EJSIT
European Journal of Science, Innovation and Technology
ISSN: 2786-4936
www.ejsit-journal.com
Volume 3 | Number 6 | 2023

A Brief Insight into a Common Short Term Sequel of Covid-19 Vaccination against the SARS-Cov-2 Virus: A Case History and Report of Shoulder Pain Syndrome

Edunjobi, A. S.[1*], Norton, H. E.[2], Aina, B.O.[3], Oluwasanya, A.N.[4], Babs-Edunjobi, A. M.[5]
[1]MBBS, FMCP (Rheumatology), MPH, MS; Inspire Santa Fe Medical Group, Santa Fe, New Mexico, USA
[2] BA, MD /Board-Certified Rheumatologist; President, Inspire Santa Fe Medical Group, Santa Fe, New Mexico, USA
[3]MBBS, FMCP; Formerly of Olabisi Onabanjo University Teaching Hospital, Sagamu, Nigeria
[4]MBBS, FWACP; Olabisi Onabanjo University Teaching Hospital, Sagamu, Nigeria
[5]MSc Global Healthcare Management, NHS, London, UK

ABSTRACT

Background: The approval of the covid-19 vaccines against the SARS-Cov-2 (Severe Acute Respiratory Syndrome Coronavirus-2) strain has proven very effective, reducing hospitalization and overall mortality and morbidity. Shoulder pain is a common symptom after any intramuscular vaccination, including against the novel covid-19 infection. However, this is not as intensely reported sequel as the involvement of other body systems. This discussion reports shoulder pain syndrome as a short-term sequel post-covid-19 vaccination in what could be described as a SIRVA (shoulder injury related to vaccine administration) - like presentation.
Objective: The objective of this study is to give a brief insight into a common short term sequel of covid-19 vaccination against the SARS-CoV-2 virus, with shoulder pain syndrome as case study.
Method: This is a retrospective cohort study of collated reports from medical colleagues and researchers resident in Canada, the United Kingdom, Nigeria and within the United States; in public and private practices involving patients whether previously infected with the SARS-Cov-2 virus or not, but that have had any of the covid-19 vaccine approved for use in their respective country injected between March 1st and December 31st 2022. Data were obtained from the various medical records applicable in each practitioner's domain and through direct interviews. A total of eighty two (82) patients were reviewed. Descriptive analysis and a case history of the study were reported.
Results: Eighty two (82) people were retrospectively reviewed across age, sex, exposure to the covid-19 vaccines and geographical distribution over the nine month period. There is a female preponderance of forty three or 52.4%; against thirty nine males which accounts for 47.6% of total cases reviewed. The age range is between ≥18 and ≤99 year-old. One of these patients is herein reported as case study.
Conclusion: The findings in this study have further confirmed a significant relationship between covid-19 vaccination and the development of shoulder pain in a SIRVA-like presentation. It is therefore hoped that this will encourage relevant stakeholders to provide ready-made interventions for this presentation, thereby preventing avoidable disability, the apprehension of post-vaccination adverse events and vaccine hesitancy in the general population.

Keywords: covid-19 pandemic/vaccine, SARS-Cov-2 virus, shoulder pain syndrome

[*] Corresponding Author: Edunjobi AS*, Inspire Santa Fe Medical Group, Santa Fe, New Mexico, USA, E-mail: baryourdoceyis@gmail.com

