

Clinical Paper

A surge in appendicitis: Management of paediatric appendicitis during the COVID-19 surge in the Royal Belfast Hospital for Sick Children.

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ABSTRACT

Background

Traditional surgical dogma is that paediatric appendicitis necessitates an appendicectomy; however there is an increasing cohort of evidence suggesting that non-operative management (NOM) using antibiotic therapy is safe and effective. During the COVID-19 surge (April – June 2020) with centralization of paediatric surgical care and risks from anaesthetics to both patients and staff a NOM pathway was used to manage clinically diagnosed appendicitis in the Royal Belfast Hospital for Sick Children (RBHSC).

Methods

Prospective data collection was undertaken of all children (<16 years) diagnosed with appendicitis who entered the NOM pathway in RBHSC from 01/04/2020 to 30/06/2020. This was compared to a cohort from the same timeframe in 2019. Primary end-points were inpatient success rate of NOM and 30-day success rate of NOM (success defined as no appendectomy performed).

Results

47 patients completed the NOM pathway, with 43% (20/47) suspected to have complicated appendicitis. The cohort was similar to that of 2019 in terms of age ($p=0.1$) and sex ($p=0.8$), but was 155% larger (42 v. 20).

For those with simple appendicitis, there was a 96% (26/27) success rate of NOM on discharge, with a 93% (25/27) 30-day success rate. For complicated appendicitis, there was a 40% (8/20) success rate on discharge, with a 30% (6/20) 30-day success rate.

Conclusion

The use of a NOM pathway for paediatric appendicitis during the COVID-19 surge in Northern Ireland was safe and effective for staff and patients. With a small sample size and restricted follow up more evidence is required to prove if this is an effective treatment modality with a return to normal theatre availability. In the interests of antibiotic stewardship we would not advocate NOM pathways utilisation by non-surgical clinicians.

Key words

COVID-19, appendicitis, paediatric, antibiotics, non-operative

Background

Traditional surgical dogma is that paediatric appendicitis necessitates an appendicectomy, however there is an increasing cohort of evidence to suggest that non-operative management (NOM) with antibiotic therapy has a role.

Prospective studies utilising antibiotic therapy in simple or uncomplicated paediatric appendicitis have resulted in 92-94%^{1,2} success rates as an inpatient, with 30 day success rates of 89%². In complicated appendicitis (perforation or abscess) primary antibiotic therapy can achieve an inpatient success rate of 66%³

Setting

During the primary surge of COVID-19 in Northern Ireland (April – June 2020), working practices for children with acute surgical conditions changed. All children (<16 years old) with suspected appendicitis were referred to the general surgery team in the Royal Belfast Hospital for Sick Children (RBHSC), whereas previously, for some children their care was provided by adult surgical services in district general hospitals. All elective operations were appropriately suspended in RBHSC to allow for this increase in emergency care, as well as reducing the potential risk to patients of anaesthesia during the pandemic⁴.

In an effort to protect theatre staff from potentially COVID-19 positive patients and the potential risks of anaesthesia in a COVID-19 positive patient a decision was made by the surgical team to develop a NOM pathway. This utilizes a scoring system⁵ to discriminate between simple and complicated appendicitis, and components of our department's original post-appendicectomy antibiotic pathway with separate arms for suspected complicated and simple appendicitis.

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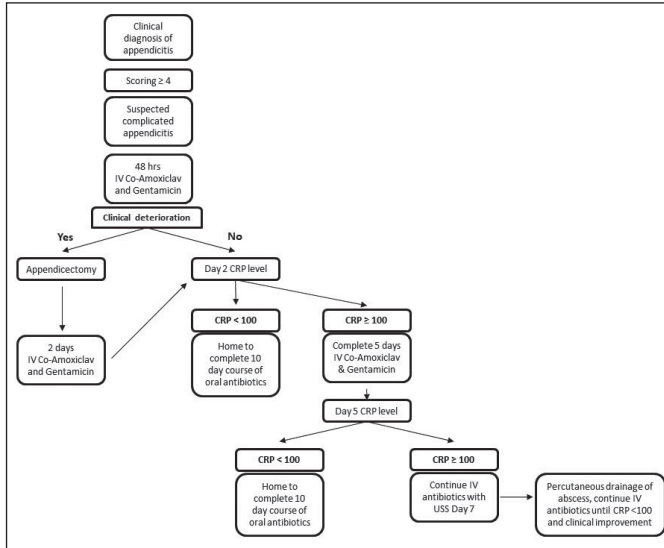
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Aims

This paper outlines our experience during the COVID-19 surge and compares it to our caseload from the same timeframe in 2019 when patients were managed primarily operatively.

