ORIGINAL RESEARCH

Could flank pain be an indicator of COVID-19 infection?

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Abstract

Background

We describe the incidental detection of patients infiltrates due to COVID-19 in lung basal sections in patients undergoing abdominal computed tomography (CT) with flank pain attending the urology outpatient clinic during the current pandemic.

Methods

We retrospectively analysed 276 patients admitted to the Siirt Training and Research Hospital Urology outpatients clinic between 15 March 2020 and 9 August 2020 with a complaint of flank pain and undergoing non-contrast abdominal CT. A total of 10 patients with COVID-19 compatible findings in CT were defined as the study group. A control group was formed from 10 patients with only urological pathologies (kidney stones, ureteral stones, and hydronephrosis) without a COVID-19 compatible appearance on CT.

Results

Ten (3.6 %) patients were identified with COVID-19 and pneumonic infiltrations in the basal regions of the lungs; diagnosis was made by cross-sectional abdominal CT. The visual analog scale (VAS) score of flank pain was significantly higher in the control group ($p<0.001$); these subjects had urological pathology and no evidence of COVID-19 in the basal regions of the lungs on abdominal CT. There were no signs of COVID-19 disease detected during the admissions procedure in the urology outpatient clinic, including fever, cough, and shortness of breath.

Conclusion

During the COVID-19 pandemic, it is important to consider a diagnosis of COVID_19 in patients reporting non-severe flank pain if no urological pathology is evident on abdominal CT scans.

Key Words; COVID-19, urology, flank pain, abdomen CT

Introduction

In December 2019, Wuhan, the capital of China's Hubei region, began to experience cases of pneumonia that did not respond to standard treatments. The cause of this infection was subsequently identified as a new coronavirus referred to as severe acute respiratory syndrome coronavirus (SARS-CoV-2)[1]. SARS-CoV-2 is a β-coronavirus and is enveloped by a non-segmented positive-sense RNA virus[2]. This infection subsequently spread rapidly across the world. On 11 March 2020, the World Health Organization (WHO) declared a pandemic[3]. As of 9 August 2020, the number of confirmed cases in Turkey was 240,804 and the number of recovered cases was 223,759. The number of patients who died during this time due to the virus was 5844. Coronavirus disease 2019 (COVID-19) is highly contagious and can progress rapidly to acute respiratory distress syndrome (ARDS), often leading to death[4,5]. Older men with comorbidities are more likely to suffer from respiratory failure as a result of COVID-19 infection, and some patients have progressed rapidly to multi-organ dysfunction[6]. The Centers for Disease Control and Prevention (CDC) recommends that after two negative respiratory tests separated by ≥ 24 h, patients can be dismissed from having a transmissibility infection risk for COVID-19. Most patients have normal or reduced white blood cell counts in their laboratory examinations, and lymphocytopenia[7,8].

Computed tomography (CT) findings are critical in the diagnosis of COVID-19. However, the imaging findings of COVID-19 are not specific and vary widely. Nevertheless, the most common findings are round pulmonary parenchymal ground-glass opacities without lung cavitation, separate pulmonary nodules, or pleural effusion[9]. Other less common imaging features include linear densities, a pavement pattern, bronchial wall thickening, and a reverse halo sign[10].

In this study, we describe a cohort of patients admitted to our urology outpatient clinic during the pandemic and complaining of flank pain. These patients were incidentally observed to have ground-glass densities that were compatible with COVID-19 in basal lung sections on abdominal CT images.

