



REVISTA DE GASTROENTEROLOGÍA DE MÉXICO

www.elsevier.es/rgmx



SPECIAL ARTICLE COVID19

Beware: Gastrointestinal symptoms can be a manifestation of COVID-19[☆]



M. Schmulson^{a,*}, M.F. Dávalos^a, J. Berumen^b

^a Laboratorio de Hígado, Páncreas y Motilidad (HIPAM), Unidad de Investigación en Medicina Experimental, Facultad de Medicina, Universidad Nacional Autónoma de México (UNAM), Hospital General de México, Dr. Eduardo Liceaga, Mexico City, Mexico

^b Laboratorio de Genómica, Unidad de Investigación en Medicina Experimental, Facultad de Medicina, Universidad Nacional Autónoma de México (UNAM), Hospital General de México Dr. Eduardo Liceaga, Mexico City, Mexico

Received 23 March 2020; accepted 9 April 2020

Available online 24 April 2020

KEYWORDS

COVID-19;
Gastrointestinal
symptoms;
Diarrhea;
Prognosis;
Fecal–oral
transmission

Abstract

Background: There is a growing number of reports of COVID-19 cases presenting gastrointestinal (GI) symptoms.

Aims: To review studies reporting GI symptoms among COVID-19 patients.

Results: Fifteen papers (2800 patients) were identified. Frequency of GI symptoms varied from 3.0% to 39.6%, including diarrhea: 7.5%, nausea: 4.5%, anorexia: 4.4%, vomiting: 1.3%, abdominal pain: 0.5%, belching/reflux: 0.3%. These may be the first manifestation of COVID-19, however, there is controversy whether these reflect better or worst prognosis. Finally, the potential relationship with the angiotensin converting enzyme 2 (ACE2) cell receptor in the digestive tract as the virus entry route, is discussed.

Conclusions: GI symptoms may be common in COVID-19 and may be the first manifestation before fever and respiratory symptoms. Therefore, clinicians and gastroenterologists need to be aware of these atypical cases during the current pandemic and of the fecal–oral transmission, and preventive measures may be implemented.

© 2020 Published by Masson Doyma México S.A. on behalf of Asociación Mexicana de Gastroenterología. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

[☆] Please cite this article as: Schmulson M, Dávalos MF, Berumen J. Beware: Alerta: los síntomas gastrointestinales podrían ser una manifestación de la COVID-19. Revista de Gastroenterología de México. 2020. <https://doi.org/10.1016/j.rgmx.2020.04.001>

* Corresponding author at: Laboratorio de Hígado, Páncreas y Motilidad (HIPAM), Unidad de Investigación en Medicina Experimental, Facultad de Medicina, Universidad Nacional Autónoma de México (UNAM), Hospital General de México Dr. Eduardo Liceaga, Dr. Balmis #148, Col. Doctores C.P. 06726, Mexico City, Mexico. Tel.: +52 5556232673; fax: +52 5556232669.

E-mail address: maxjulio@prodigy.net.mx (M. Schmulson).

PALABRAS CLAVE

COVID-19;
Síntomas
gastrointestinales;
Diarrea;
Pronóstico;
Transmisión fecal-oral

Alerta: los síntomas gastrointestinales podrían ser una manifestación de la COVID-19**Resumen**

Antecedentes: Existe un incremento de reportes sobre casos del COVID-19 que presentan síntomas gastrointestinales (GI).

Objetivo: Revisión de estudios que reportaron síntomas GI en COVID-19.

Resultados: Quince artículos (2800 pacientes) fueron identificados. La frecuencia de síntomas GI varió del 3.0 al 39.6%, incluyendo diarrea: 7.5%, náuseas: 4.5%, anorexia: 4.4%, vómito: 1.3%, dolor abdominal: 0.5% y eructos/reflujo: 0.3%. Estos pueden ser la primera manifestación de COVID-19, pero existe controversia sobre si reflejan mejor o peor pronóstico. Se discute la relación potencial del receptor de la enzima convertidora de la angiotensina 2 (ACE2) en el tracto digestivo como ruta de entrada del virus.

