Abstract: Coronavirus disease (COVID-19), an infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has severely ravaged the world since the end of 2019. Although most cases range from mild to severe with primarily respiratory symptoms, there have been some unusual clinical presentations, one of which is described in this case report. A 30 year-old woman with no significant medical history presented to the emergency department (ED) in October 2020 with sudden onset of severe left upper and lower abdominal pain. Her initial triaged blood pressure was 70 mmHg systolic, associated with mild tachycardia. Her beta human chorionic gonadotropin (beta-hCG) was negative, and her initial hemoglobin was 9.3 g/dL. A bedside ultrasound (US) was immediately performed, which showed moderate free fluid in the pelvis as well as in the right and left upper quadrants of the abdomen. She was stabilized with a fluid bolus and later underwent a CT scan of the abdomen and pelvis, which showed an apparent grade III splenic laceration without active extravasation. The patient underwent a successful embolization procedure by interventional radiology (IR) and was discharged from the hospital 2 days later. The initial medical workup included a positive polymerase chain reaction (PCR) COVID-19 test but included no other findings that could serve as a cause for her spleen to spontaneously rupture. The purpose of this case report is to illustrate and make other clinicians aware of unusual potential complications and clinical presentations of COVID-19. The condition of spontaneous splenic rupture (SSR) is an uncommon but emergent differential diagnosis in an otherwise healthy person with potential drastic outcomes. A careful approach in the management and care of these patients is warranted. This is one of a handful of case reports on SSR secondary to COVID-19 to the best of our knowledge.

Keywords: acute abdomen; COVID-19 complications; intraperitoneal hemorrhage; spontaneous splenic rupture.

As clinicians, when we think of splenic rupture, we lean toward trauma as the most common cause. The diagnosis of SSR is rare but must remain on the differential for patients who present with abdominal pain, with or without hemodynamic instability [1]. The pathologic phenomenon of atraumatic splenic rupture has been documented since at least 1861 and been further researched by others over the last century, which has led to a wide spectrum of clinical symptoms when making the diagnosis, especially given the growing number of possible causes outside of the realm of trauma [2, 3]. The causes encompass both viral and bacterial infections, neoplastic, hematological, and local causes such as cysts and thromboses, as well as autoimmune diseases like AA amyloidosis and systemic lupus erythematosus [2, 4, 5].

The diagnosis of spontaneous splenic rupture (SSR) can be made utilizing a quick and harmless ultrasound (US), a computed tomography (CT) scan, or in dire conditions when the patient is hemodynamically unstable, a laparotomy in the operating room. An astute clinician in the emergency department (ED) who utilizes all diagnostic tools and laboratory results is certainly integral to the management and decision making. Numerous grading systems for splenic injuries have been established to help guide the best treatments, which are usually more helpful in the setting of trauma [6]. The case below describes the importance of maintaining an expansive pathological differential inclusive of this potentially devastating emergent condition that can easily be overlooked.

Case description

This case involved a 30 year-old female with no significant medical history, status post–tubal ligation in February...
2020, who presented to the ED in October 2020 with sudden onset of severe lower abdominal pain. The patient was seen by her primary care physician earlier that morning and was referred for concern of possible acute intra-abdominal pathology such as infection or rupture. Prior to evaluation, the patient denied having any recent illnesses, travels, known sick contacts, new medications, or anything else out of the ordinary, nor was she on oral contraception. She also denied having any recent fevers, chills, chest pain, shortness of breath, vomiting, diarrhea, dysuria, or abnormal vaginal bleeding or discharge. She was in her normal state of health until the abrupt onset of symptoms that morning. The patient described the pain as aching with radiation to the left and right upper parts of her abdomen associated with nausea but no vomiting. Her pain was worse with standing and other bodily movements.

