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COVID-19 Diagnosis in Patients With Acute Abdominal Pain Without Respiratory Symptoms: A UK Emergency General Surgical Unit Experience

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Abstract

Background: Recent evidence has emerged reporting atypical clinical symptoms of the novel coronavirus (COVID-19). There is a sparsity of existing studies examining COVID-19-related abdominal pain and the role of investigative imaging for the virus in these patients. Study aims were to determine COVID-19 incidence in those with acute abdominal pain in the absence of respiratory symptoms and to assess the diagnostic performance of CT thoracic imaging in such patients.

Methods: Retrospective analysis of all consecutive patients admitted to our emergency general surgical unit between 1st March 2020 and 31st May 2020 was performed. In adherence with national guidelines, all patients underwent nasal and oro-pharyngeal COVID-19 RT-PCR swabs as well as thoracic and abdominal computed tomography (CT) on admission.

Results: From 112 patients admitted with acute abdominal pain in the absence of respiratory symptoms, 16 (14.3%) tested positive for COVID-19 on RT-PCR swab testing. Overall, 50% (8/16) of these patients had no intra-abdominal pathology on CT. The sensitivity and specificity of CT thoracic imaging for diagnosing COVID-19 was 43.8% and 91.7%, respectively. Patients with positive COVID-19 swabs had higher C-reactive protein levels, lower potassium levels and a higher proportion of those with a low lymphocyte count.

Discussion: One in seven patients with abdominal pain without any respiratory symptoms tested positive for COVID-19. Half of these patients represented COVID-19 manifesting primarily as acute abdominal pain. Combined swab testing and CT imaging should be performed in all abdominal pain presentations due to the varying diagnostic performance of thoracic CT in diagnosing COVID-19.

Keywords
COVID-19, general surgery, radiology

Key Takeaways

- This study examined a surgical patient population presenting to our unit with acute abdominal pain without the typical respiratory symptoms usually associated with COVID-19.
- We report a 14.3% (16/112) incidence of COVID-19 in this population. Half of these patients (8/16) had normal abdominal CT findings, suggesting COVID-19 was potentially presenting primarily with abdominal pain.
- Our secondary aims also assessed the diagnostic performance of thoracic CT in diagnosing COVID-19 (by demonstrated typical COVID-19 CT changes) in this cohort of surgical patients presenting with abdominal pain in the absence of respiratory symptoms.

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- We believe our findings are novel and emphasise an important strategy in diagnosing COVID-19 by performing CT thorax with CT abdominal imaging along with COVID-19 swab testing in all patients presenting with abdominal pain in this current COVID-19 era.

Introduction

A novel viral illness linked to the Huanan seafood market in Wuhan City (China) emerged in December 2019.[1,2] The discovered responsible pathogen was called the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and subsequently escalated to a global pandemic (COVID-19) declared by the World Health Organisation (WHO) on 11th March 2020.[3,4] Typical COVID-19-related symptoms include fever, cough, dyspnoea, fatigue and anosmia.[3] Clinical manifestations of gastrointestinal upset such as abdominal pain, diarrhoea and vomiting have also been reported.[5,6] However, studies reporting acute abdominal pain as an initial presenting complaint of COVID-19 are scarce in the existing literature.