Conclusión: Los síntomas GI pueden ser comunes en COVID-19 y ser la primera manifestación, incluso antes de fiebre y síntomas respiratorios. Por ello, los clínicos y gastroenterólogos debemos estar alerta a estos casos atípicos durante la actual pandemia y sobre la probable transmisión fecal-oral, y considerar medidas preventivas.

© 2020 Publicado por Masson Doyma México S.A. en nombre de Asociación Mexicana de Gastroenterología. Este es un artículo Open Access bajo la licencia CC BY-NC-ND (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

The coronavirus disease-2019 (COVID-19), the clinical name of the new severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2) infection,¹ has been confirmed in 1,237,420 cases worldwide, with 67,259 deaths.² The disease struck Mexico 3 weeks ago, and as of April 5, 2020, there have been 2143 confirmed cases and 94 reported deaths, with a total of 5209 patients currently under observation as suspicious cases.³ Although the main manifestations of this viral infection are fever, dry cough, and shortness of breath,⁴ as clinicians and gastroenterologists, we must learn from the experience of other countries, such as China, and be aware that gastrointestinal (GI) manifestations, albeit infrequent, can present in the course of the clinical scenario of this infection.⁴ Therefore, our aim was to review the recent publications on COVID-19 to learn about the GI manifestations of this infectious disease.

Methods

A search was conducted utilizing the Medline database, with the words COVID-19 AND Gastrointestinal symptoms: AND with specific symptoms including Diarrhea; Nausea; Vomiting; Abdominal Pain; Belching; Anorexia. We then combined the descriptor COVID-19 AND China; South Korea; Italy; Europe; North America; United States. The review was conducted by two reviewers (MS and MFD). Only full papers published in English were selected. In addition, the search was complemented with other references cited in the papers identified. The reported prevalence of GI symptoms in patients with COVID-19 was summarized. The following information was extracted: the countries of the diagnosed cases; the number of patients analyzed; age in median and range (for the papers that did not report a median, in which that central tendency measure could not be calculated,

the mean was reported); and sex percentages. In addition, the number and percentage of total GI symptoms were extracted, if they were reported, as well as the number and percentage of patients reporting the abovementioned individual symptoms. We also reviewed GI symptoms as atypical presentations of COVID-19 and their relation to patient prognosis and to epidemiologic factors, such as exposure to the Huanan Seafood Market, if reported. Given that the majority of the studies were published between December 2019 and April 2, 2020, the Table results are listed in alphabetical order, by the surnames of the lead authors.

Results

A total of 15 papers were identified that analyzed the clinical experience with the COVID-19 infection and reported the presence of gastrointestinal symptoms.⁵⁻¹⁹ Thirteen papers were from China,^{5-13,15-17,19} one was from Singapore,¹⁸ and one was from the World Health Organization (WHO) European Region¹⁴ (Table 1), and together, they analyzed a total of 2800 patients. In general, the prevalence of GI symptoms varied widely from 3.0% to 39.6%. Specifically, 210 (7.5%) patients reported diarrhea, 125 (4.5%) nausea, 124 (4.4%) anorexia, 15 (0.5%) abdominal pain, 9 (0.3%) belching and reflux, and 7 (0.25%) patients from one study reported a combination of different symptoms (i.e. diarrhea, vomiting, nausea). Importantly, 37 (1.3%) patients reported vomiting, but in 2 of the papers, nausea and vomiting were grouped together (56 patients).^{6,8} The sex distribution of the COVID-19 patients that presented with GI symptoms appears to be equally distributed. One-half of the patients were women and one-half were men, with no reported differences in GI symptoms, according to sex.

Certain details of those studies merit comment, especially in relation to the characteristics of the GI symptoms and their presence as atypical manifestations, their

Table 1 Summary of papers reporting gastrointestinal symptoms in patients with COVID-19.