Patients and methods

The Institutional Ethical Board approved this study which was carried out in Siirt University (Approval Number 2020/08.01). In our routine practice, patients with a family or personal history of urolithiasis, and have findings that support the presence of a stone in laboratory examinations are generally offered non-contrast abdomen CT. Data relating to patients with flank pain are routinely recorded in a Microsoft Excel program in our hospital's urology clinic. The severity of this flank pain was scored and recorded on a scale of 1–10 using the visual analog scale (VAS) pain scoring system (Figure 1). A total of 276 patients were

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admitted to the Siirt Training and Research Hospital Urology outpatient clinic between 15 March 2020 and 9 August 2020 complaining of flank pain. These patients underwent non-contrast abdominal CT. We analysed this data retrospectively accompanied by a radiologist with 5 years of post-fellowship experience. Abdominal CT images were acquired for all patients and analysed using the Siso-Pacs image archiving and communication system (Sisoft Healthcare Information Systems, Ankara, Turkey). Abdominal CT images were reexamined in the lung parenchyma window, and patients showing ground-glass density that was compatible with COVID-19 findings in the basal regions of the lungs were included in the study. Ten patients with CT findings that were consistent with COVID-19 were classified as the study group. A control group was formed from 10 patients who only showed urological pathologies (kidney stones, ureteral stones, hydronephrosis.) without a COVID-19 compatible CT appearance. The two groups were compared statistically according to the selected parameters. Patients with respiratory symptoms at admission, and only those with ultrasound (US) imaging, were excluded. Also, patients with a negative polymerase chain reaction (PCR) test for COVID-19 were excluded.

Statistical analysis

SPSS Statistical software version 25.0 (IBM, Armonk, NY, USA) was used for all statistical analyses. The Shapiro–Wilk test was used to test the numerical variables for normality. Continuous variables were specified as means and standard deviations, or medians and interquartile ranges, as appropriate. The chi-square (χ^2) test and Fisher's exact test were applied to categorical variables. Student's *t*-test and the Mann Whitney *U* test were used for continuous variables. A *P*-value <0.05 was defined as statistical significance.

Results

Ten (3.6 %) patients with COVID-19 infection were shown to have pneumonic infiltrations in the basal lung regions on cross-sectional abdominal CT scans. Three of these patients had unilateral infiltrations (Figure 2); the remaining seven patients had bilateral infiltration (Figure 3). The male to female ratio was 6:4 and the mean age was 52.4±21.6 years. Four patients reported pain in their right flank, four patients reported pain in their left flank, and two patients reported bilateral flank pain. In one patient, two 5-mm-sized stones were detected in the right kidney and a 5-mm-sized stone was detected in the middle part of the right ureter. One patient had a bilateral grade one hydronephrosis; during retrospective analysis, it was observed that the hydronephrosis was a chronic condition. In the other eight patients, no urological pathologies were observed upon abdominal CT. A 16-year-old patient reported pain in the left flank that was reflected in the left testicle. This patient showed no abnormalities on abdominal CT scans. Scrotal Doppler ultrasonography, however, detected left epididymo-orchitis.

During admissions to the urology outpatient clinic, there were no signs of COVID-19, such as fever, cough, and shortness of breath. In our study group, the PCR test was positive in all 10 patients with COVID-19 findings in the basal lung regions on abdominal CT. The median length of time taken for these patients to attend the COVID-19 outpatient clinic with another symptom after leaving the urology outpatient clinic was 2.4 (range: 1–5) days. The median VAS score of patients with COVID-19 findings on abdominal CT scans was 4 points. The median VAS score of patients with urological pathology but without COVID-19 findings was 8 points.