INTRODUCTION

The sudden outbreak and subsequent worldwide infiltration of the novel coronavirus diseases (COVID-19) has left the health sectors worldwide gasping for breath and survival, leading to disruption and discharge of normal service delivery and impacting negatively on the unsuspecting population with an equally sudden rise in morbidity and mortality especially in those with existing chronic illnesses and malignancies (Riad et al., 2020; Mercier, Arquizan & Roubille, 2020; Chang et al., 2021). The development of the Covid-19 vaccine against this SARS-Cov-2 strain has therefore proven to be a major game changer in the effort to curtail the spread and the overall management of the SARS-Cov-2 virus and the covid-19 pandemic, as evidenced by reported reduction in hospitalization and overall mortality and morbidity. Despite this feat, there are however reports of some medical sequelae arising from getting these mainly complex protein-based vaccines which has led to apprehension of post-vaccination adverse events thereby triggering vaccine hesitancy amongst some groups of people all over the world (McDonald et al., 2015; SAGE n.d; Troiano, 2021). The approved covid-19 vaccine mostly include any of viral vector, genetic, protein subunits, attenuated or inactivated vaccines depending on the manufacturers and the approved brand in the region of the world. Covid-19 vaccines authorized by the U.S. Food and Drug Administration (FDA) past and present include Pfizer-BioNTech and Moderna COVID-19 vaccines which are mRNA vaccines. Novavax COVID-19 vaccine which is a protein subunit vaccine. J&J/Janssen COVID-19 vaccine, a viral vector vaccine has expired and is no longer available for use in the United States as of May 6, 2023. Transient shoulder pain is one of the most frequent side effects experienced in the general population after any intramuscular vaccine administration (Atanasoff et al., 2010; Bancsi, Houle, & Grindrod, 2018). This is usually accompanied by local inflammatory reactions which may include any combination of bruising, pain, and induration at the local injection site after vaccination. (Cook, 2014). However, this prevailing sequel after vaccination is not as often intensely discussed as other more systemic medical sequelae of the covid-19 infection itself. This goes beyond the common presentation of allergy or transient febrile illness commonly reported post-vaccination but the involvement of the shoulder and periarticular tissues termed shoulder pain syndrome presenting as a short-term sequel following the covid-19 vaccination with propensity to present on a long-term basis in what can be referred to as a SIRVA- like presentation. The common immediate side effects of getting an intramuscular injection of the covid-19 vaccine usually within 48 hours include transient mild muscle pain, redness and soreness of the injected arm, headache, fever, tiredness and easy fatigability. These are self-limiting and usually disappear after a few days without treatment. There are however other notable adverse effects, albeit rare and manifesting in severe diseases as a short to long-term sequelae. These include anaphylaxis, coagulation, myocarditis, thyroiditis, and in some cases may lead to death. In a study evaluating the adverse effects following the 1st dose of COVID-19 Vaccination, more than 40% (n=204) of the respondents reported one or more side effects to vaccination on a short-term basis. The six most reported side effects were: soreness of the injected arm (78.9%), tiredness (71.1%), fever (54.9%), headache (49.8%), generalized soreness of muscles (46.6%), and longer-than-usual sleeping period (43.1%) (Majumder, et al., 2023). Shoulder injury related to vaccine administration (SIRVA) described above which refers to shoulder pain and dysfunction arising after vaccine administration, is usually limited to events following the influenza, pneumococcal, and diphtheria-tetanus-pertussis vaccination. The shoulder pain syndrome and soft-tissue disorders can therefore be referred to as SIRVA-like presentation since they follow the same pattern as the SIRVA (Wharton, Doan & Wolcott, 2022; Cagle, 2021; Yuen, Loh & Wang 2022).

PATENTS AND METHODS

This is a retrospective cohort study of collated reports from medical colleagues and researchers resident in Canada, the United Kingdom, Nigeria and within the United States; in public and private practices involving patients whether previously infected with SARS-Cov-2 virus or not, but that have had any of the covid-19 vaccine approved for use in their respective country injected on the deltoid muscle intramuscularly between March 1st and December 31st 2022. Vaccines common to these countries are the Pfizer–BioNTech COVID-19 vaccine (Comirnaty); the Oxford/AstraZeneca vaccines (Covishield, Vaxzevria), Moderna's (Spikevax) and the Johnson & Johnson's Janssen. Data were mostly obtained from the various medical records applicable in each practitioner's domain and through direct interviews of retrospective survey. A total of eighty two (82) patients were reviewed. Descriptive analysis and a case history of the study were reported.

RESULTS

Eighty two (82) patients were retrospectively reviewed across age, sex, exposure to the covid-19 vaccines and geographical distribution over the nine month period. The demographic characteristics and other clinical parameters of the patients are as presented below:

Table 1 below reveals the age range between ≥18 and ≤99 year-old. The 36-40-year-old age bracket were the most affected accounting for 20.7% of total. Estimated mean age is 44 and 50 years for females and males respectively. There is a female preponderance of forty-three accounting for 52.4% of total; against thirty-nine males which accounted for 47.6% of total cases reviewed. Most of the cases reviewed, numbering 36 (M=16, F=20) of the 82 and accounting for 43.9% of total, were from practices within the United States. Others are notably from Canada, 12 (M=7, F=5); the United Kingdom, UK, 14 (M=7, F=7) and Nigeria, 20 (M=9, F=11).