Within the United Kingdom, presence of COVID-19 has primarily been diagnosed with reverse transcription polymerase chain reaction (RT-PCR) testing of nasal and deep oro-pharyngeal swabs in suspected patients.[7] A recent meta-analysis concluded RT-PCR swabs had an estimated positive predictive value (PPV) of 47.3% to 96.4% and a negative predictive value (NPV) range of 96.8% to 99.9%, therefore potentially leading to missed COVID-19 diagnoses.[8] The use of radiological imaging with computed tomography (CT) of the thorax has been advocated in diagnosis of COVID-19 with typical features including peripheral consolidation, ground glass opacification, crazy paving appearance and bronchovascular thickening. From 601 patients with confirmed positive COVID-19 RT-PCR swab results, *Ai* et al[4] reported 580 (97%) had CT thorax findings typically associated with the virus. However, the same study also revealed 75% of those with a negative RT-PCR swab result had typical CT findings, equating to a low specificity. National guidelines released in the United Kingdom during the pandemic recommend all acute abdominal pain presentations requiring CT imaging of the abdomen should also include thoracic CT to aid diagnosis of possible co-existing COVID-19.[9,10] This would reduce potential transmission of the disease to other patients and health care personnel working on surgical wards and in operating theatre environments. It would also augment risk stratification and guide perioperative management in patients requiring emergency surgery. A multitude of biochemical parameters have also been associated with COVID-19 positivity; however, this has yet to be examined in those presenting with acute abdominal pain. Diagnosis of COVID-19 is challenging and often requires numerous tests from the available investigative armamentarium.

The current literature is limited in regard to COVID-19 presenting as abdominal pain in the absence of respiratory symptoms as well as the diagnostic value of CT and biochemical markers in this cohort. Our primary aim was to report the incidence of COVID-19 in patients admitted with acute abdominal pain with no respiratory symptoms. Secondary aims were to analyse the diagnostic performance of thoracic CT imaging against RT-PCR swab results in detecting COVID-19 in these patients and also to compare biochemical results between those with positive and negative COVID-19 RT-PCR swab results.

Methods

Retrospective analysis of all consecutive patients presenting to our emergency general surgical unit between March and May 2020 with acute abdominal pain without respiratory symptoms was performed. Our institution is a busy UK district general hospital providing a 24-hour emergency surgery service. All patients underwent routine diagnostic nasal and oro-pharyngeal swabs for SARS-CoV-2 and acute CT imaging of the thorax, abdomen and pelvis with intravenous contrast at time of admission in accordance with national guidance. All CT scans performed were formally reviewed and reported by a consultant radiologist. Patients of all ages were included within this study. We excluded patients who had elective CT scans for abdominal pain, incomplete acute CT imaging of the thorax, abdomen and pelvis or missing RT-PCR swab results. Patients presenting with prior or existing respiratory symptoms (cough, shortness of breath, chest pain, wheeze, haemoptysis and anosmia) at time of admission with abdominal pain were also excluded.

Data on patient demographics, presenting symptoms, comorbidities, RT-PCR swab results, CT findings and biochemical markers including white cell count (WCC), lymphocytes, C-reactive protein (CRP), sodium, potassium, urea, creatinine, bilirubin, alkaline phosphatase (ALP) and alanine aminotransferase (ALT) were collected via patient electronic notes, CT reports and online blood test results.

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS Windows version 24.0, Chicago, IL, USA). Statistical significance was set at $P<.05$. Data are expressed as whole numbers with percentages, means with standard deviations and medians with interquartile ranges (IQRs). For data analysis, chi-squared test or Fisher's exact test was used for categorical variables dependent on group size and Student t-test or Mann-Whitney U test for parametric and non-parametric continuous variables, respectively. This study has been conducted in accordance with the Strengthening the

Table 1. Characteristics and Radiological Findings in Patients Testing Positive for COVID-19.