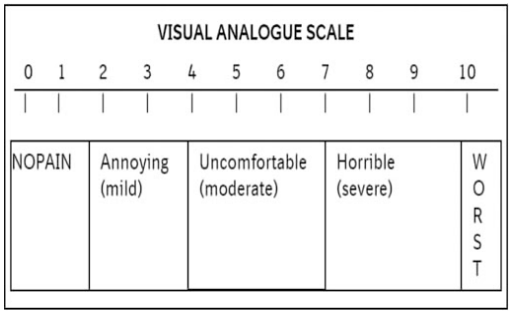

Figure 1. Visual analog scale (VAS) for scoring pain

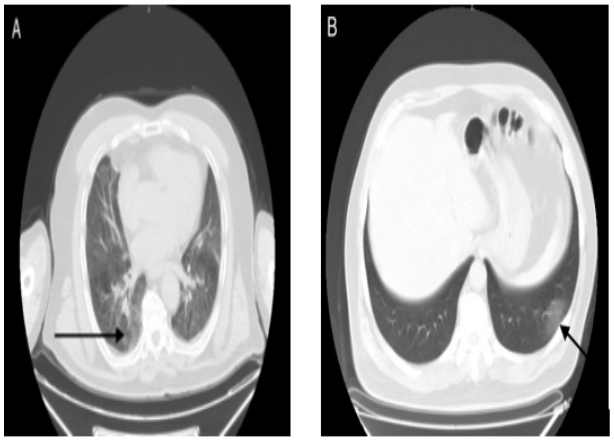

Figure 2. Unilateral basal pneumatic infiltrations. (A) A 54-year-old male was admitted with pain in the right flank. An abdominal non-contrast CT showed ground-glass density compatible with COVID-19 in the right lung base. (B) A 16-year-old male who presented with pain in the left flank and the left testicle. Axial abdominal CT demonstrated nodular ground-glass density compatible with COVID-19 in the left lung base section.

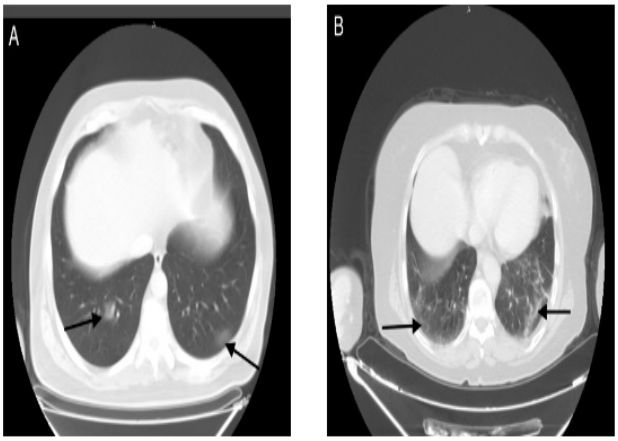

Figure 3. Bilateral basal lung pneumatic involvements. (A) A 47-year-old male presented with pain in the left flank. A basal thoracic section of abdominal CT was carried out. In bilateral lung basal sections, there were consolidation areas with ground-glass density compatible with COVID-19. Subpleural involvement on the left side. (B) A 68-year-old female with pain in the right flank. Axial abdominal CT showed peribronchial thickening in the bilateral lung basal sections and consolidations in the subpleural areas as peribronchial ground-glass regions.

The VAS score was significantly higher (*P*<0.001) in the control group with urological pathology and no COVID-19 findings in the basal lung regions on abdominal CT (Table 1).

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Table 1. Patient characteristics and clinical features

Charecteristics	COVID-19 Group (n=10)	Control Group (n=10)	Total (n=20)	P-value
Age, mean±SD	52.4±21.6	51.3±20	51.8±20.3	0.908
Sex, n (%)				0.653
Male	6 (60)	5 (50)	11 (55)	
Female	4 (40)	5 (50)	9 (45)	
Comorbidities, n (%)				0.494
None	7 (70)	6 (60)	13 (65)	
HT	2 (20)	1 (10)	3 (15)	
DM	1 (10)	3 (30)	4 (20)	
Flank pain laterality, n (%)				0.801
Right	4 (40)	5 (50)	9 (45)	
Left	4 (40)	4 (40)	8 (40)	
Bilateral	2 (20)	1 (10)	3 (15)	
Urinary pathology in abdomen CT, n (%)				0.001
Yes	2 (20)	10 (100)	12 (60)	
No	8 (80)	0	8 (40)	
Lung involvement in abdomen CT, n (%)				
Unilateral	3 (30)	0	3 (15)	
Bilateral	7 (70)	0	7 (35)	
VAS sore, median (IQR)	4 (0.5)	8 (2)	6 (4)	<0.001

