Complicated appendicitis due to diagnosis delay during lockdown period in Italy

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Although children seem to be less affected than adults by COVID-19, Italian paediatric hospitals have had to significantly reorganise services to deal with the pandemic. These include the tertiary-level Gaslini Children’s Hospital in Genoa, which handles around 35,000 emergency room (ER) visits per year. The Government lockdown has dramatically reduced ER admissions and delayed programmed admissions.¹ We noticed this from the first verified cases of COVID-19 in Italy, and ER visit fell significantly after the schools closed in our region on 25 February.² Parents stopped bringing children to the paediatric ER due to Government restrictions and fears about COVID-19. In addition, telemedicine partially failed to provide adequate paediatric care, and this resulted in delays to urgent surgery.³,⁴

This observational cohort study retrospectively compared appendectomies at our hospital from 1 March to 3 May and during the same periods in 2017–2019. We looked at the severity in terms of clinical presentation and laboratory data to identify possible diagnostic delays, which can lead to delayed diagnosis of peritonitis, abscess formation or sepsis. Diagnoses were based on the International Classification of Diseases (ICD-9th Revision) to facilitate post-surgery data collection. The non-complicated appendicitis group covered acute appendicitis (code 54.09), including catarrhal, phlegmonous and non-perforated gangrenous appendicitis. The complicated appendicitis group comprised acute appendicitis with peritonitis (54.00) and peritoneal abscesses (54.01).

The data extracted from the records were age, gender, any fever or vomiting, laboratory tests and surgical diagnoses. Continuous variables are presented as medians and interquartile ranges (IQR) and categorical variables as numbers and percentages. Fisher’s exact test or the chi-square test was used to evaluate differences in the distribution of the categorical variables between the groups. Continuous variables were evaluated using the Mann–Whitney U test. The incidence rate was calculated by dividing the numbers of complicated appendicitis by the person-days. A p value of <0.05 was statistically significant. All the data analyses were carried out with Stata version 13 software (StataCorp LLP).

Table 1 compares the demographic characteristics, symptoms on arrival and laboratory tests between the two groups. No significant differences were found in 2017–2019, and the data were grouped together. The 2020 lockdown group comprised 27 children that underwent a laparoscopic or open appendectomy. The diagnosis was complicated appendicitis in 13 cases: eight peritonitis, four peritoneal abscesses and one peritoneal tuberculosis. There were also 14 acute cases: 10 phlegmonous appendicitis, three non-perforated gangrenous and one catarrhal. The 2017–2019 non-lockdown group comprised 75 cases. There were 20 cases of complicated appendicitis: 16 cases of peritonitis and four cases of abscess. There were also 55 cases of acute appendicitis: 39 phlegmonous appendicitis, eight non-perforated gangrenous appendicitis and eight catarrhal appendicitis. Complicated cases were more frequent in the lockdown group than non-lockdown group: 13 cases/989 person-days versus 20/3032 person-days (p < 0.00). There were no significant differences between the acute cases in 2020 and the previous three years: 14 cases/989 person-days versus 55/3032 person-days (p > 0.2). All patients were tested for the virus that causes COVID-19 with real-time polymerase chain reaction nasopharyngeal and deep nasal swabs, and all the results were negative. This study showed that the burden of severe cases of acute appendicitis, caused by diagnostic delays, increased significantly during the Italian lockdown from 1 March to 3 May 2020.
Appendicitis is the most common abdominal surgical emergency in pediatric patients and early diagnosis and appropriate surgical and, or, antibiotic therapy could prevent complications.

During lockdown, there was no overall increase in acute appendicitis requiring surgical treatment, but there was a different distribution in the severity of cases seen by the ER. Table 1 shows the lockdown group cases had worse parameters on admission, with regard to their clinical presentation and blood tests. Moreover, we found a higher incidence of complicated cases in the lockdown group, which was probably due to delays in accessing the ER due to the COVID-19 pandemic.

Laboratory data showed higher levels of C-reactive protein and fibrinogen in the lockdown group, even in the non-complicated cases. This suggested a more advanced state of inflammation and diagnostic delay.

Our study was limited because it was a single centre retrospective study, but it was carried out in the main pediatric hospital in Italy.

These results demonstrate an increased incidence of complicated appendicitis during the COVID-19 lockdown in March to May 2020, and this appears to reflect parents’ reluctance to come to the ER even when children have worsening medical symptoms. Since the beginning of March 2020, several unexpected procedures and regulations have been introduced in Italy. Authorities strongly advised people to stay at home and avoid hospitals and ERs, but telemedicine was unable to replace direct physical examinations. Although there was general agreement about Government measures to manage the pandemic, some of the knock-on effects were not immediately detected.

Our study shows that it is dangerous to delay the diagnosis of surgical emergencies and, although mitigating the virus is essential, pediatric emergencies will continue to occur and should be diagnosed and treated promptly.

### TABLE 1  Comparison of demographic characteristics, symptoms on arrival and laboratory tests between the two groups

|                  | Lockdown group | Control group | p value |
|------------------|----------------|---------------|---------|
| Patients         | 27             | 75            |         |
| Gender (male)    | 18(66.6%)      | 41(54.6%)     | 0.27    |
| Age (years)      | 9.5 (2.5–14.5) | 10.5 (2–16.5) | 0.37    |
| Fever            | 18 (66.6%)     | 33 (44.0%)    | 0.04    |
| Vomiting         | 20 (74.0%)     | 34 (45.3%)    | 0.01    |
| Complicated appendixis | 13 (48.1%) | 20 (26.6%) | 0.04 |
| White blood cells (median, IQR) | 15,000 (12,040–18,320) | 15,930 (1202–18,480) | 0.7 |
| Neutrophils (median, IQR) | 12,200 (9720–16,010) | 13,030 (9200–16,150) | 0.9 |
| Fibrinogen (median, IQR) | 493 (407–557) | 380 (338–449) | 0.0019 |
| Coagulation disorders | 9 (33.3%)  | 11 (1.6%)     | 0.04    |
| C-reactive protein (median, IQR) | 6.83 (3–12.3) | 2.77 (0–8.2) | 0.04 |

Note: Lockdown group: appendicitis cases treated between 1 March and 3 May 2020. Control group: appendicitis cases treated from 1 March to 3 May 2017, 2018 and 2019. Bold figures indicate significant p values.

### CONFLICT OF INTEREST

None.

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