Patient Number	Age	Gender	Presenting Symptoms	CT Thoracic Findings	CT Abdominal Findings
1	45	F	Right-sided abdominal pain and fever	Ground glass opacity peripheral consolidation	NAD
2	50	F	Upper abdominal pain and vomiting	Ground glass opacity	Acute appendicitis
3	42	F	Lower abdominal pain, vomiting, and diarrhoea	Ground glass opacity peripheral consolidation bronchovascular thickening	NAD
4	87	F	Widespread abdominal pain	Peripheral consolidation	NAD
5	70	M	Upper abdominal pain and lethargy	Ground glass opacity	NAD
6	74	M	Lower abdominal pain and rectal bleeding	Crazy paving appearance, peripheral consolidation	Rectosigmoid procto-colitis
7	96	F	Left-sided abdominal pain, bloating	Ground glass opacity	NAD
8	76	F	Left-sided abdominal pain and diarrhoea	Atelectasis	Left-sided colitis
9	76	F	Widespread abdominal pain and vomiting	Atelectasis	NAD
10	81	F	Lower abdominal pain	NAD	Intra-abdominal collection
11	84	M	Upper abdominal pain	Left-sided pleural effusion	Pancreatic cystic lesion
12	11	F	Right-sided abdominal pain, fever	Bronchiectasis changes	NAD
13	83	F	Right-sided abdominal pain and vomiting	Left-sided pleural effusion atelectasis	NAD
14	41	F	Right upper quadrant pain	Lobar consolidation	Acute cholecystitis
15	66	F	Upper abdominal pain	NAD	Inflammatory pancreatic phlegmon
16	70	F	Lower abdominal pain and fever	NAD	Pelvic collection

Abbreviation: NAD: no abnormalities detected.

Reporting of Observational studies in Epidemiology guidelines.[11]

Results

Overall, 112 patients were admitted to our general surgical department with abdominal pain in the absence of respiratory symptoms over this time period. The median age was 57 years (IQR: 42-78 years) with a female majority of 59.8% (n = 67/112). The majority of patients were Caucasian (83.9%) or of an Asian (12.5%) ethnic background. All included patients underwent nasal and oro-pharyngeal swabs as well as CT imaging of the thorax, abdomen and pelvis. Overall, 16 (14.3%) patients tested positive for COVID-19 from nasal or oro-pharyngeal swabs. Details of these COVID-19 confirmed patients are on Table 1. Additional swab tests were performed on all patients testing negative; however, no further positive results were yielded. Of the patients with abdominal pain and testing positive for COVID-19, 50% (n = 8/16) had normal abdominal CT scans with no apparent intra-abdominal pathology. Comparative analysis between those testing positive and negative for COVID-19 on RT-PCR swabs for patient demographics, comorbidities and presenting symptoms is displayed on Table 2.

A study flowchart of swab results and CT thorax findings has been displayed in Figure 1. From our overall study population, 15 (13.4%) patients had evidence of typical COVID-19 radiological features on CT thoracic imaging. In this study, there was a sensitivity of 43.8% and specificity of 91.7% for CT thorax diagnosing COVID-19 when using a positive RT-PCR swab result for confirmation of COVID-19 disease status. Presence of COVID-19 typical features on thoracic CT was compared in the COVID-19 swab positive and swab negative cohorts within our study population (Table 3). A higher proportion of COVID-19 positive swab patients had ground glass opacity and peripheral consolidation on

Table 2. Baseline Patient Demographics and Presenting Symptoms of COVID-19 Swab Positive and COVID-19 Swab Negative Patients.

	COVID-19 Swab Positive (n = 16)	COVID-19 Swab Negative (n = 96)	*P*-Value
Age (years)	65.8 (±22.2)	56.3 (±22.7)	.062
Sex			.059
Male	3 (18.8%)	42 (43.8%)	
Female	13 (81.3%)	54 (56.3%)	
Ethnicity			.365
Caucasian	12 (75.0%))	82 (85.4%)	
Asian	4 (25.0%)	10 (10.4%)	
African/Afro-Caribbean	0 (0%)	3 (3.1%)	
Other	0 (0%)	1 (1.0%)	
Charlson comorbidity score	3.5 (IQR: 1-4.3)	1 (IQR: 0-4)	.078
Presenting symptoms on admission			
Fever	3 (18.8%)	11 (11.5%)	.414
Nausea/vomiting	5 (31.3%)	29 (30.2%)	0.933
Abdominal distension	1 (6.3%)	3 (3.1%)	0.533
Diarrhoea	2 (12.5%)	8 (8.3%)	0.588
Rectal bleeding	1 (6.3%)	1 (1.0%)	0.145
Constipation	1 (6.3%)	10 (10.4%)	0.604

Data expressed as whole numbers (%), means (± standard deviation) or medians (interquartile range). P-values from chi-squared or Fisher's exact test for categorical variables and Student t-test (parametric data) or Mann-Whitney U test (non-parametric data) for continuous variables.
Abbreviation: IQR = interquartile range.