Table 1: Demographic pattern of patients reviewed

Age	**Years**		
Range	≥18 to ≤99		
Max (%)	36-40 (20.7%)		
Sex	**No (%)**	**Estimated Mean(Years)**	
Female	43 (52.4)	44	
Male	39 (47.6)	50	
Distribution of Cases	**Male**	**Female**	**Total**
	No (%)	**No (%)**	**No (%)**
U.S.A	16 (19.5)	20 (24.4)	36 (43.9)
Others (Canada, UK, Nigeria)	23 (28.05)	23 (28.05)	46 (56.10)

Fifty (50) patients, accounting for 61% of total {M=22(27%); F=28(34%)}, received only the covid-19 vaccine before presentation irrespective of the brand. Twenty two (22) patients, 27% of total, including {(M=13(16.0%); F=9(11.0%)} received both the covid-19 vaccine and the influenza vaccine (the 'flu' shot) on both arms during a single visit. Ten (10) patients, and 12% of total, {M=4(5.0%); F=6(7.0%)} had associated trauma either from outdoor or domestic accidents around the period they were vaccinated (Table 2).

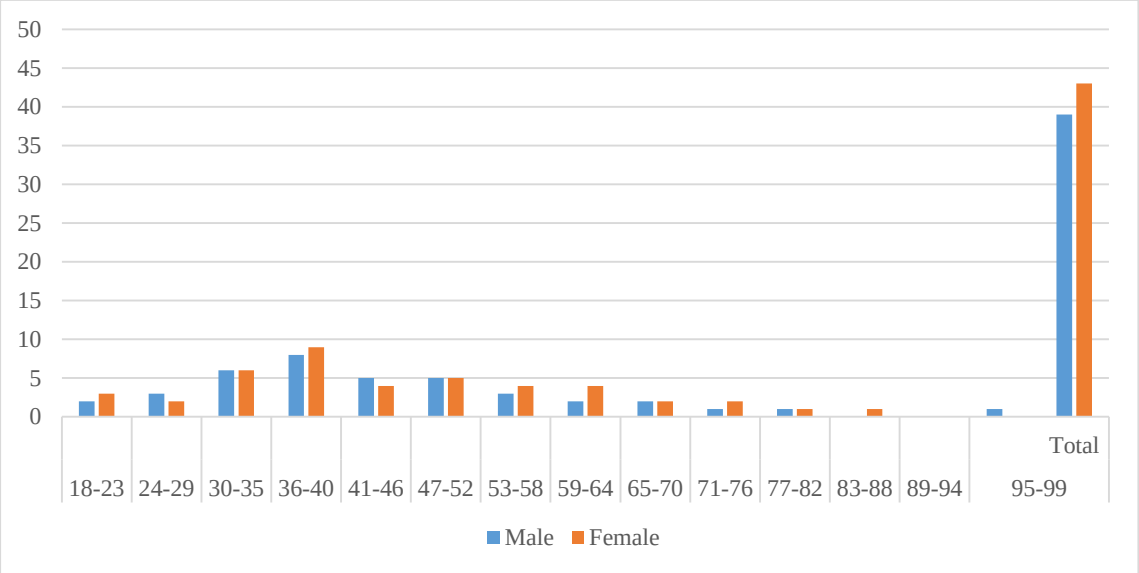


Figure 1: Age distribution of patients reviewed

Table 2: Sex Distribution and Type of Exposure/Associated Trauma

	Male	Female	Total
	No (%)	No (%)	No (%)
Covid-19 vaccine only	22 (27)	28 (34)	50 (61)
Covid-19 + 'Flu' vaccines	13 (16)	9 (11)	22 (27)
Covid-19 vaccine + Associated Trauma	4 (5)	6 (7)	10 (12)
TOTAL:	**39 (48)**	**43 (52)**	**82 (100)**