Patients and methods

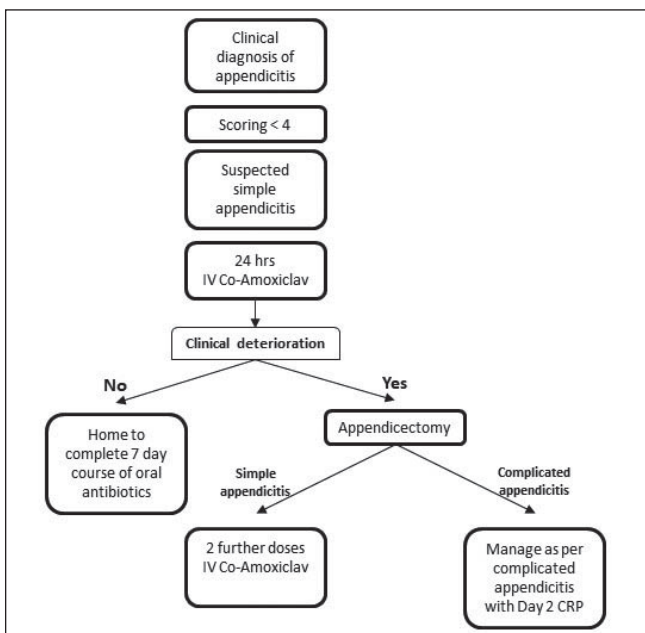
Figure 1



We prospectively collected data on all patients diagnosed with appendicitis <16 years old managed in RBHSC from 01/04/2020 to 30/06/2020, during the COVID-19 surge phase in Northern Ireland. Not included were patients who were commenced on antibiotic treatment by clinicians outside of the Paediatric Surgical team in RBHSC or did not follow the NOM pathway.

Primary endpoints included inpatient success rate of NOM and 30 day success rate or NOM (success meaning no appendicectomy performed during admission or within 30 days of discharge).

Figure 2



The NOM pathways are outlined in **Figures 1 & 2**. During NOM treatment if the patient exhibited clinical deterioration on review by a consultant surgeon, they would proceed to an appendicectomy.

These findings were then compared to previously collected data on patients managed in RBHSC from 01/04/2019 to 30/06/2019 on the aforementioned post-appendicectomy pathway using Student t-test, or Fischer’s exact test where applicable. Significance was set at $p < 0.05$.

Results

During this 3 month surge phase, 51 patients with acute appendicitis were managed in RBHSC with 47 entering the NOM pathway (92%). Median age of all patients was 10 years (IQR 8-12 years), and 71% (36/51) were male. None of the patients provided a positive COVID-19 swab on admission. 10% of patients (5/51) underwent an ultrasound to aid diagnosis.

Table 1

NOM pathway appendicitis	April – June 2020 (COVID SURGE)		April – June 2019 (Comparison)		
	N =	%	N =	%	p=
Patients	47		20		
Age (median)	10 years		9 years		0.1
Male	33/47	70%	13/20	65%	0.8
Average length of stay	3.2 days		3.5 days		0.7
Successful NOM on discharge	34/47	72%			
Re-admission	6/34	18%	1/20	5%	0.2
Successful NOM 30 days post-discharge	32/47	68%			

Overall 72% (34/47) of patients were successfully managed with antibiotics alone until discharge with an 18% (6/34) readmission rate at 30 days. 2 of these readmitted patients went on to have an appendicectomy (**Table 1**). In comparison to the same time frame in 2019, there was an increase in admissions from 20 to 51 cases (155% increase).

For suspected simple appendicitis, 96% (26/27) were successfully treated with antibiotics on their initial admission, with a 30 day readmission rate of 19% (5/26). 1 of these patients required an appendicectomy on readmission giving a 30 day success rate for NOM of 93% (25/27).

Table 2 outlines the results of patients suspected to have complicated appendicitis. 40% (8/20) of patients were successfully managed with NOM, 3 (15%) required abscess drainage and 9 (45%) proceeded to appendicectomy. Of the NOM patients, 2/8 (25%) were readmitted within 30

Table 2

Complicated appendicitis	April – June 2020 (COVID SURGE)		April – June 2019 (Comparison)		
	N =	%	N =	%	p=
Complicated appendicitis	20/47	43%	12/20	60%	0.3
Age (median)	10 years		9 years		
Male	14/20	70%	7/12	59%	0.7
Average length of stay	5.2 days		5.1 days		0.9
Successful NOM on discharge	8/20	40%			
Re-admission	5/20	25%	1/12	8%	0.4
Re-admission NOM	2/8	25%			
Re-admission (Had operation)	3/12	25%	1/12	8%	0.6
Successful NOM at 30 days	6/20	30%			



days, giving a 30 day success rate for NOM in complicated appendicitis of 30% (6/20). Both of the readmitted patients subsequently underwent an appendectomy on readmission. All patients who were suspected to have complicated appendicitis and had an appendectomy had this diagnosis confirmed on histopathological assessment.