The initial triaged nursing note documented a blood pressure of 70/40 mmHg and heart rate of 103 BPM, thereby the patient was given immediate attention. The patient was afebrile, breathing comfortably on room air and saturating around 95%. A rapid physical exam and bedside US were performed to quickly evaluate the likelihood of an acute abdomen. The US demonstrated an obvious large amount of free fluid in the pelvis with layering further in the left and right upper quadrants. A liter bolus of lactated ringers was given, and analgesia was provided, both of which resulted in the improvement of symptoms and a blood pressure with a systolic of 108 mmHg. The ED workup included a stat beta-hCG, serum complete blood count (CBC), comprehensive metabolic panel (CMP), coagulation factors, type and screen, lipase and urinalysis with culture, and Coronavirus disease (COVID-19) polymerase chain reaction (PCR) test.

The patient’s initial hemoglobin was 9.3 g/dL (12–16 g/dL) and her beta-hCG was <5 mIU/mL (<5 mIU/mL). Other pertinent initial laboratory findings demonstrated a white blood cell (WBC) count of 14.1 × 10^9/L (4.5–11.0 × 10^9/L) with 6% lymphocytes (22–44%) reported, platelets (PLT) of 198 K/mcl (150–450 K/mcl), prothrombin time (PT) of 13.8 s (11–13.5 s), and international normalized ratio (INR) of 1.2 (0.8–1.1). The patient’s serum chemistry and urinalysis did not result in significant abnormalities as they relate to this case, yet her COVID-19 PCR test was positive.

A formal bedside US and gynecology consult was obtained with initial concern for a possible hemorrhagic cyst in the absence of trauma. The radiologist reported US findings suggesting possible rupture of the spleen, hemorrhagic ovarian cyst, or hepatic adenoma (Figure 1). Again, there was evidence of a moderate amount of free fluid or blood in the abdomen. The spleen was noted as a

![Figure 1: Ultrasound findings were significant for free fluid in the abdomen. (A) Free fluid is shown around the spleen. (B) The spleen is shown with free fluid, and the color doppler shows blood flow. (C) The pelvis with moderate fluid around the uterus. (D) The left adnexa with free fluid.](image-url)
possible culprit, so general surgery was consulted and requested a stat upright chest and abdominal film and, if stable, an emergent CT of the abdomen and pelvis.

The patient’s upright and flat X-ray of the chest and abdomen did not reveal any acute processes that would explain this clinical presentation. The CT of the abdomen and pelvis did show a substantial amount of free fluid or blood resulting from a grade III splenic laceration (Figure 2). In the absence of trauma, it was determined this patient had an SSR.

The patient continued to maintain borderline hemodynamic stability while in the ED. In consultation with the general surgeon, she was deemed a good candidate for a splenic arteriogram and embolization with interventional radiology (IR). While in the IR suite, multiple small pseudoaneurysms and blush in the upper pole of the spleen were found, which were subsequently embolized. The proximal splenic artery was also embolized with two 6 mm coils (Figure 3). The patient was then transferred to the intensive care unit in stable condition.

**Figure 2:** (A) Coronal and (B) axial CT images of the splenic laceration.

**Figure 3:** Embolization of the spleen (A) pre- and (B) post-coil placement.
On postoperative day 1, the patient did have a small drop in her hemoglobin from 9.4 g/dL (12–16 g/dL) to 7.7 g/dL and was transfused with 1 unit of packed red blood cells. Her pain was well controlled, and her diet was advanced slowly. The patient continued to do well and was discharged from the hospital 2 days after the initial presentation.

With the patient’s permission, she was screened for viruses known to be implicated in SSR, including cytomegalovirus (CMV), Epstein-Barr virus (EBV), and human immunodeficiency virus (HIV), all of which were negative. This patient did not have any risk factors for malaria, another known cause of SSR. Given the patient’s age and state of health, there was low suspicion for other blood, metabolic, pathologic, or infectious diseases that would result in this unusual condition. Without findings suggestive of an alternative cause, it is suspected that this patient’s SSR was related to infection with COVID-19, which was the only positive test result.