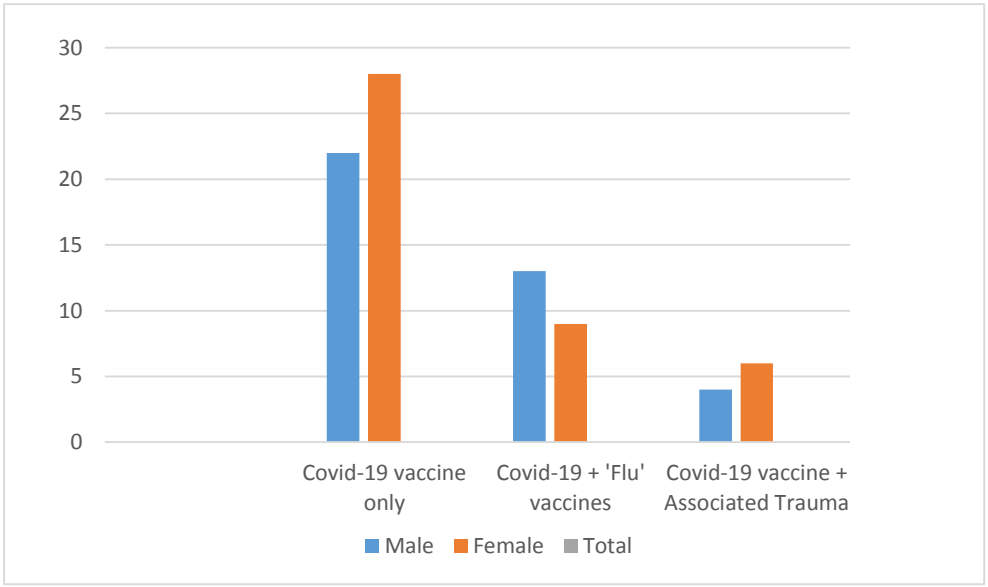
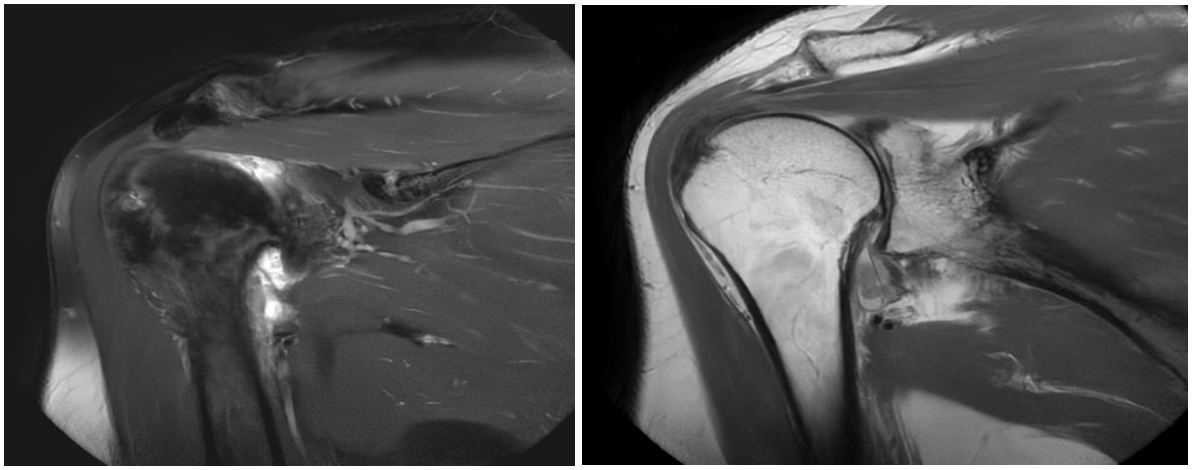


