# Acute myopericarditis and left shoulder capsulitis following second dose of mRNA SARS-CoV-2 Moderna vaccination

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## SUMMARY

Vaccination against mRNA SARS-CoV-2 has been administered on a very large scale and various side effects have been described. The increased risk of myopericarditis is known, and only a few cases of shoulder capsulitis have been reported after vaccination. These two pathologies have never been reported in the same patient after vaccination. Our article presents the history of a man in his 40s who presented with myopericarditis a few days after vaccination against SARS-CoV-2 with mRNA(Messenger RNA) Moderna® vaccine and who at the same time developed shoulder capsulitis. His cardiovascular symptoms resolved rapidly, and his shoulder symptoms improved/resolved within 1 year. This case should make physicians aware of the possibility of several concomitant side effects following vaccination against SARS-CoV-2.

## BACKGROUND

Vaccination against SARS-CoV-2 is still relatively new, and we are beginning to get some perspective concerning side effects. Vaccines can lead to painful clinical symptoms of the shoulder, known as shoulder injury related to vaccine administration (SIRVA), which can be either bursitis, shoulder capsulitis or rotator cuff injuries. They are usually related to poor injection technique outside of the deltoid muscle.[1] Symptoms include pain and decreased passive and active shoulder mobility in the days following vaccination. There are several studies describing the occurrence of SIRVA during vaccination against SARS-CoV-2 and poor injection technique has also been most often incriminated.[2–8] However, in some cases, the aetiology is a postvaccination inflammatory response.[9] A few studies associate SARS-CoV-2 vaccination with shoulder capsulitis.[4 10–14] SARS-CoV-2 infection could also trigger shoulder capsulitis within 1.5–3 months without any other identifiable cause.[15] In this last study, the suggested hypothesis is that it can be triggered by SARS-CoV-2 infection both directly and indirectly through an inflammatory cascade. Another recent study[16] showed a 40% increase in diagnoses of shoulder capsulitis over an 11-month period during the onset of the SARS-CoV-2 pandemic compared with an 11-month period prior to the pandemic. It is interesting to note that this period was prior to widespread vaccination (4% of the study population was vaccinated at the end of the study period).

Myocarditis and pericarditis have also been reported in association with SARS-CoV-2 vaccination.[17–21] A 2022 systematic review showed an incidence rate of 0.001% for myocarditis and 0.0004% for pericarditis.[22] The incidence appears to be the highest in young men who received the Moderna vaccine rather than the Pfizer vaccine, and whose interval between the two doses was shorter.[23] According to current data, the incidence of myocarditis and pericarditis remains significantly higher after SARS-CoV-2 infection than after vaccination.[24] Like coronary artery disease, myopericarditis can be associated with pain radiating to the shoulder. However, to our knowledge, there is no literature describing the occurrence of myopericarditis and shoulder capsulitis in the same patient after SARS-CoV-2 vaccination with Moderna® vaccine. We report a case illustrating a patient with these two conditions.

## CASE PRESENTATION

A healthy and physically active man in his 40s received the second dose of the Moderna® SARS-CoV-2 vaccine and 2 days later presented with chest pain. He was evaluated in the emergency room where the ECG showed a mild PR subshift in the inferior territories without evidence of acute myocardial ischaemia. Results from the laboratory showed an inflammatory syndrome with CRP at 36.9 mg/L and elevated troponin-T-hs (peak 823 ng/L) and CK (peak 126 U/L). A diagnosis of myopericarditis was made, leading to hospitalisation in the cardiology department. During his stay, he underwent a coronary angiography, which showed healthy coronaries without visible atheromatous lesions, and a cardiac MRI, which showed multifocal sequelae of myocarditis but good cardiac function. He made a rapid recovery from his myopericarditis without requiring any symptomatic treatment, apart from the introduction of an antihypertensive medication. He was hospitalised for 2 days and then returned home with a cardiology outpatient follow-up.