Authors	Location	Patients <i>n</i>	Age median (range)	Sex F/M (%)	Diarrhea <i>n</i> (%)	Nausea <i>n</i> (%)	Vomiting <i>n</i> (%)	Abdominal pain <i>n</i> (%)	Anorexia <i>n</i> (%)	Belching/ reflux <i>n</i> (%)	Others/ mixed
Chang et al. ⁵	Beijing-China	13	34 ^a (34–48)	23/77	1 (7.7)	–	–	–	–	–	–
Chen et al. ⁶	Wuhan-China	99	55.5 ^b (21–82)	32/68	2 (2)	1 (1)	Included with nausea	–	–	–	–
Chen et al. ⁷	Anhui-China	9	50 (14–56)	45/55	2 (22.2)	–	–	–	–	–	–
Guan et al. ⁸	30 Regions-China	1099	47 (35–58)	42/58	42 (3.8)	55 (5.3)	Included with nausea	–	–	–	–
Huang et al. ⁹	Wuhan-China	41/38 ^d	49 (41–58)	27/73	1 (3)	–	–	–	–	–	–
Jin et al. ¹⁰	Zhejiang-China	651	46.1 ± 4.1 ^c	49/51	53 (8.1)	10 (1.5)	11 (1.7)	–	–	–	7 (1.1)
Lin et al. ¹¹	Zhuhai-China	95	45.3 ± 18.3 ^c	53/47	23 (24.2)	17 (17.9)	4 (4.2)	– ^e	17 (17.9)	2 (2.1)	–
Liu et al. ¹²	Hubei-China	137	57 (20–83)	55/45	11 (8)	–	–	–	–	–	–
Pan et al. ¹³	Hubei-China	204	54.9 ± 15.4 ^c	48/52	29 (14.2)	–	8 (3.9)	4 (2.0)	83 (40.7)	–	–
Spiteri et al. ¹⁴	WHO European Region	38	42 (2–81)	34/66	1 (2.6)	1 (2.6)	–	–	–	–	–
Wang et al. ¹⁵	Wuhan-China	138	56.0 (22–92)	46/54	14 (10.1)	14 (10.1)	5 (3.6)	3 (2.2)	–	–	–
Wang et al. ¹⁶	Wuhan-China	69	42 (35–62)	54/46	10 (14)	3 (4)	–	–	7 (10)	–	–
Yang et al. ¹⁷	Wuhan-China	52	59.7 (30–79)	33/67	–	–	2 (4)	–	–	–	–
Young et al. ¹⁸	Singapore	18	47 (31–73)	50/50	3 (17)	–	–	–	–	–	–
Zhang et al. ¹⁹	Wuhan- China	140	57 (25–87)	49/51	18 (12.9)	24 (17.3)	7 (5)	8 (5.8)	17 (12.2)	7 (5)	–

In the location column, although Wuhan is a city in the province of Hubei, in papers which included hospitals from other cities, Hubei was used, while in papers that were only from the city of Wuhan, this was the location used.

^a Only the range was not reported (25th–75th percentile, 34–48 years of age). In addition, 2 patients were children, 2 and 15 years of age.

^b Age was reported as mean.

^c Age was reported in mean ± SD.

^d Only 38 patients were analyzed for GI symptoms.

^e 2 (2.1%) Epigastric discomfort was reported.

–: not reported.

epidemiologic associations, time of onset, and relation to COVID-19 prognosis. For example, in a retrospective case series by Wang et al. that evaluated 138 hospitalized patients in Wuhan, China, fever was the most common symptom (98.6%), followed by fatigue (69.6%) and dry cough (59.4%). GI symptoms were less common, and they included diarrhea in 10.1% of the cases, and nausea, vomiting, and abdominal pain, at a much lower frequency.¹⁵ In the first report of COVID-19 from the WHO European Region, a low frequency of GI symptoms was also found.¹⁴ In contrast, in another study from Wuhan, with 140 cases, Zhang et al. reported a higher frequency (39.6%) of GI symptoms. In their case series, nausea was the most common symptom, whereas there was a similar frequency of diarrhea (12.9%).¹⁹ Another study from the city of Zhuhai in China, GI symptoms were present in 11.6% of the cases, and the most common were diarrhea (24.2%) and anorexia (17.9%)¹¹ (Table 1).