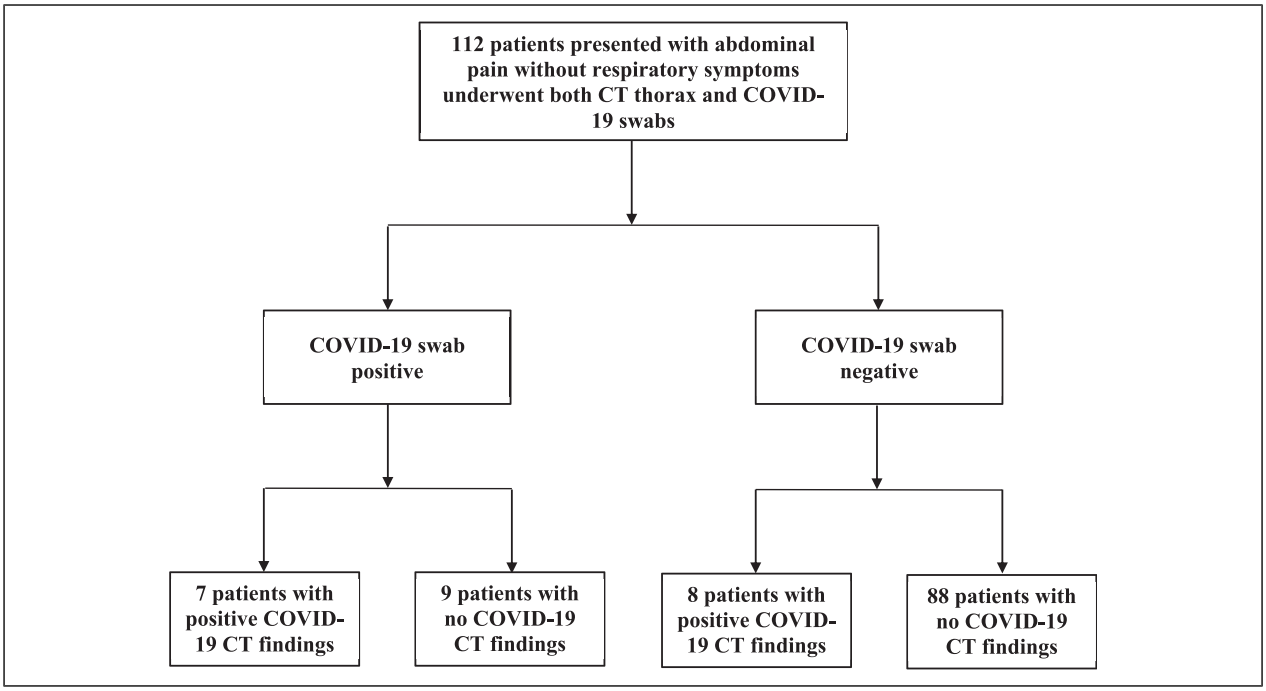

Figure 1. Study cohort flowchart.

CT imaging compared to COVID-19 swab negative patients.

Comparative data from biochemical blood test results between patients with COVID-19 positive and COVID-19 negative swab results are tabulated on Table 4. Patients with COVID-19 positive swab results had a significantly higher CRP and lower potassium. This group also had a higher proportion of patients with a low lymphocyte count.

Discussion

Recent emergence of the global COVID-19 pandemic has resulted in a multitude of studies published in the literature

Table 3. Radiological Variables of COVID-19 Swab Positive and COVID-19 Swab Negative Patients.

