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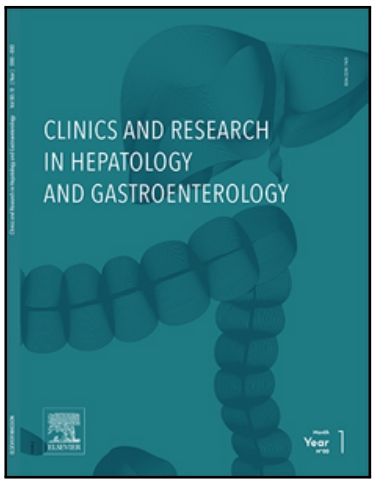

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PII: S2210-7401(22)00162-0
DOI: https://doi.org/10.1016/j.clinre.2022.102028
Reference: CLINRE 102028

To appear in: *Clinics and Research in Hepatology and Gastroenterology*

Please cite this article as: Ali Asgarzdeh , Shahram Habibzadeh , Vahid Asghariazar , Elham Safarzadeh , Drug-induced hepatitis (DIH) after SARS-CoV-2 vaccination, *Clinics and Research in Hepatology and Gastroenterology* (2022), doi: https://doi.org/10.1016/j.clinre.2022.102028

Drug-induced hepatitis (DIH) after SARS-CoV-2 vaccination

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1. Introduction

The 2019 coronavirus disease (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has emerged as a major worldwide burden, resulting in serious public health challenges and claiming millions of infected cases and deaths [1]. This called for an urgent need for vaccinations against COVID-19. Several vaccines using diverse platforms were developed. The BBIBP-CorV vaccine (also known as the Sinopharm COVID-19 vaccine) is one of these vaccines, which is an inactivated vaccine and has been widely administered in the Middle East and Iran since December 2020. In its clinical trials, the predominant side effects were injection site pain, fatigue, and headache with mainly mild to

moderate intensity. However, few cases have been reported with more severe side effects that required hospitalization [2].

As vaccination moves further, its side effects, which have not been fully explored start to appear. Recently, one of these side effects that has been frequently reported is liver injury. So far, COVID-19 vaccination has been associated with the development of various liver disorders, such as autoimmune hepatitis (AIH), primary biliary cholangitis (PBC), and primary sclerosing cholangitis (PSC), presumably through cross-reactivity with host cells [3-5]. Additionally, several studies have reported cases of DIH following Pfizer-BioNTech [6] and Sinopharm [7] SARS-CoV-2 vaccination. Herein, we reported another case of DIH following Sinopharm COVID-19 vaccination in a 34-year-old female patient.

A 34-year-old female patient was presented to our outpatient gastrointestinal clinic with a one-week history of abdominal pain that began one week after receiving the first dose of the Sinopharm SARS-CoV-2 vaccine on 14th September 2021 (Figure 1). The pain was described as a non-radiating constant dull ache with intermittent sharp pains in the right upper quadrant of the abdomen, which was not accompanied by nausea, vomiting, diarrhea, fever, shortness of breath, and chest pain. Past medical history of the patient was significant for cholecystectomy [2019]. Liver enzymes were completely normal in a routine check-up two years prior. She was not taking any medications or herbal remedies and did not consume alcohol. There was no recent complaint of SARS-CoV-2 infection symptoms, and she denied a history of previous COVID-19 infection or contact with a known COVID-19 infected individual.

On examination, the patient's mental status was intact and vital signs were stable. She had obvious scleral icterus and jaundice. Abdominal examination was notable for tenderness in

the right upper quadrant without guarding or rigidity. Liver span was normal, and no sign of splenomegaly, hepatomegaly, or lymphadenopathy was identified.