There is evidence that GI symptoms should be considered atypical manifestations of COVID-19. For example, Pan et al. reported that 7% of their patients strictly presented with digestive symptoms,¹³ and in the studies by Huang et al. and Liu et al., 2% and 25% of their patients, respectively, did not present with fever.^{9,12} Regarding the time of onset of GI symptoms, in the case series from the Chinese city of Zhuhai, in the province of Guangdong, 61.1% of the 95 patient total presented with GI symptoms. Nineteen percent of them had symptoms upon hospital admission, whereas the remaining 81% developed symptoms during hospital stay.¹¹ In the 651 cases from the Chinese province of Zhejiang, the onset of GI symptoms was not reported, but the median duration of diarrhea was 4 days, ranging from one to 9 days, and was self-limited in the majority of cases.¹⁰

In terms of epidemiologic factors related to the presence of GI symptoms, Chen et al. reported that 49% of their 99 patients had a history of exposure to the Huanan Seafood Market, where the first cases of COVID-19 appear to have arisen.⁶ However, they did not report whether that epidemiologic factor was related or not to the presence of GI symptoms or any other clinical manifestations. In the case series by Huang et al., 66% of the patients also had direct exposure to the Huanan Seafood Market, but that factor was not analyzed in relation to the prevalence of symptoms, either. They only compared the symptoms according to hospitalization in the intensive care unit (ICU) or not, finding no difference in the prevalence of diarrhea.⁹ In the previously mentioned Zhejiang study, there was no difference in patients with or without GI symptoms, with respect to a history of having been in Wuhan or in contact with other patients with COVID-19. However, family clustering was significantly higher in the patients with GI symptoms.¹⁰

In relation to patient prognosis, according to the presence or absence of GI symptoms, Wang et al. compared the frequency of GI symptoms between patients hospitalized in the ICU and those that were not. They found no difference, except for abdominal pain, which was more common in the patients in the ICU (8.3% vs 0, $p=0.02$).¹⁵ In agreement with that finding, diarrhea was reported in 3 of the first 18 patients hospitalized with transcriptase-polymerase chain reaction (RT-PCR)-confirmed SARS-CoV-2 in Singapore, none of whom required supplemental oxygen.¹⁸ Lin et al. also found no difference in clinical outcomes, such as hospital stay, discharge, or mortality, in patients with or without

GI symptoms, in a case series conducted in the Chinese city of Zhuhai.¹¹ The last 2 case series described above possibly suggest a milder outcome in patients that do not present with digestive symptoms, such as abdominal pain and diarrhea.^{15,19} In contrast, other studies have reported different outcomes. Pan et al. found that 48.5% arrived at the hospital with digestive symptoms as their main complaint. Those patients had a significantly longer time interval from onset to admission than those with no digestive symptoms (9.0 vs. 7.3 days), and 7 patients presented only with digestive symptoms, not respiratory ones.¹³ Digestive symptoms also became more apparent, as the severity of the disease increased. The patients with no GI symptoms were twice as likely to be cured and discharged, than those with GI symptoms (60% vs. 34.3%).¹³ In Zhejiang, Jin et al. reported that almost 23% of the patients with GI symptoms had a severe or critical type of illness. The presence of acute respiratory distress syndrome and the need for mechanical ventilation were significantly more frequent in the patients with GI symptoms, compared with the patients that did not have them.¹⁰ In another case series from Wuhan, China, that included 52 critically ill patients with SARS-CoV-2 pneumonia, 2 cases reported diarrhea, one in the survivor group and one in the non-survivor group.¹⁷ Furthermore, in the largest study published so far, diarrhea was the only GI symptom described in the 1099 patients hospitalized at 552 sites in China, with a low prevalence of 3.8%.⁸ The primary endpoints of that study were admission to an ICU, the use of mechanical ventilation, or death, and the authors did not report whether diarrhea was different, according to those endpoints. However, they did recognize there was recall bias in 291 patients that could have affected their results.⁸