	COVID-19 Swab Positive (n = 16)	COVID-19 Swab Negative (n = 96)	*P*-Value
COVID-19 typical thoracic CT findings			
Ground glass opacity	5 (31.3%)	9 (9.4%)	**.029***
Peripheral consolidation	5 (31.3%)	5 (5.2%)	**0.005***
Crazy paving appearance	1 (6.3%)	0 (0%)	0.143
Bronchovascular thickening	1 (6.3%)	0 (0%)	0.143
Pleural effusion	2 (12.5%)	5 (5.2%)	0.262
Atelectasis	3 (18.8%)	18 (18.8%)	1.000

Data expressed as whole numbers (%). P-values from chi-squared or Fisher's exact test for categorical variables.

Table 4. Biochemical Variables of COVID-19 Swab Positive and COVID-19 Swab Negative Patients.

	COVID-19 Swab Positive (n = 16)	COVID-19 Swab Negative (n = 96)	*P*-Value
Biochemical variables			
White cell count (x 10^9/L)	10.0 (7.6-11.7)	9.5 (6.7-13.6)	.704
Lymphocytes (x 10^9/L)	0.8 (.6-1.0)	1.1 (.7-1.8)	0.099
Low lymphocytes (≤1 × 10^9/l)	12 (75.0%)	43 (44.8%)	**0.025***
C-reactive protein (mg/L)	111.3 (81.8-171)	38.5 (6.1-127.7)	**0.009***
Sodium (mmol/L)	139 (135-142)	139 (136-140)	0.682
Potassium (mmol/L)	3.9 (3.5-4.0)	4.2 (3.9-4.6)	**0.029***
Urea (mmol/L)	3.8 (2.4-6.2)	4.6 (3.5-6.6)	0.379
Creatinine (μmol/L)	75 (57.5-89.3)	77 (63.0-92.3)	0.447
Bilirubin (μmol/L)	9 (7-17)	10 (7-14)	0.610
Alkaline phosphatase (U/L)	84 (66-113)	83 (67-118)	0.897
Alanine aminotransferase (U/L)	23 (15-45)	19 (12-35)	0.342

Data expressed as whole numbers (%) or medians (interquartile range). P-values from chi-squared or Fisher's exact test for categorical variables and Mann-Whitney U test (non-parametric data) for continuous variables.

in regard to diagnosis and management of the deadly virus. A plethora of symptoms attributed to COVID-19 has been identified, including gastrointestinal upset manifesting clinically as abdominal pain. Patients with COVID-19-related abdominal pain may mimic other common surgical conditions; therefore, prompt recognition and diagnosis of the virus is paramount to facilitate early appropriate treatment.

This is the first observational study in the COVID-19 era to examine patients presenting with acute abdominal pain in the absence of respiratory symptoms. We report 14.3% of such patients were diagnosed with COVID-19 via nasal or oro-pharyngeal RT-PCR swabs with 50% of these patients having normal CT imaging of the abdomen. These patients potentially represent COVID-19 primarily presenting as abdominal pain as previously reported in the limited published literature.

Saeed et al[5] recently reported similar findings with 11.8% COVID-19 positive patients from a small cohort of 76 patients presenting with abdominal pain with or without other co-existing symptoms. Six of the COVID-19 positive patients also had unremarkable CT abdominal scans; however, they did all have COVID-19 typical features on CT thoracic imaging. We reported five such cases, but also three patients who did not have any COVID-19 typical thoracic features or abdominal pathology on CT. COVID-19 patients with abdominal pain as their main presenting complaint with no radiological findings have rarely been previously reported. A higher proportion of patients with severe COVID-19-related disease experienced abdominal pain compared to non-severe cases in a recent Chinese study.[12] Surgeons must consider a diagnosis of COVID-19 in all acute abdominal pain presentations. These patients should routinely be tested for the virus with diagnostic resources available locally. It is also imperative that those with abdominal pain attributed to surgical pathology requiring operative management have their perioperative COVID-19 status established early. Postoperative mortality significantly increases with co-existence of COVID-19 when performing emergency surgery with the recently published large international COVIDSurg collaborative study reporting a 30-day mortality rate of 25.6%.[13]