From the start, the patient also had left shoulder pain, which was attributed to myopericarditis. However, this pain did not diminish with the resolution of his cardiac symptoms and worsened during the following weeks. The pain was nocturnal and associated with progressive functional limitation of the left shoulder. The patient attended physical therapy sessions as prescribed by his family physician. He then consulted our physicians for the first time 4 months after the myopericarditis. Clinical examination showed discreet pain at the palpation of the left shoulder. The active and passive range of motions were limited on the left-hand side: flexion 120° (vs 150° on the right), abduction 110° (vs 160°

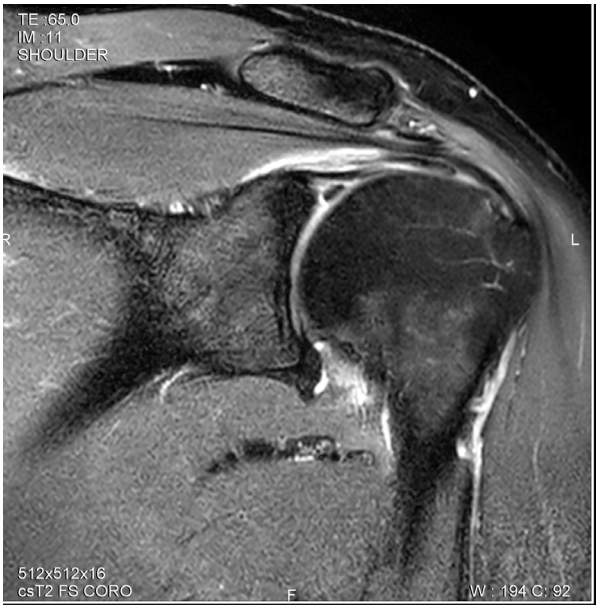


**Figure 1** Coronal section MRI FatSat images showing oedematous infiltrate of the rotator interval and fatty spaces adjacent to the inferior glenohumeral joint recess in coronal and of the rotator interval in sagittal.

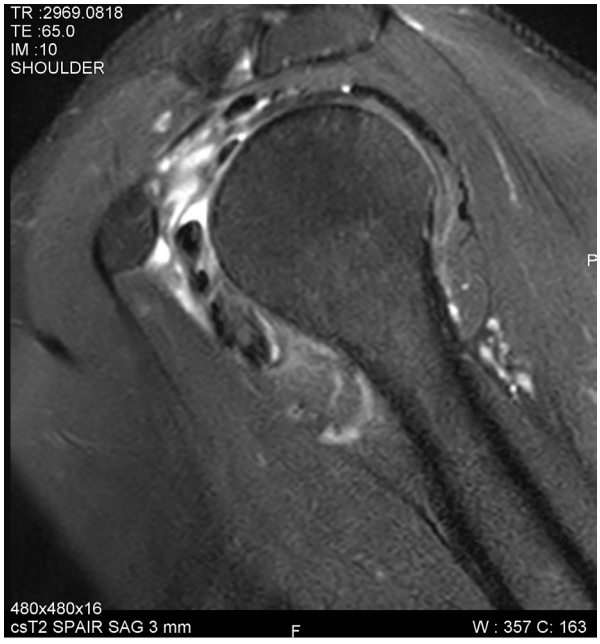


**Figure 2** Sagittal section MRI fatsat images showing oedematous infiltrate of the rotator interval and fatty spaces adjacent to the inferior glenohumeral joint recess in coronal and of the rotator interval in sagittal.

on the right), external rotation position 1 (elbow flexed at 90° with the arm attached to the trunk) at 25° (vs 60° on the right), external rotation position 2 (elbow flexed at 90° and shoulder abducted at 90°) at 60° (vs 90° on the right) and internal rotation (distance from thumb to C7) 51 cm (vs 12 cm on the right). The rest of the assessment was normal. The clinical diagnosis of shoulder capsulitis was made with a typical picture of reduced active and passive range of motion. We then recommended an MRI to confirm the diagnosis and exclude another lesion, levels I and II analgesia to reduce the pain, and a break from physiotherapy due to the pain intensity, while continuing exercises at home.