Laboratory investigations were significant for hepatic function panel with elevated levels of total bilirubin 5.41 mg/dL (normal < 1.2 mg/dL), direct bilirubin 2.14 mg/dl (normal < 0.3 mg/dl), indirect bilirubin 3.27 mg/dl (normal < 1.1 mg/dl), aspartate aminotransferase (AST) 688 U/L (normal < 31 U/L), alanine aminotransferase (ALT) 983 U/L (normal < 31 U/L), alkaline phosphatase (ALP) 549 U/L (normal range: 64-320 U/L) (Figure 2). The laboratory results for hepatitis panel, including, reactive IgG and IgM antibodies for hepatitis A, B, C, and E virus, cytomegalovirus, Epstein-Barr virus, and herpes virus were reported negative.

The hematological panel was normal. Serum immunoglobulins G (IgG) and ceruloplasmin were within normal ranges. Serological autoimmune studies (anti-nuclear antibody (ANA), anti-smooth muscle antibody (SMA), and anti-liver kidney microsome type 1 antibody (LKM-1 Ab)) were negative. The urine analysis was normal.

The patient underwent abdominal ultrasound, abdominal computerized tomography (CT) scan, and magnetic resonance cholangiopancreatography (MRCP), which showed normal liver parenchyma, normal portal vein flow, no ascites, and no evidence of biliary lithiasis or dilatation of biliary ducts. The gallbladder was not seen, which was in line with the patients' history of cholecystectomy. Additionally, there were no significant abnormalities of kidneys, spleen, pancreas, and abdominal vessels in the imaging.

Jaundice and other symptoms lasted for one week and then decreased in intensity. One day before administration of the second dose of Sinopharm COVID-19 vaccine, on 14th October 2021, liver tests were within normal ranges, except for ALT (70 U/L). However, one week after the second dose, the same clinical presentations reappeared. Two weeks later, laboratory findings were: total bilirubin 6.5 mg/dl, direct bilirubin 3.2 mg/dl, indirect bilirubin 3.3

mg/dl, AST 815 U/L, ALT 1180 U/L, ALP 610 U/L, with normal hematological panel (Figure 2). Hepatitis panel, serological tests for autoimmune liver disease, and abdomen imaging did not repeat. Additionally, the Roussel Uclaf Causality Assessment Method (RUCAM), an established tool to quantitatively evaluate causality in cases of suspected drug/herb induced liver injury [8], score for the patient was 8, showing a probable relationship between vaccination and liver damage. Since all work-up excluded infection, autoimmune, or obstruction liver diseases, and along with the high score of the RUCAM, she was diagnosed with SARS-CoV-2 vaccine developed DIH. Oral capsule of Ursodeoxycholic (300mg) was administered empirically based on decision of the infectious disease specialist. Corticosteroid treatment was not used since there was no evidence for the incidence of autoimmunity. The patient's liver function values were completely normalized within 35 days after treatment (Figure 1).

2. Discussion

This study presented a 34-year-old female patient with hepatitis after receiving both the first and second dose of the COVID-19 vaccine. Several cases of hepatitis have been reported after COVID-19 vaccines, but most of them were diagnosed as vaccine-triggered AIH. Although DIH cases following COVID-19 vaccination have also been reported before, to our best knowledge, the present study is the first report of the DIH occurrence following both the first and second dose of the Sinopharm COVID-19 vaccine and only second to [7] to report hepatitis following administration of this vaccine.

By ruling out the other causes of hepatitis, such as infectious, autoimmune, or obstructive hepatitis, the close relationship between the timeline of the vaccination and symptoms onset may be interpreted as the contribution of the Sinopharm COVID-19 vaccination in the

development of DIH in our patient. As causality cannot be proven, it is possible that this association is just coincidental. However, as the viral spike protein appears to be responsible for damaging tissues like the liver [9], it is plausible that inactivated COVID-19 vaccines, like Sinopharm, may also trigger liver injuries in vaccinated individuals. Therefore, it is crucial to note the DIH rather than AIH as one of the side effects of the Sinopharm COVID-19 vaccine to avoid prescribing immunosuppressive drugs like corticosteroids.