Discussion

COVID-19 is spreading rapidly worldwide, although there is still no effective drug treatment, studies on the vaccine are ongoing.. However, the transmission rate of this infection can be reduced if the population take specific precautions. Therefore, it is essential to detect patients with COVID-19 early in order to prevent the spread of infection[11,12]. Medical treatments (antivirals, antibiotics, corticosteroids, and hydroxychloroquine) have been administered as supportive therapies. A standard treatment protocol for use across the world has yet to be developed. Many treatment options have been attempted in China and other countries, and their effects have been published. For example, a recent study identified four small molecular drugs (prulifloxacin, nelfinavir, bictegravir, and tenofovir) which exhibit high binding capacities with the main protease of SARS-CoV-2[13]. It has also been shown that agents such as remdesivir, chloroquine, and baricitinib, can be used to treat COVID-19[14,15]. Although the most common symptom of COVID-19 infection is fever, cough and shortness of breath are also considered to be the other most common symptoms[16,17]. Uncommon symptoms such as abdominal pain, diarrhoea, and olfactory disorders, have also been reported in the literature as first-line symptoms[18–20]. However, flank pain has not yet been identified as a first-line symptom. According to our literature review, there has been no patient-based research investigating the abdominal CT images of patients presenting with flank pain with regards to COVID-19.

The sensitivity of US in detecting urinary stones varies from 3% to 98% according to the existing literatüre[21,22]. US can be challenging in obese patients and generally offers limited or poor visualisation of the mid ureter. Furthermore, US has only limited ability to depict renal or ureteral calculi, which are smaller than 5 mm. However, detecting calculi smaller than 5 mm is of questionable clinical significance, as such patients are unlikely to require urological intervention[23]. Many studies have shown that non-contrast abdominal CT is unlikely to miss stones that require intervention compared to US[24,25]. Recent data suggest that less than 7% of patients diagnosed with kidney stones were scanned by US; rather, the use of CT is increasing[26]. The American College of Radiology Appropriateness Criteria states that a low-dose non-enhanced CT of the abdomen and pelvis is the imaging examination of choice for evaluating patients with suspected urolithiasis (with a sensitivity of 97% and a specificity of 95%)[27]. Non-contrast abdominal CT can sometimes be the first imaging method used in patients with severe renal colic[28].

The prevalence of stone disease is very high in our region. For this reason, in our clinic, patients with a history of urolithiasis in the themselves or in their family, and who have the findings to support the presence of a stone in their laboratory examinations, are generally scanned by abdominal CT to detect suspected kidney and uretal stones that are not evident on US.

A recent publication describing COVID-19 and CT imaging reported that the sensitivity of thorax CT (98%) in the early diagnosis of COVID-19 was higher than that of the reverse transcription (RT)-PCR test (71%)[29]. This information increases the importance of thorax CT in the diagnosis of this infection. During the pandemic period in our country, all physicians, irrespective of their specialty, were required to take care of COVID-19 patients. Our experience with the thorax CT imaging method, which we usually do not use as a specialist urology tool, has increased during this period. We had the opportunity to use and evaluate many thorax CTs. In this way, we learned to assess the basal lungs on abdominal CT scans, which we acquired for urological reasons, in the lung parenchyma window. For COVID-19 infection, the most common findings of thorax CTs are round pulmonary parenchymal ground-glass opacities.

Studies show that 5.74% of COVID-19 patients have viral RNA in their urine samples. Viral shedding in stools can take up to 6 weeks, but there is no definitive data relating to the duration of viral shedding in urine samples. Therefore, precautions are needed when we perform transurethral or transrectal procedures[30]. In our present study, it was not possible to test for viral RNA in urine samples as the patients were evaluated retrospectively.