Discussion

We summarized all papers that reported GI symptoms in patients with COVID-19 disease, up to April 2, 2020. The majority of the studies (87%) came from China,^{5,15-17,19} with one from Singapore,¹⁸ and only one small case series from Europe.¹⁴ The frequency of GI symptoms varied widely from 3.0% to 39.6% in the studies reviewed, and diarrhea was the most frequently reported, followed by anorexia. However, because the majority of the studies were retrospective, recall bias may have been a contributing factor to that low prevalence. In addition, given that pulmonary-related symptoms are the most important in terms of patient survival, most of the analyses and patient charts may have suffered bias in the collection of information regarding the respiratory manifestations and not that of other systems, such as the GI symptoms. Nevertheless, the fact that in some cases, GI symptoms were the only symptoms, or the first clinical manifestation, even before fever and respiratory symptoms, means that healthcare providers must be aware of that phenomenon, when seeing such patients during the current pandemic.^{13,17} Furthermore, reports in the literature on GI symptoms are mainly from hospitalized patients, and information regarding outpatients with milder symptoms, is lacking.⁸ To the best of our knowledge, there are no published reports about the presence of GI symptoms in patients with COVID-19 in Mexico, only the personal experience of those of us that have already diagnosed some cases

presenting with GI manifestations during the present pandemic. Therefore, we must be aware of this possibility.

The underlying explanation for GI symptoms, in patients infected with SARS-CoV-2 that developed COVID-19 disease, needs to be addressed. It has been reported that the angiotensin-converting enzyme 2 (ACE2) is the main host cell receptor of the novel 2019 coronavirus SARS-CoV-2, and plays a crucial role in the docking and entry of the virus into the cell.²⁰ Those receptors have been identified in type II alveolar cells of the lung, the stratified epithelial cells of the esophagus, the enterocytes from the ileum and colon, and cholangiocytes, as well as in myocardial cells, kidney proximal tubule cells, and bladder urothelial cells.^{20–22} More recently, the ACE2 receptor has been shown to be expressed in the mucosa of the oral cavity, and highly enriched in the epithelial cells of the tongue.²³ Thus, the oral cavity and digestive tract may be a route of infection, and ACE2 receptor expression in the digestive tract may explain why digestive symptoms occur in patients with COVID-19. Furthermore, SARS-Cov-2 viral nucleic acids have not only been found in respiratory samples, but also in saliva and stools.^{18,24} For example, Zhang et al. reported that the nucleic acid detection of COVID-19 in fecal specimens was as accurate as pharyngeal swab specimens, and patients with a positive stool test did not experience GI symptoms.²⁵ In fact, in the Singapore case series, the virus was detected in the stools of 4 out of 8 patients that were tested, regardless of the presence of diarrhea.¹⁸ In another study, the presence of viral RNA in feces was not related to the presence or severity of GI symptoms.¹¹ In addition, a positive stool test was not related to the severity of the lung infection.²⁵ More importantly, a group from China found that viral RNA was still present in the stools of more than 20% of the patients infected with SARS-Cov-2 that had a negative conversion of the viral RNA in the respiratory tract.²⁶ Such evidence supports a fecal–oral transmission of the SARS-CoV-2, which deserves further study.²⁴

Another important issue to highlight is the recent finding reported by Lin et al., of the presence of herpetic-type erosions and ulcers located in the esophagus, as a source of GI bleeding in one of their patients, along with the detection of SARS-CoV-2 RNA in those erosions.¹¹ Viral RNA was also detected in biopsies of the esophagus, stomach, duodenum, and rectum in 2 other patients that had no endoscopic lesions, suggesting that the virus can be docked in the digestive tract.¹¹