3. Conclusion

Vaccine-induced hepatitis is a rare complication, and the majority of reported cases have been minor and self-limited. In the background of benefits over risks from the vaccine, it is essential that this article should not discourage the general population from taking the vaccine. However, it is crucial to inform the healthcare providers about the potential association between the vaccine and the onset of liver injuries as more and more countries start to consider the first and second booster dose of the COVID-19 vaccination. Further clinical and epidemiological studies are needed to confirm the causality between COVID-19 vaccination and the development of liver injuries like DIH.

Patient consent statement

Written informed consent was obtained from the patient for publication of this case report.

Ethical approval

This study was approved by the ethics committee of Ardabil University of Medical Sciences.

Funding

None.

Conflict of interests

The authors declare no conflict of interest.

Contributions

Sh. Habibzadeh and E. Safarzadeh were involved in planning and supervised the work. Sh. Habibzadeh and E. Safarzadeh, and A. Asgarzadeh worked out almost all technical details. A. Asgarzadeh and V. Asghariazar wrote the manuscript in consultation with Sh. Habibzadeh and E. Safarzadeh. V. Asghariazar designed the pictures. All authors discussed the results and contributed to the final manuscript

Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Acknowledgments

The authors would like to thank the staff of Imam Khomeini hospital for providing great support.

Abbreviations

ALP; alkaline phosphatase, ALT; alanine aminotransferase, AMA; anti-mitochondrial antibody, ANA; anti-nuclear antibodies, APCA; anti-parietal cell antibody, ASA; acetylsalicylic acid, ASMA; anti-smooth muscle antibodies, AST; aspartate aminotransferase, COVID-19; coronavirus disease, CT; computerized tomography, DIH; drug-induced hepatitis, ds-DNA; double-stranded DNA antibodies, GGT; gamma-glutamyl transferase, HAV Ab; hepatitis A virus antibody, IgG; immunoglobulins G, LC; liver cytosol antibodies, LKM-1 Ab; liver-kidney microsome type 1 antibody, MRCP; magnetic resonance cholangiopancreatography, PBC; primary biliary cholangitis, PSC; primary sclerosing cholangitis, SARS-CoV-2; severe acute respiratory syndrome coronavirus 2, SLA; soluble liver antigen antibodies.