The first diagnosis that comes to mind in a patient admitted to the urology outpatient clinic with flank pain is stone disease. However, there may be flank pain associated with diseases of the gastrointestinal system, diseases of the gall bladder, and

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diseases of the chest. Abdominal and back pain have long been described as a symptom of pneumonia in adults and children secondary to pleural irritation[31,32]. Parambil et al. reported right flank pain as the first presentation complaint related to COVID-19 in a 73-year-old patient[33]. When the patients who attended the urology outpatient clinic during the pandemic period were retrospectively screened, we found that 10 patients (3.6 %) presented with flank pain and COVID-19, with abdominal CT scans that were compatible with pneumonic infiltrations in the basal regions of the lungs. In some patients, flank pain may occur due to parietal pleural irritation caused by pulmonary inflammation during COVID-19 infection. The parietal pleura is innervated by the intercostal nerves, which also innervate the rib cage in a dermatomal fashion. Irritation of the pleural branches of the intercostal nerves may thus result in hyperaesthesia of the cutaneous branches which innervate the flank area[34]. As the COVID-19 pandemic continues, it should be kept in mind that if the pain score according to the VAS pain scoring system is not very high in patients presenting with flank pain, and there is no urological pathology in the abdominal CT, there is a possibility that this pain may be a COVID-19 symptom. Moreover, radiologists should not overlook COVID-19 when evaluating images of abdominal CTs taken in standard clinics other than the pandemic outpatient clinic. Unfortunately, there is no more effective option to contend with the COVID-19 pandemic than to reduce contagion.

Our study was limited by the fact that it was performed retrospectively in a single centre and with a limited number of patients. Multicentre and more comprehensive studies are now needed to verify our findings.

Conclusion

COVID-19 patients may visit many departments and spread the infection with extrapulmonary findings. This situation may pose a risk to healthcare professionals and other patients. If patients present with non-severe flank pain during the pandemic period, and if no urological pathology is observed on abdominal CT, then we should consider a differential diagnosis of COVID-19.

Before radiologists report their findings, clinicians should be knowledgeable enough to evaluate the basal regions of the lungs entering the cross-sectional CT area of abdominal CT scans for COVID-19 infection. In this way, clinicians can protect themselves and other healthcare workers from transmission during clinical examinations. In this way, patients can be diagnosed earlier before severe COVID-19 symptoms begin.

Ethical Approval

Informed consent was obtained from all the individuals who participated in this study. All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of interest

None of the authors have any conflicts of interest to declare.

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References

1. The Lancet. Emerging understandings of 2019-nCoV. Lancet. 2020;395(10221):311. doi:10.1016/S0140-6736(20)30186-0

2. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, et al.; China Novel Coronavirus Investigating and Research Team. A novel coronavirus from patients with pneumonia in China, 2019. N Engl J Med. 2020;382(8):727-33. doi: 10.1056/NEJMoa2001017. Epub 2020 Jan 24.

3. World Health Organisation (WHO) Coronavirus disease (COVID-19) . Available from: https://www.Who.Int/Emergencies/Diseases/Novel-Coronavirus-2019 (2020 march 11).

4. Li Q, Guan X, Wu P, Wang X, Zhou L, Tong Y, et al. Early transmission dynamics in Wuhan, China, of novel coronavirus-infected pneumonia. N Engl J Med. 2020;382(13):1199-207. doi: 10.1056/NEJMoa2001316. Epub 2020 Jan 29.

5. Wang D, Hu B, Hu C, Zhu F, Liu X, Zhang J, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus-infected pneumonia in Wuhan, China. JAMA. 2020;323(11):1061-9. doi: 10.1001/jama.2020.1585.

6. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020;395(10223):497-506. doi: 10.1016/S0140-6736(20)30183-5. Epub 2020 Jan 24. Erratum in: Lancet. 2020 Jan 30.

7. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med. 2020;382(18);1708-20. doi:10.1056/NEJMoa2002032

8. Liu K, Fang YY, Deng Y, Liu W, Wang MF, Ma JP, et al. Clinical characteristics of novel coronavirus cases in tertiary hospitals in Hubei Province. Chin Med J (Engl). 2020;133(9):1025-31. doi: 10.1097/CM9.0000000000000744.