Figure 2: Sex Distribution and Type of Exposure/Associated Trauma

Case History

62 year-old Caucasian lady, single, retired; referred for evaluation following a fall where she fractured a rib and injured her right shoulder. She did physical therapy and had seen an orthopedic surgeon initially who diagnosed acromioclavicular sprain. She improved a bit with initial intervention. She has always had some back pain and goes to the chiropractor. She is positive for the HLB-27 antigen. Her weight at presentation was 188 Ibs, BMI 26.7. She consumes alcohol occasionally, does not engage in use of any illicit drugs. Does physical exercises which includes walking and swimming occasionally. She had earlier tested positive for the covid-19 infection while in Mexico in the first quarter of 2022. She was managed conservatively and got well. She then had two negative tests one week apart three weeks after initial presentation. On this present 2023 history, she has had the intramuscular influenza and covid-19 (Moderna/Spikevax) vaccines injected on each arm over the deltoid muscle about 4 weeks before the fall incident in which she had a usual initial injection site reaction, muscle aches and swelling and some movement restrictions, worse on the covid-19 vaccine site over the right shoulder. She had applied cold compress, limb resting/elevation and use of acetaminophen and ibuprofen to combat the symptoms. There was a remarkable improvement over the course of 2 weeks after this approach with the arm with influenza vaccine on the left almost completely resolved. Afterwards, she started complaining of some local pain at the covid-19 injection site, with heaviness and inability to elevate the right limb through its full range of movement. She had visited her primary physician who intensified the analgesic therapy, and also had some sessions at her chiropractor's. This has continued until she had a fall and the pain on the covid-19 vaccinated arm and the shoulder became aggravated, with increased swelling and heaviness, low grade fever and with more restrictions in the joint movement. This was what made her visit her primary physician, who referred her to the orthopedic surgeon who did the initial evaluation and management above. With no significant improvement, her primary doctor referred her to a rheumatologist while suggesting continuation of physiotherapy. She also returned to her chiropractor and engaged the services of an acupuncturist. The rheumatologist made a provisional diagnosis of an inflammatory arthritis involving the right shoulder joint to keep in view shoulder pain syndrome including rotator cuff tendinitis/partial thickness tendon tear and adhesive capsulitis (frozen shoulder).An MRI of the right shoulder was ordered which came back with a result confirming an inflammatory arthritis at the joint. *"Although there is no rotator cuff tear, there is evidence of tendinopathy, increased signal subscapularis and supraspinatus with moderate to large effusion. There is joint space narrowing and capsular thickening of the acromioclavicular joint."* She had intra-articular corticosteroid (triamcilonone) injection by the rheumatologist after the swelling has resolved. This was complemented by the use of celecoxib and oxycodone/acetaminophen depending on the severity of pain, and she continued with physical therapy. The symptoms were however not immediately taken care with the use of the inta-articular corticosteroid injection, but with continued resting of the limb, rationed oral and topical analgesia, and physical therapy, including resuming passive swimming sessions, she made a remarkable improvement, and at about 7 months after initial presentation, she has almost regained the normal use of her right shoulder joint again, with physical examination revealing a right shoulder with full range of motion, non-tender to palpation, and with no obvious swelling. She reported a weight gain of 20 Ibs throughout the course of management which she attributed to reduced physical activity.



A B

Figure 3 (A, B): MRI of Right shoulder joint showing evidence of tendinopathy, increased signal subscapularis and supraspinatus with moderate to large effusion

Perhaps the experience of a 92-year old veteran who went through the SIRVA-like presentation post-covid-19 vaccination should be mentioned to further buttress the point. He had agreed to take the covid-19 (Moderna/Spikevax) vaccine after much persuasion. His fears were two-fold: one, for the fear his body might not be able to tolerate the vaccine because of his age and his co-morbid state. He has a cardiac pacemaker in-situ for a bad arrhythmia. Two, was the Emergency Use Authorization (EUA) status of the COVID-19 vaccine by the Food and Drug Administration (FDA), granted because COVID-19 was a Public Health Emergency (PHE). He was worried about possible unknown adverse events from what he called a yet-to-be completed process. He was injected intramuscularly on his left deltoid with the Moderna brand following all the pre- and post-procedure precautions. Apart from having a mild pain over the injection site with a little soreness and warmness and which reduced in intensity within the next 24 hours, there were no other symptoms following the vaccination. However, he noticed 48 to 72 hours after getting vaccinated a gradual firmness of the deltoid, worsening pain, with the local warmness becoming a generalized low grade fever and difficulty in elevating the right arm to a horizontal plane. This continued for up to 6 weeks during which he saw his primary physician who had a plain x-ray of the right shoulder done but which showed no abnormality. He was encouraged to rest the arm, had it suspended in an arm sling, was commenced on celecoxib capsule 200mg twice daily and as needed with methylsalycylate spray and cream. The symptoms had eventually resolved as gradually as they have appeared.