Despite all of the digestive findings associated with the coronavirus, there are currently no guidelines for the diagnostic approach in the presence of GI symptoms related to the COVID-19 pandemic, nor for their treatment. At present, there are only preventive measures that should be considered in endoscopy units.^{27,28} They are beyond the scope of the current review but can be summarized as delaying elective procedures for 8 weeks, implementing a pre-procedural triage, and using personal protective equipment (PPE), if there is a time-sensitive endoscopic procedure that needs to be performed.²⁹ Likewise, no differences in inflammatory markers, such as C-reactive protein and procalcitonin, have been found in patients with COVID-19, with or without GI symptoms.¹⁰ It is still of the utmost importance that physicians and caregivers be aware of the possibility that patients may be having this infection. However,

the possibility of fecal–oral transmission implies there can be preventive measures. On the one hand, toilet flushing can produce aerosols, resulting in fomite transmission.³⁰ On the other hand, GI symptoms have been related to family clustering, as previously described.¹⁰ Therefore, toilet isolation measures should be implemented in households with positive cases of likely COVID-19 contact. In addition, the fact that patients with SARS-CoV-2 infection may atypically present with GI symptoms, even before fever or respiratory symptoms, suggests that testing for that virus may be recommended, in cases in which other GI infections have been ruled-out. Healthcare providers may also consider preventive actions to not contract the infection from those patients in the clinic. However, the latter suggestions are based only on the current available studies reviewed herein, but there are no published guidelines on these situations and newer studies may shed light on them.

Conclusions

We reviewed 15 papers published up to April 2, 2020 that reported GI symptoms in patients with COVID-19. The frequency of those symptoms varied from 3.0% to 39.6% of the patients, and diarrhea was the most common. GI symptoms may be present, even before fever or respiratory symptoms, but no conclusions can be drawn, regarding their association with illness prognosis. Furthermore, the studies analyzed are based on hospitalized patients, therefore the presence of GI symptoms in outpatients with milder symptoms is unknown. It is vitally important that clinicians and gastroenterologists be aware of the GI manifestations in patients with COVID-19, especially during the current pandemic. The possibility of fecal–oral transmission may also have preventive implications, in terms of infection transmission, both at home and in the clinic.

Ethical disclosures

This is a Brief Review of the Literature, and so patients were not studied, and no informed consent was collected.

Because this is a Review of the Literature, no Ethics Committee authorization was required.

No specific cases are discussed in the present review, making patient identification impossible.

Funding

The present paper was funded by the Research Division of the Faculty of Medicine of the *Universidad Nacional Autónoma de México (UNAM)*.

Conflict of interest

The authors declare that they have no conflict of interest.

References

1. Sohrabi C, Alsafi Z, O'Neill N, et al. World Health Organization declares global emergency: a review of the 2019 novel coronavirus (COVID-19). *Int J Surg*. 2020;76:71–6.