9. Chung M, Bernheim A, Mei X, Zhang N, Huang M, Zeng X, et al. CT Imaging features of 2019 novel coronavirus (2019-nCoV). Radiology. 2020;295(1):202-7. doi: 10.1148/radiol.2020200230. Epub 2020 Feb 4.

10. Bernheim A, Mei X, Huang M, Yang Y, Fayad ZA, Zhang N, et al. Chest CT findings in coronavirus disease-19 (COVID-19): Relationship to duration of infection. Radiology. 2020;295(3):200463. doi: 10.1148/radiol.2020200463. Epub 2020 Feb 20.

11. Chan JF, Yuan S, Kok KH, To KK, Chu H, Yang J, et al. A familial cluster of pneumonia associated with the 2019 novel coronavirus indicating person-to-person transmission: A study of a family cluster. Lancet. 2020;395(10223):514-23. doi: 10.1016/S0140-6736(20)30154-9. Epub 2020 Jan 24.

12. Phan LT, Nguyen TV, Luong QC, Nguyen TV, Nguyen HT, Le HQ, et al. Importation and human-to-human transmission of a novel coronavirus in Vietnam. N Engl J Med. 2020 Feb;382(9):872-4. doi: 10.1056/NEJMc2001272. Epub 2020 Jan 28.

13. Li Y, Zhang J, Wang N, Li H, Shi Y, Guo G, et al. Therapeutic drugs targeting 2019-ncov main protease by highthroughput screening. bioRxiv. 2020. doi: 2020.01.28.922922.

14. Wang M, Cao R, Zhang L, Yang X, Liu J, Xu M, et al. Remdesivir and chloroquine effectively inhibit the recently emerged novel coronavirus (2019-nCoV) in vitro. Cell Res. 2020;30(3):269-71. doi: 10.1038/s41422-020-0282-0. Epub 2020 Feb 4.

15. Richardson P, Griffin I, Tucker C, Smith D, Oechsle O, Phelan A, et al. Baricitinib as potential treatment for 2019-nCoV acute respiratory disease. Lancet. 2020;395(10223):e30-e31. doi: 10.1016/S0140-6736(20)30304-4. Epub 2020 Feb 4. Erratum in: Lancet. 2020;395(10241):1906.

16. Wang W, Tang J, Wei F. Updated understanding of the outbreak of 2019 novel coronavirus (2019-nCoV) in Wuhan, China. J Med Virol. 2020;92(4):441-7. doi:10.1002/jmv.25689

17. Xie X, Zhong Z, Zhao W, Zheng C, Wang F, Liu J. Chest CT for typical coronavirus disease 2019 (COVID-19) pneumonia: Relationship to negative RT-PCR testing. Radiology. 2020;296(2):E41-E45. doi: 10.1148/radiol.2020200343. Epub 2020 Feb 12.

18. Wong SH, Lui RNS, Sung JJY. Covid-19 and the digestive system. J Gastroenterol Hepatol. 2020;35(5):744-8. doi:10.1111/jgh.15047

19. Song Y, Liu P, Shi XL, Chu YL, Zhang J, Xia J, et al. SARS-CoV-2 induced diarrhoea as onset symptom in patient with COVID-19. Gut. 2020;69(6):1143-4. doi: 10.1136/gutjnl-2020-320891. Epub 2020 Mar 5.

20. Lechien JR, Chiesa-Estomba CM, De Siati DR, Horoi M, Le Bon SD, Rodriguez A, et al. Olfactory and gustatory dysfunctions as a clinical presentation of mild-to-moderate forms of the coronavirus disease (COVID-19): a multicenter European study. Eur Arch Otorhinolaryngol. 2020;277(8):2251-2261. doi: 10.1007/s00405-020-05965-1. Epub 2020 Apr 6.