DISCUSSION

COVID-19 vaccines like most vaccines can cause side effects, most of which are mild or moderate and resolves spontaneously within a few days on their own. However, results of some clinical trials have shown that more serious or long-lasting side effects are possible (Voysey, 2021; Sadoff, 2022). This is referred to as vaccine reactogenicity, that is the ability of the vaccine to produce common, 'expected' adverse reactions especially excessive immunological responses and associated signs and symptoms; and represents various local and systemic manifestations because of the inflammatory response to vaccination. This reactogenicity depends on various factors like the host characteristics including age, gender, etc; type of vaccine, composition, route of administration, amongst others. The chances of any of these side effects occurring after vaccination differ according to the specific vaccine. Less common immediate side effects reported for some COVID-19 vaccines have included severe allergic reactions such as anaphylaxis; however, this reaction is extremely rare. Although our survey

and review reveals a slight female preponderance of 52% in terms of reactogenicity and associated trauma in a ratio of F: M= 1.1:1, the overall result is a reflection that every covid-19 vaccinated individual is prone to the immediate, short and long-term sequelae of the vaccine, including the shoulder pain syndrome being discussed here regardless of geographical location, race, ethnicity or gender. Associated traumatic experience is not also peculiar to any of the cohorts reviewed. Expected spontaneous resolution of symptoms was not experienced in these patients despite the established self-limiting nature of symptoms of the covid-19 vaccine and of every other vaccine which have been established to be triggered by individual's body immunological response. Of shoulder pain as a sequel to the COVID-19 vaccination, the 92-year-old man presented above initially had a brief moment of respite of two weeks following initial common adverse reactions from the covid-19 vaccine before he insidiously developed the shoulder pain and mobility issues which mimics an adhesive capsulitis presentation or frozen shoulder. Transient shoulder pain is one of the most frequent side effects experienced in the general population after any intramuscular vaccine administration. (Atanasoff et al., 2010; Bancsi, Houle, & Grindrod, 2018; Kuether et al., 2011; IMAEVEC, 2011). This is usually accompanied by local inflammatory reactions which may include any combination of erythema, pain, and induration at the local injection site after vaccination (IMAEVEC, 2011; CDC & P, 2015). Soreness of the deltoid muscle and dysfunction which initiate the cascade of reactions that eventually culminate into the shoulder pain syndrome presentation appearing insidiously within the first 48 hours of being vaccinated and resulting in severe local pain that transitions into weakness or heaviness and overall decreased shoulder joint mobility without neurological dysfunction (Martín Arias et al., 2017). Apart from an inappropriate site of vaccine delivery being usually implicated in this situation., other proposed mechanism of this reaction includes the activation of pro-inflammatory mediators at the peri-capsular and the bursal spaces of the gleno-humeral joints following the infiltration of antigens and other adjuvants of the covid-19 vaccine, eventually provoking an inflammatory reaction at the joints and peri-articular spaces (Barnes, Ledford & Hogan, 2012; Jęśkowiak, 2021). This SIRVA reaction is typically implicated in vaccination against the influenza, pneumococcal, and diphtheria-tetanus-pertussis usually resulting from subacromial-subdeltoid bursitis, rotator cuff tendinitis or injury, axillary nerve injury, or frozen shoulder (Hibbs et al., 2020; Honarmand, Mackey, & Hayeri, 2021). This however cannot be said to be attributed only to these vaccines as the damage appears to arise from local immune reaction, rather than the antigens contained in the vaccination (Institute of Medicine, 2011, Sadoff et al., 2022). Other implicated mechanisms include when the vaccine is administered too distal to the joint and in the area traversing axillary nerve thereby resulting in a local axillary neuritis and shoulder dysfunction related to local nerve irritation, or from inappropriate needle length in relation to the patient's overall weight. Patients weighing over 70 kg require a 1-inch needle and those weighing less require a 5/8-inch needle to properly administer an intramuscular vaccine (Wharton, Doan & Wolcott, 2022; Martín Arias et al., 2017). This is according to the most recent immunization guidelines (Bancsi, Houle, & Grindrod, 2018). The afore-mentioned mechanisms can therefore justify the inclusion of shoulder pain syndrome and related pathologies which include subacromial bursitis, rotator cuff tendinitis, rotator cuff tear, or adhesive capsulitis, as SIRVA and a short term sequelae of Covid-19 vaccination against the SARS-Cov-2 virus. Following above submission, it can be deduced that the 92-year-old man developed shoulder pain, weakness and movement restrictions due to a combination of factors including administration of the vaccine too distal to the joint and in the area traversing axillary nerve thereby resulting in a local axillary neuritis and shoulder dysfunction and from inappropriate needle length in relation to his overall weight. This can be explained by the expected reduced muscle mass in people of his age which may allow an easy access of the needle to the surrounding nerves. His overall reduced immunity is also a factor. The main case presentation, the 62-year old lady may

have been a victim of over-reactive immune response or cytokine storm because of an ongoing inflammatory reaction following the covid-19 vaccination, now exacerbated by a compounded inflammatory process following trauma to the same shoulder.