Discussion

The lifetime risk of appendicitis is between 6-9%^{6,7} with a known peak between 10-20 years old⁸. For over a century^{9,10} an appendectomy has been the mainstay of treatment, however in an effort to reduce morbidity and the risk of removal of a normal appendix, NOM in children has been shown to be effective¹¹.

NOM of appendicitis in environments without access to emergency surgical care is also well established^{12,13}. During the COVID-19 surge it appeared to be an appropriate step to utilise antibiotics as the primary treatment modality for appendicitis with the understanding that the established practice of appendectomy was available if there was any evidence of clinical deterioration. Although only 1-2% of COVID-19 cases have been in children, the risks to staff of general anaesthesia in a COVID-19 positive patient were significant¹⁴ with aerosolization of virus and contamination of the theatre environment. Previously patients with appendicitis would undergo appendectomy on the day of admission, or if admitted overnight, the following day. During the surge period there was no rapid method for identifying COVID-19 positive patients in the normal timeframe between admission and theatre. Every procedure therefore required full personal protective equipment (PPE) and theatre deep cleaning as asymptomatic carriage and transmission to healthcare workers by children has been well documented¹⁵. From August 2017 to January 2019; 56% of emergency appendectomies were performed laparoscopically in RBHSC. During the COVID 19 surge there was concern that uncontrolled expulsion of laparoscopic gas and surgical smoke plume may lead to virus transmission to staff from even asymptomatic patients. With a lack of effective PPE and surgical equipment to improve staff safety, the initial departmental decision was to use the open approach when surgical intervention was deemed necessary.

Our results for suspected simple appendicitis managed non-operatively are in line with international results (96% and 93% at discharge and 30 days vs. 92-94%^{1,2} and 89%¹¹ respectively). Relying on clinical diagnosis without radiological (again in an effort to reduce staff exposure) or intra-operative evidence would suggest that some patients may have been over treated, however our department's negative appendectomy rate over the preceding two years has been 3% with no change to personnel.

For complicated appendicitis 40% were successfully managed non-operatively which is lower than other centres (66%)³. The majority of patients undergoing an appendectomy for failed NOM were operated on within 24 hrs of commencing treatment and it may be reasonable to suggest that if this

had been a randomised trial, a longer period of NOM may have been tolerated by the clinical team. It was hypothesised that the rate of complicated appendicitis would increase, expecting parents to be reluctant to attend the emergency department early in a disease process with concerns about coronavirus transmission. However in comparison to the previous year, this proportion of complicated appendicitis fell (60-43%).

Recurrent appendicitis

For suspected simple or uncomplicated appendicitis, long term recurrence rates with histologically confirmed appendicitis have been published from 16-17%^{16,17} over follow up periods of up to 5 years.

For complicated appendicitis, long term recurrence rates vary depending on the feature which defines complicated. In acute perforated appendicitis, recurrence rates of 8% at 7 years follow up have been documented in retrospective studies¹⁸. For those with an appendix mass, one systematic review calculated 20.5% recurrence rates (with follow up ranging from 6 months to 13 years)¹⁹. These findings form the statistical basis for informed consent with patients and their parents regarding interval appendectomy during our outpatient review in RBHSC following NOM.

Recommendation

Utilizing this pathway during the COVID-19 surge appears to have been a safe and appropriate step. Most patients with presumed simple appendicitis can be treated with antibiotics alone and there are some patients with suspected complicated appendicitis who can be managed non-operatively. However drawing conclusions that abandoning primary appendectomy for both complicated, and simple appendicitis would not be advocated by our team. Without review by an experienced surgeon, over-treating abdominal pain in the emergency department, of which appendicitis typically accounts for 1%¹⁶, may lead to poor antibiotic stewardship. There is also a concern about long term sequelae of NOM; recurrent appendicitis, adhesions, chronic abdominal pain and the risk of a missed neuroendocrine tumour. All patients involved in this pathway have been offered an outpatient discussion regarding an interval appendectomy.

With an ongoing concern about a second spike in COVID-19 cases, or other future pandemics, we believe that similar NOM pathways in similar settings may be of benefit for the health service in Northern Ireland, without detriment to our paediatric patients.

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