2. Gutierrez P. Coronavirus world map which countries have the most cases and deaths. Coronavirus updates. April 5-2020, 11.25 UTC. In: Volume 2020. The Guardian; 2020.
3. Reporte diario COVID-19. Gobierno de México: Secretaría de Salud; 2020. Abril 5 de 2020.
4. Del Rio C, Malani PN. 2019 novel coronavirus-important information for clinicians. *JAMA*. 2020.
5. Chang D, Lin M, Wei L, et al. Epidemiologic and clinical characteristics of novel coronavirus infections involving 13 patients outside Wuhan, China. *JAMA*. 2020.
6. Chen N, Zhou M, Dong X, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet*. 2020;395:507–13.
7. Chen Q, Quan B, Li X, et al. A report of clinical diagnosis and treatment of nine cases of coronavirus disease 2019. *J Med Virol*. 2020.
8. Guan WJ, Ni ZY, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med*. 2020.
9. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet*. 2020;395:497–506.
10. Jin X, Lian JS, Hu JH, et al. Epidemiological, clinical and virological characteristics of 74 cases of coronavirus-infected disease 2019 (COVID-19) with gastrointestinal symptoms. *Gut*. 2020.
11. Lin L, Jiang X, Zhang Z, et al. Gastrointestinal symptoms of 95 cases with SARS-CoV-2 infection. *Gut*. 2020.
12. Liu K, Fang YY, Deng Y, et al. Clinical characteristics of novel coronavirus cases in tertiary hospitals in Hubei Province. *Chin Med J (Engl)*. 2020.
13. Pan L, Mu M, Yang P, et al. Clinical characteristics of COVID-19 patients with digestive symptoms in Hubei, China: a descriptive, cross-sectional, multicenter study. *Am J Gastroenterol*. 2020.
14. Spiteri G, Fielding J, Diercke M, et al. First cases of coronavirus disease 2019 (COVID-19) in the WHO European Region, 24 January to 21 February 2020. *Euro Surveill*. 2020;25.
15. Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. *JAMA*. 2020.
16. Wang Z, Yang B, Li Q, et al. Clinical features of 69 cases with coronavirus disease 2019 in Wuhan, China. *Clin Infect Dis*. 2020.
17. Yang X, Yu Y, Xu J, et al. Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. *Lancet Respir Med*. 2020.
18. Young BE, Ong SWX, Kalimuddin S, et al. Epidemiologic features and clinical course of patients infected with SARS-CoV-2 in Singapore. *JAMA*. 2020.
19. Zhang JJ, Dong X, Cao YY, et al. Clinical characteristics of 140 patients infected with SARS-CoV-2 in Wuhan, China. *Allergy*. 2020.
20. Guo YR, Cao QD, Hong ZS, et al. The origin, transmission and clinical therapies on coronavirus disease 2019 (COVID-19) outbreak – an update on the status. *Mil Med Res*. 2020;7:11.
21. Zou X, Chen K, Zou J, et al. Single-cell RNA-seq data analysis on the receptor ACE2 expression reveals the potential risk of different human organs vulnerable to 2019-nCoV infection. *Front Med*. 2020.
22. Zhang H, Kang Z, Gong H, et al. The digestive system is a potential route of 2019-nCoV infection: a bioinformatics analysis based on single-cell transcriptomes. *bioRxiv*. 2020, <http://dx.doi.org/10.1101/2020.01.30.927806>.
23. Xu H, Zhong L, Deng J, et al. High expression of ACE2 receptor of 2019-nCoV on the epithelial cells of oral mucosa. *Int J Oral Sci*. 2020;12:8.
24. Gu J, Han B, Wang J. COVID-19: gastrointestinal manifestations and potential fecal–oral transmission. *Gastroenterology*. 2020.
25. Zhang J, Wang S, Xue Y. Fecal specimen diagnosis 2019 novel coronavirus-infected pneumonia. *J Med Virol*. 2020.
26. Xiao F, Tang M, Zheng X, et al. Evidence for gastrointestinal infection of SARS-CoV-2. *Gastroenterology*. 2020.
27. AASLD, ACG, AGA, AGE. Joint Gastroenterology Society Message: COVID-19. COVID-19 use of personal protective equipment in GI endoscopy; April 1st, 2020, https://webfiles.gi.org/links/media/JOINT_GI_SOCIETY_MESSAGE_PPE_FINAL_04012020.pdf.
28. Sociedad Espanola de Patologia Digestiva, Asociacion Espanola de Gastroenterología. Recommendations by the SEPD and AEG, both in general and on the operation of gastrointestinal endoscopy and gastroenterology units, concerning the current SARS-CoV-2 pandemic (March, 18). *Rev Esp Enferm Dig*. 2020;112:319–22.
29. Sultan S, Lim JK, Altayar O, et al. AGA institute rapid recommendations for gastrointestinal procedures during the COVID-19 pandemic. *Gastroenterology*. 2020.
30. Wong SH, Lui RN, Sung JJ. Covid-19 and the digestive system. *J Gastroenterol Hepatol*. 2020.