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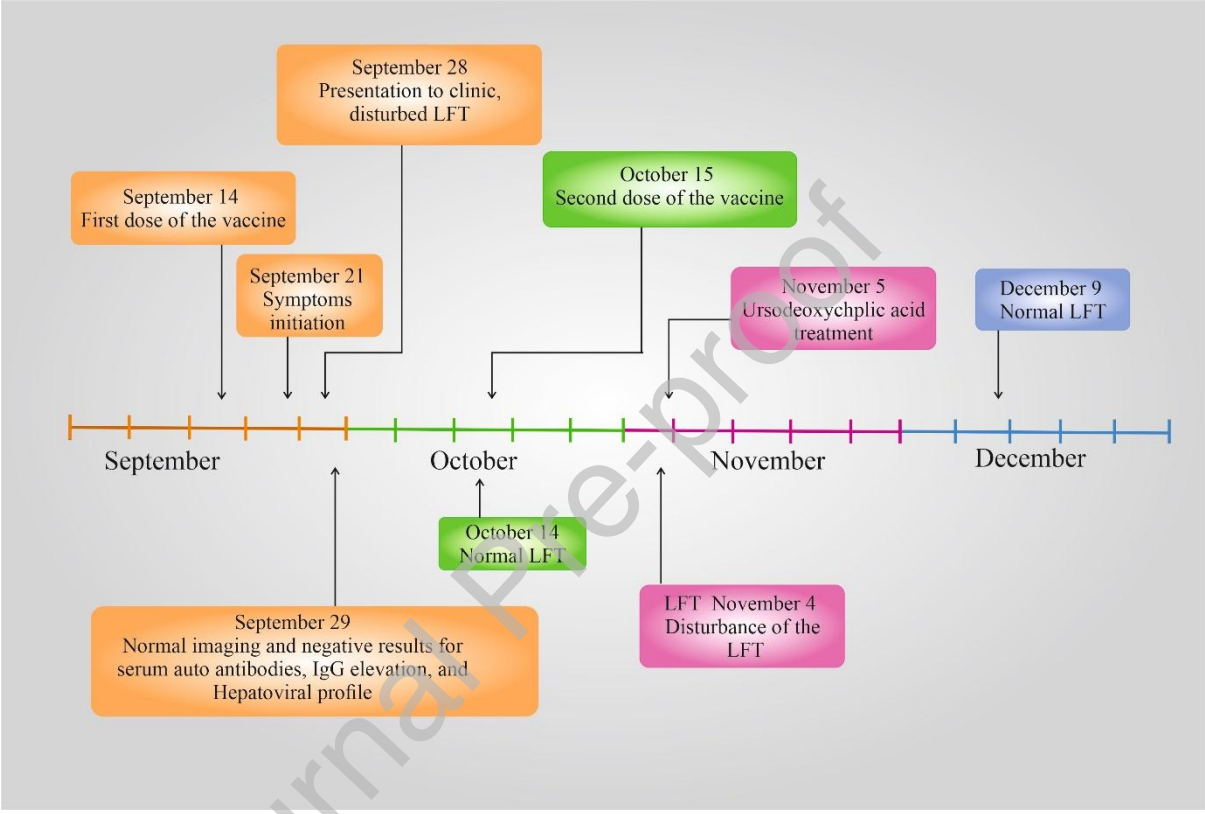
Figure 1. Timeline of the patients' clinical and para-clinical status.

Figure 2. Trends of the total, direct, and indirect bilirubin levels (mg/dl) **(A)** and liver enzymes levels (U/L) **(B)** during the two episodes of liver injury after two dose of the COVID-19 vaccinations. ALP; alkaline phosphatase, AST; aspartate aminotransferase, ALT; alanine aminotransferase.



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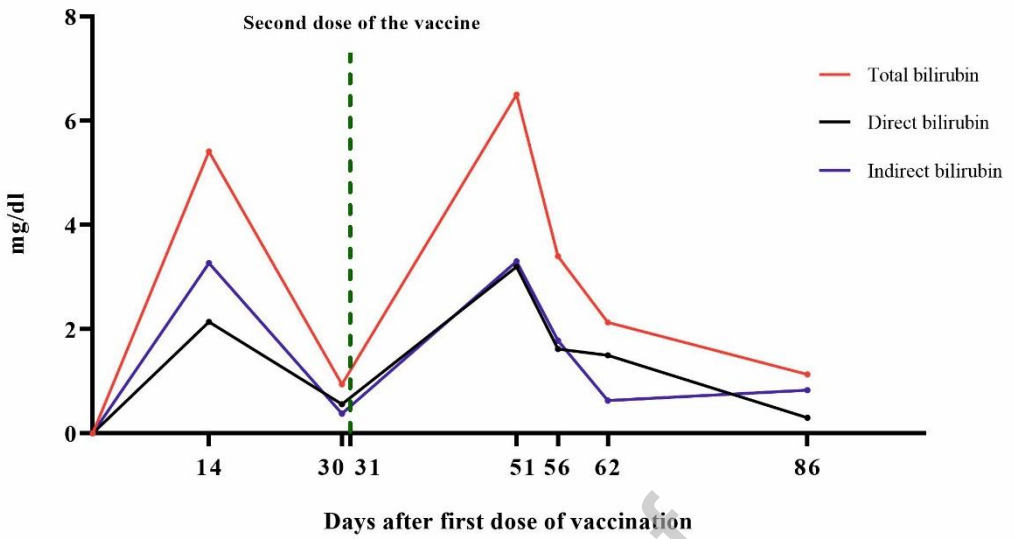

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