher complication rates in the open and NOTA treatment groups compared to the Laparoscopic group. This, however, was not statistically significant (24.3 % vs 14.8%; $P=0.29$).

We followed up NOTA for 10 months. A total of 41 % of the patients (5 out of 12) had emergency or interval appendectomy in this period.

Pre COVID	Laparoscopic:	- Allergic Reaction - Ongoing pain - Intraoperative gas related pain
	Open	Pelvic collection
	NOTA	
COVID	Laparoscopic	- Drain site complications - Wound complications - Drain site complication - Allergic Reaction - COVID
	Open	- Wound complications - Oral candidiasis - Post op collection - Wound complications - Pelvic collection - PONV
	NOTA	- Ongoing pain - Ongoing pain - USS Drain site complication

Table 2: List of Complications
NOTA Non operative treatment of appendicitis

DISCUSSION

Following the UK government advice, our hospital's practice shifted toward NOTA or open surgery for managing acute appendicitis in the early weeks of the COVID-19 pandemic. There has been a slight reduction in the number of patients presenting with appendicitis during the pandemic compared to the same period last year (35 vs 43) a reduction of 19%. We have performed more open appendectomies (18 vs 2) and more NOTA (8 vs 4) during the pandemic too. More patients had CT scans to confirm the diagnosis during the COVID period compared to non COVID period (65.7% vs 42.2%; $P=0.036$). This practice was also observed in few other hospitals in the UK. [14]

Laparoscopic surgery was avoided after 'side of safety' RCOs recommendations for the theoretical potential of virus transmission during laparoscopic surgery via surgical smoke and laparoscopy gas [10]. Hence, laparoscopic surgery was deemed high risk. This reflected the shift towards open surgery. In our study there was a higher complication risk in the open group compared to the Laparoscopic approach group, but this was of no statistical significance (24.3 % vs 14.8%; $p=0.29$).

However, studies have shown that laparoscopic surgery in adults was associated with lower incidence of wound infection, fewer

postoperative complications, shorter postoperative stay, and earlier return to normal activity [15]. Moreover, Laparoscopic approach surgery appears to have significant benefits with improved morbidity compared to open in complicated appendicitis [16].

NOTA was recommended by the Royal College of Surgeons to be a valid approach in managing uncomplicated appendicitis [6]. Our study also showed that NOTA was associated with higher LOS when compared to laparoscopic surgery (2.6 vs 1.7 days; $P=0.03$), even without considering the readmissions. In our study NOTA management failed in 41% of patients.

Patients admitted during the COVID-19 period had more complicated appendicitis compared to the pre-COVID group (59.2 vs 28.2; $P=0.021$). This finding is similar to several studies done during COVID-19 pandemic [17-19]. It was suggested that delayed presentation and decision making might be a contributory factor in us seeing more complicated appendicitis. [20-22].

Complicated appendicitis presentations during the COVID pandemic, makes them less suitable for NOTA (which has longer LOS and is associated with higher rate of complication when managed by open surgery [16]).

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