21. Hamm M, Wawroschek F, Weckermann D, Knöpfle E, Häckel T, Häuser H, et al. Unenhanced helical computed tomography in the evaluation of acute flank pain. Eur Urol. 2001;39(4):460-5. doi: 10.1159/000052486.

22. Abdel-Gawad M, Kadasne R, Anjikar C, Elsobky E. Value of color Doppler ultrasound, kub and urinalysis in diagnosis of renal colic due to ureteral stones. Int Braz J Urol. 2014 Jul;40(4):513-9. doi: 10.1590/S1677-5538.IBJU.2014.04.10.

23. Smith-Bindman R, Aubin C, Bailitz J, Bengiamin RN, Camargo CA Jr, Corbo J, et al. Ultrasonography versus computed tomography for suspected nephrolithiasis. N Engl J Med. 2014;371(12):1100-10. doi: 10.1056/NEJMoa1404446.

24. Ekici S, Sinanoglu O. Comparison of conventional radiography combined with ultrasonography versus nonenhanced helical computed tomography in evaluation of patients with renal colic. Urol Res. 2012;40(5):543-7. doi: 10.1007/s00240-012-0460-8. Epub 2012 Mar 14.

25. Ripollés T, Agramunt M, Errando J, Martínez MJ, Coronel B, Morales M. Suspected ureteral colic: plain film and sonography vs unenhanced helical CT. A prospective study in 66 patients. Eur Radiol. 2004;14(1):129-36. doi: 10.1007/s00330-003-1924-6. Epub 2003 Jun 19.

26. Chang H, Dai J, Holt S, Sorensen M, Sternberg K, Harper J. Mp50-20 national imaging trends for acute kidney stone disease: do renal ultrasounds for nephrolithiasis in the emergency department pave the way to computerized tomography? J Urol. 199(4S), e683-e684. doi: 10.1016/j.juro.2018.02.1631.

27. Coursey CA, Casalino DD, Remer EM, Arellano RS, Bishoff JT, Dighe M, et al. ACR Appropriateness Criteria® acute onset flank pain – suspicion of stone disease. Ultrasound Q. 2012;28(3):227-33. doi: 10.1097/RUQ.0b013e3182625974.

28. Schoenfeld EM, Pekow PS, Shieh MS, Scales CD Jr, Lagu T, Lindenauer PK. The diagnosis and management of patients with renal colic across a sample of US hospitals: High CT utilization despite low rates of admission and inpatient urologic intervention. PLoS One. 2017;12(1):e0169160. doi: 10.1371/journal.pone.0169160.

29. Fang Y, Zhang H, Xie J, Lin M, Ying L, Pang P, et al. Sensitivity of Chest CT for COVID-19: Comparison to RT-PCR. Radiology. 2020;296(2):E115-E117. doi: 10.1148/radiol.2020200432. Epub 2020 Feb 19.

30. Chan VW, Chiu PK, Yee CH, Yuan Y, Ng CF, Teoh JY. A systematic review on COVID-19: Urological manifestations, viral RNA detection and special considerations in urological conditions. World J Urol. 2020 27:1-12. doi: 10.1007/s00345-020-03246-4. Epub ahead of print.

31. Gauss H. Abdominal pain in pneumonia. Am J Dig Dis. 1946;13:73-7. doi: 10.1007/BF03002754.

32. Grief SN, Loza JK. Guidelines for the evaluation and treatment of pneumonia. Primary Care: Clinics in Office Practice. 45(3), 485-503. doi:10.1016/j.pop.2018.04.001.

33. Parambil JV, Abdulrahman R, Al-Shokri S. A 73-year-old man with a history of hypertension and ischemic heart disease who presented with pain in the right flank as a symptom of COVID-19 pneumonia. Am J Case Rep. 21; e925771-1. doi: 10.12659/AJCR.925771.

34. Kaminski N, Lossos IS, Ben-Sira L, Laxer U, Jaffe R. Flank pain as a presentation of pulmonary embolism. Respir Med. 1995;89(1):65-6. doi: 10.1016/0954-6111(95)90075-6.