## INVESTIGATIONS

Standard X-rays of the left shoulder and an MRI were performed 5 months after the myopericarditis. The radiographs were normal ; the MRI showed an oedematous infiltration of the rotator interval and fatty spaces adjacent to the inferior glenohumeral joint recess on coronal T2 FAT SAT sequences and of the rotator interval on sagittal sections, confirming the diagnosis of shoulder capsulitis. Figures 1 and 2

## DIFFERENTIAL DIAGNOSIS

The diagnosis of shoulder capsulitis was made on the basis of the clinical picture (decreased active and passive shoulder range of motion), normal radiographs and a typical appearance on MRI.[25] The absence of subacromial bursitis or rotator cuff tendinopathy on MRI supported this diagnosis.

## TREATMENT

The initial treatment applied was a course of anti-inflammatory drugs; physiotherapy was not recommended in the initial inflammatory phase. The patient did not wish to receive a glenohumeral corticosteroid joint injection. Exercises were taught for home-based training.

## OUTCOME AND FOLLOW-UP

The patient was seen again 1 month after the diagnosis of shoulder capsulitis (5 months after initial onset),the symptoms improved with anti-inflammatory drugs by an overall decrease in pain severity and resolution of night waking due to pain . The range of motion of the shoulder was similar to what was measured during the first consultation, and still painful . The suggested management was to continue the anti-inflammatory treatment for another 3 weeks. In the case of significant recurrence of pain, a glenohumeral corticosteroid joint injection could be proposed. Physiotherapy was suggested, but the patient had already resumed his usual activities at work and in everyday life and preferred to renounce. He was seen one last time 1 year after the myopericarditis and the onset of the shoulder capsulitis, and he had recovered more than 90% of his range of motion, with a very slight limitation in internal rotation and some pain in extreme movements. Flexion and abduction were similar on both sides (150° and 165°, respectively), external rotation (in position 1) was 55° on the right vs 50° on the left (55° passively), passive external rotation (in position 2) was 100° on the right and 80° on the left and internal rotation (distance from thumb to C7) was 15 cm on the right vs 20 cm on the left.

## DISCUSSION

To our knowledge, this is the first clinical case reporting myopericarditis and shoulder capsulitis in the same patient following anti-SARS-CoV-2 vaccination with the Moderna ®vaccine. The association between myopericarditis and anti-SARS-CoV-2 vaccination has already been demonstrated by numerous studies.[17–22] The pathophysiology behind this association is not yet fully understood, but the hypotheses suggest a hyperimmune or inflammatory response, autoimmunity, delayed hypersensitivity or hypersensitivity to vaccine components.[23] The temporality between myopericarditis and vaccination was also studied. There seems to be two peaks of incidence, a first in the first 3 days after vaccination, more important for myocarditis

and a second 15–30 days after vaccination, more associated with pericarditis.[26] The incidence has also been shown to be higher in younger men (16–24 years) and especially following the second dose[27 28] as in our patient.

The patient's shoulder symptoms appeared at the same time as the myopericarditis, that is, about 48 hours after vaccination. Cardiac pathologies cause frequent shoulder pain, whether it is myocardial infarction[29] or myopericarditis.[19 30] Arm or shoulder pain in cardiac injury is explained by cardiac and shoulder/arm sensory information convergence in the same neurons of the spinothalamic tract, which does not allow accurate localisation projection in the somatosensory cortex.[29 31 32] Significant progress has been made in the last two decades in the understanding of pain. From pain caused solely by the activation of peripheral nociceptors following a tissue lesion, the concept of central sensitisation of pain was developed, which corresponds to a hypersensitivity of the pain circuits in the central nervous system whose response is disproportionate to the level of peripheral nociceptive stimuli.[33 34] This central sensitisation mechanism could be considered in the explanation of shoulder pain in myopericarditis observed in our patient.