Discussion

An extraordinary amount of knowledge has been amassed about COVID-19 and how it is affecting the health of millions of people worldwide [7–9]. A wide spectrum of symptoms have been documented including body aches, dry cough, fever, and loss of taste and smell, with complications ranging from microthromboses to large pulmonary emboli to full-blown disseminated intravascular coagulation [10–14]. The present case suggests that COVID-19 infection may also be associated with atraumatic spontaneous splenic rupture.

Viral infections, most notably HIV, dengue, CMV, and EBV, have been implicated in splenic pathology such as splenomegaly and rupture [2, 4, 5, 15–18]. The etiology of such splenic complications is not entirely clear, although it is thought to involve microvascular thrombosis and necrosis, similar to the processes observed in COVID-19 [12, 19, 20]. Additionally, postmortem examinations of six COVID-19 patients revealed evidence of secondary lymph organ tissue damage including splenic atrophy, lymphoid follicular destruction, and hyperplasia of the histiocytes, which are thought to result from SARS-CoV-2–induced apoptosis of resident lymphocytes leading to acute inflammation [21]. In extreme cases, continued splenic inflammation and tissue damage, coupled with dysregulation of the normal immune response, may ultimately lead to splenic rupture, as reported in a handful of other cases [22–24].

While we cannot definitively state that this patient’s SSR was caused by COVID-19, the complete lack of findings suggestive of other causes in the workup suggests that COVID-19 be strongly considered. The workup for autoimmune diseases, including antinuclear antibody (ANA) and amyloid testing, was deferred as part of the shared decision-making process because the patient denied any history of symptoms consistent with autoimmune diseases. It is possible that the patient’s prior tubal ligation played a role, although no complications were noted to the procedure, and the patient had over 6 months of normal health between the operation and the sudden onset of symptoms, making it unlikely that this was the sole cause.

Additional work remains in elucidating the mechanism by which COVID-19 causes splenic damage. In the current case, a biopsy was not available for histopathological or molecular analysis. Furthermore, while the patient had a positive COVID-19 test on presentation to the ED, it is unclear how long prior to symptom onset the patient became infected, and therefore the time-course over which the splenic damage occurred remains unknown. It is interesting to note that the patient was asymptomatic prior to manifestation of the splenic rupture, raising questions about the relationship between overt COVID-19 symptoms and underlying pathologic changes. Enhanced awareness of the potential for splenic rupture as a complication of COVID-19 will hopefully lead to increased recognition of and research into this phenomenon.

Conclusions

COVID-19 can present clinically in a variety of ways, some of which are more serious and life-threatening than others. While in the ED, we may encounter patients who present with rare symptoms as they relate to COVID-19. As one can see from this case, critical patients may present with unusual findings such as an SSR without any other apparent causes. The utilization of all clinical tools, evidence-based medicine, and most importantly, clinical acumen, can mean the difference between life and death, as described in this case report.

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References

1. Weaver H, Kumar V, Spencer K, Maatouk M, Malik S. Spontaneous splenic rupture: a rare life-threatening condition; diagnosed early and managed successfully. Am J Case Rep 2013;14:13–5.

2. Aubrey-Bassler FK, Sowers N. 613 cases of splenic rupture without risk factors or previously diagnosed disease: a systemic review. BCM Emerg Med 2012;12:11.

3. Lieberman ME, Levitt MA. Spontaneous rupture of the spleen. Am J Emerg Med 1989;7:28–31.

4. Rice JP, Sutter CM. Spontaneous splenic rupture in an active duty marine upon return from Iraq: a case report. J Med Case Rep 2010;4:353.

5. Renzulli P, Hostettler A, Schoepfer AM, Gloor B, Candinas D. Systematic review of atraumatic splenic rupture. Br J Surg 2009;96:1114–21.

6. Morell-Hofert D, Primavesi F, Fodor M, Gassner E, Kranebitter V, Braunwarthx E, et al. Validation of the revised 2018 AAST-OIS classification and the CT severity index for prediction of operative management and survival in patients with blunt spleen and liver injuries. Eur Radiol 2020;30:6570–81.