A small case series of three COVID-19 patients with afebrile acute abdominal pain was reported by *Gahide* et al.[6] They all had normal abdominal CT scans but demonstrated COVID-19 typical peripheral lung consolidation on thoracic imaging. These findings highlighted the usefulness of early CT imaging in general surgical presentations and further support existing

national guidelines advocating inclusion of thoracic CT with investigative abdominal CT imaging. This strategy potentially helps identify those with COVID-19 while waiting for swab confirmation. Our study findings yielded a high specificity of 91.7% for CT thoracic imaging diagnosing COVID-19 when using a positive RT-PCR swab result as reference. Based on this observation, abdominal pain presentations without respiratory symptoms and radiological signs typical of COVID-19 have a low risk of having the virus. This could potentially guide ward allocation to low risk areas for such patients as well as aid preoperative assessment in those requiring emergency surgery. However, a low sensitivity of only 43.8% suggests one cannot solely rely on radiological findings to diagnose COVID-19 status and further subsequent swab testing would be necessary. These findings differ from existing studies examining patients presenting with typical respiratory and febrile symptoms suspicious of COVID-19. As previously mentioned, *Ai* et al[4] reported a sensitivity of up to 97% with CT thoracic imaging in diagnosing COVID-19 when correlated with positive RT-PCR swab results but also low specificity. The diagnostic performance of CT varies dependent on the predominant presenting symptom related to COVID-19.

Ground glass opacities and peripheral consolidation are recognised CT features of COVID-19 on thoracic imaging and can be present in up to 100% and 72% of confirmed cases, respectively.[14] Although this study has small numbers, our findings demonstrated a significantly higher proportion of patients with these radiological signs in the COVID-19 positive cohort compared to the disease negative cohort.

On intergroup analysis between the COVID-19 swab positive and negative patients, we found those diagnosed with COVID-19 were more likely to have a lower potassium, low lymphocyte count and higher CRP levels. A Chinese hospital reported up to 62% of admitted COVID-19 patients had hypokalaemia.[15] This could be accounted for by COVID-19 related diarrhoea and vomiting leading to hypokalaemia, although there were not a higher proportion of patients with these symptoms in our COVID-19 positive cohort. Low lymphocytes and elevated CRP levels have been associated with COVID-19 and even as an indicator of viral-related disease severity. A systematic review concluded a three-fold increased risk of severe COVID-19 infection in patients with a lymphocyte count of less than 1.5×10^9/L.[16] Severe cases of COVID-19 were also associated with higher levels of CRP compared to mild cases.[17]

Several limitations must be acknowledged within this retrospective single centre observational study. The relatively small sample size can result in Type 2 error and larger future studies are required to validate our findings. RT-PCR swab results were used as a reference for COVID-19 positivity; however, diagnostic accuracy has been questioned and reported as low as 60%.[18] As more accurate means of testing for COVID-19 emerge, such as serological antibody testing, the gold standard test for confirming COVID-19 status will likely change for future studies. Inevitably, there is inter-observer variability between radiologists in formally reporting CT thorax changes as COVID-19 typical. A Chinese study demonstrated variation in performance of radiologists in differentiating COVID-19 typical features from viral pneumonia on CT imaging with overall high specificity but only moderate sensitivity in correctly diagnosing the virus.[19]

In conclusion, our reported incidence of COVID-19 in those presenting with acute abdominal pain without respiratory symptoms was 14.3%. Half of these patients had normal CT abdominal imaging suggesting acute abdominal pain as a possible presenting symptom of COVID-19. Initial admission CT thorax imaging had low sensitivity but high specificity in diagnosing COVID-19 in our study population. From these findings, we advocate all patients with acute abdominal pain should undergo CT imaging of the thorax with abdominal imaging as well as COVID-19 swab testing. Future studies will need to assess the performance of more sophisticated diagnostic tests such as serological antigen/antibody testing.

Declaration of Conflicting Interests

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