One could evoke an idiopathic shoulder capsulitis developed concomitantly with the myopericarditis, but the patient is a middle-aged man, without history of diabetes, whereas in general idiopathic shoulder capsulitis those affected are almost exclusively women over 50 years old.[35] To date, there is no consensus on the exact pathophysiology of idiopathic shoulder capsulitis. In a recent review,[36] it is concluded that the capsule is affected by both inflammation and fibrosis mediated by proinflammatory cytokines, metalloproteinase, growth factors and immune cells (macrophages, B lymphocytes in particular). As mentioned above, one study showed an increase in shoulder capsulitis during the SARS-CoV-2 pandemic, even before vaccination.[16] A definitive explanation could not be given, and the authors propose two hypotheses. On the one hand, a low-grade inflammatory state could be an important predisposing factor for shoulder capsulitis, as can be observed in depression, for example, whose prevalence increased during the SARS-CoV-2 pandemic.[37] On the other hand, in view of the numerous multisystem complications of SARS-CoV-2 infection, it is suggested that shoulder capsulitis may be triggered by inflammatory and immunological pathways. It is, therefore, possible to imagine a mechanism mediated by immunity triggered by vaccination in the same way as myopericarditis or shoulder capsulitis after SARS-CoV-2 infection. Most studies presenting cases of SIRVA considered a poor injection technique as the cause, and therefore, a direct lesion by injection of the vaccine into the bursa, for example.[2–8] Intracapsular localisation of the injection is unlikely due to the depth of the capsule. Injection into the subacromial bursa is theoretically possible, but unlikely too and would not explain the myopericarditis. Education and appropriate training of vaccine administrators are important to ensure proper injection technique in the deltoid muscle and to decrease the risk of SIRVA.[11] Studies have already reported an association between shoulder capsulitis and influenza vaccination[1 38] but there are few studies describing cases of shoulder capsulitis following vaccination against SARS-CoV-2.[12 14 39] Interestingly, in an Indian study describing 10 cases of shoulder capsulitis,[39] the vaccine involved was not a messenger RNA vaccine. In that study, five patients had concomitant diabetes and three patients had hypothyroidism, which makes the interpretation of the results questionable. In Chu *et al*'s study, the 10 cases of shoulder capsulitis were related to the Pfizer messenger RNA vaccine, but insufficient clinical information on the patients' comorbidities made the results hard to interpret. To our knowledge, there have been no cases reported with the Moderna vaccine.

We did not find any recent description in the literature of shoulder capsulitis associated with myopericarditis. Only 1 article from 1955 reports the case of a patient who presented with pericarditis followed by a 'shoulder-hand' syndrome.[40]

Thus, according to the current state of knowledge, it can be assumed that the SARS-CoV-2 vaccination in our patient was responsible for both the myopericarditis and shoulder capsulitis, most likely mediated by an immune reaction, the exact pathophysiology remaining unclear, and by a central sensitisation phenomenon of pain triggered by the cardiac lesion. To confirm a causal link, pharmacoepidemiological studies are necessary,[41] no single criterion is sufficient. To confirm this link further, more studies may improve our understanding of the pathophysiology of shoulder capsulitis and the side effects reported with SARS-CoV-2 vaccination.

## Patient's perspective

Personally, I immediately made a connection between these various pains and the anti-Covid vaccine.

The doctors immediately thought it was a heart problem. In the hospital, I imagined the worst and I saw myself on the operating table with my chest open.

Then, I had to stop all physical activities. I did not have any trouble breathing, but as soon as I made the slightest effort (climbing stairs for example), I was out of breath. This lasted for a few months before gradually returning to normal. I was very tired for a few months. I returned to work fairly quickly but not 100% right away.

On the other hand, the problem with my shoulder got worse and became very annoying. It is finally this frozen shoulder problem that lasted the longest, an entire year.

From the beginning to the end, I was very well treated. On the other hand, at the beginning, the doctors at the hospital and the cardiologist never wanted to make a direct link between the anti-Covid vaccine and my peri-myocarditis.

Today, I did not get a third vaccine because I was not forced to do so. And the doctors did not bother to ask me about it.

## Learning points

- Shoulder capsulitis is a rare side effect of SARS-CoV-2 vaccination.
- Myopericarditis is a known side effect of SARS-CoV-2 infection and SARS-CoV-2 vaccination.
- Immune mechanisms and central sensitisation of pain could explain the two pathologies in this case.
- Several side effects may coexist following SARS-CoV-2 vaccination and it is important clinicians to remain vigilant for an atypical clinical presentation after SARS-CoV-2 vaccination.
- Education and appropriate training of vaccine administrators are important to ensure proper injection technique in the deltoid muscle and to decrease the risk of shoulder injury related to vaccine administration.

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Case reports provide a valuable learning resource for the scientific community and can indicate areas of interest for future research. They should not be used in isolation to guide treatment choices or public health policy.

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