7. Docherty AB, Harrison EM, Green CA, Hardwick HE, Pius R, Norman L, et al. Features of 20 133 UK patients in hospital with Covid-19 using the ISARIC WHO clinical characterisation protocol: prospective observational cohort study. BMJ 2020;369:mi1985.

8. Guan WJ, Ni ZY, Hu Y, Liang W, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020;382:1708–20.

9. Henry BM, de Oliveira MHS, Benoit S, Piebani M, Lippi G. Hematologic, biochemical and immune biomarker abnormalities associated with severe illness and mortality in coronavirus disease 2019 (COVID-19): a meta-analysis. Clin Chem Lab Med 2020;58:1021–8.

10. García LF. Immune response, inflammation, and the clinical spectrum of COVID-19. Front Immunol 2020;11. https://doi.org/10.3389/fimmu.2020.01441.

11. Lechien JR, Chiesa-Estomba CM, De Slati DR, Horoi M, Le Bon SD, Alexandra R, 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 Oto-Rhino-Laryngol 2020;277:2251–6.

12. McFadyen JD, Stevens H, Peter K. The emerging threat of (micro) thrombosis in COVID-19 and its therapeutic implications. Circ Res 2020;127:571–87.

13. Spinato G, Fabbri C, Polesel J, CazzadoroD, DorsettoD, HopkinsC, et al. Alterations in smell or taste in mildly symptomatic patients with SARS-CoV-2 infection. JAMA 2020;323:2089–90.

14. Tabary M, Khanmohammadi S, Araghi F, Dadkhahfar S, Tavangar SM. Pathologic features of COVID-19: a concise review. Pathol Res Pract 2020;216:153097.

15. Vallabhaneni S, Scott H, Carter J, Treseler P, Machtinger EL. Atraumatic splenic rupture: an unusual manifestation of acute HIV infection. AIDS Patient Care STDS 2011;25:461–4.

16. Redondo MC, Rios A, Cohen R, Ayala J, Martinez J, Arellano G, et al. Hemorrhagic dengue with spontaneous splenic rupture: case report and review. Clin Infect Dis 1997;25:1262–3.

17. Alliot C, Beets C, Besson M, Derolland P. Spontaneous splenic rupture associated with CMV infection: a report of a case and review. Scand J Infect Dis 2001;33:875–7.

18. Won AC, Ethell A. Spontaneous splenic rupture resulted from infectious mononucleosis. Int J Surg Case Rep 2012;3:97–9.

19. Debnath D, Valerio D. Atraumatic rupture of the spleen in adults. J R Coll Surg Edinb 2002;47:437–45.

20. Oudkerk M, Büller HR, Kuijpers D, Oudkerk F, McLoud T, Gommers D, et al. Diagnosis, prevention, and treatment of thromboembolic complications in COVID-19: report of the National Institute for Public Health of The Netherlands. Radiology 2020;297:E216–22.

21. Feng Z, Diao B, Wang R, Wang G, Wang C, Tan Y, et al. The novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) directly decimates human spleens and lymph nodes. medRxiv 2020;31. https://doi.org/10.1101/2020.03.27.20045427. Preprint posted online Mar 31.

22. Shaukat I, Khan R, Diwakar L, Kemp T, Bodasing N. Atraumatic splenic rupture due to Covid-19 infection. J R Coll Surg Edinb 2002;47:437–45.

23. Agus M, Ferrara ME, Bianco P, Manieli C, Mura P, Sechi R, et al. Atraumatic splenic rupture in a SARS-CoV-2 patient: case report and review of literature. Case Rep Surg 2021;2021:5553619.

24. Mobayen M, Yousefi S, Mousavi M, Anbaran AS. The presentation of spontaneous splenic rupture in a COVID-19 patient: a case report. BMC Surg 2020;20:220.