CONCLUSION

Shoulder pathologies following COVID-19 vaccination may present with the exact clinical features of the idiopathic shoulder pain syndrome spectrum. The only deviation is that those with the covid-19 presentation may improve over time with only conservative management, and ultimately arriving at the same improvements in function and range of motion albeit through this different mode of management. It is important for health providers, policy makers and other relevant stakeholders to reckon with shoulder pathology as a potential and an existing adverse event following covid-19 vaccination; and not just as SIRVA which in the real sense is a definition used for medico-legal purposes only. This will help providers to reach a quick diagnosis and institute prompt measures to alleviate the adverse events and prevent the attending prolonged sequel, including possible joint damage and disabilities. It is also a way of reducing vaccine hesitancy in the general population. Although, this is a SIRVA-like presentation, but because it is an on-going global scourge, the covid-19 related shoulder pathology should be isolated and prioritized for diagnosis and management at every vaccination clinic. All appropriately qualified vaccine administrators including physicians, nurses, physician assistants, nurse practitioners, pharmacists, and medical assistants should be educated on universal best practices in this field to prevent vaccine-related morbidities thereby making the process more globally acceptable.

REFERENCES

Atanasoff, S., Ryan, T., Lightfoot, R., & Johann-Liang, R. (2010). Shoulder injury related to vaccine administration (SIRVA). *Vaccine, 28,* 8049-52. https://doi.org/10.1016/j.vaccine.2010.10.005.

Bancsi, A., Houle, S.K.D., & Grindrod, K.A. (2018). Getting it in the right spot: Shoulder injury related to vaccine administration (SIRVA) and other injection site events. *Can Pharm J (Ott), 151*, 295-9. https://doi.org/10.1177/1715163518790771.

Barnes, M.G., Ledford, C., & Hogan, K. (2012). A "needling" problem: shoulder injury related to vaccine administration. *J Am Board Fam Med, 25*, 919–922. https://doi.org/10.3122/jabfm.2012.06.110334.

Bodor, M. & Montalvo, E. (2007). Vaccination-related shoulder dysfunction. *Vaccine, 25*(4), 585–587.

Cagle, P.J., Jr. (2021). Shoulder Injury after Vaccination: a Systematic Review. *Rev Bras Ortop (Sao Paulo), 56*(3), 299–306. https://doi.org/10.1055/s-0040-1719086.

Centers for Disease Control and Prevention. (2015). Epidemiology and prevention of vaccine-preventable diseases. [Accessed June 3, 2019]. https://www.cdc.gov/vaccines/pubs/pinkbook/vac-admin.html.

Chang, A.Y., Cullen, M.R., Harrington, R.A., & Barry, M. (2021). The impact of novel coronavirus COVID-19 on noncommunicable disease patients and health systems: A review. *J. Intern. Med, 289*, 450–462.

Cook, I.F. (2014). Subdeltoid/subacromial bursitis associated with influenza vaccination. *Hum Vaccin Immunother, 10*, 605-6. https://doi.org/10.4161/hv.27232.

Hibbs, B.F., Ng, C.S., Museru, O., et al. (2020). Reports of atypical shoulder pain and dysfunction following inactivated influenza vaccine, Vaccine Adverse Event Reporting System (VAERS), 2010–2017. *Vaccine, 38*(5), 1137–1143.

Honarmand, A.R., Mackey, J., & Hayeri, R. (2021) Shoulder injury related to vaccine administration (SIRVA) following mRNA COVID-19 vaccination: report of 2 cases of

subacromial-subdeltoid bursitis. *Radiol Case Rep, 16*(12), 3631–4. https://doi.org/10.1016/j.radcr.2021.08.019

Institute of Medicine. Adverse effects of vaccines: evidence and causality. (2011). [Accessed June 3, 2019]. http://www.nationalacademies.org/hmd/~/media/Files/Report%20Files/2011/Adverse-Effects-of-Vaccines-Evidence-and-Causality/Vaccine-report-brief-FINAL.pdf.

Jęśkowiak, I., Wiatrak, B., Grosman-Dziewiszek, P., & Szeląg, A. (2021). The incidence and severity of post-vaccination reactions after vaccination against covid-19. *Vaccines (Basel), 9*(5), 502. https://doi.org/10.3390/vaccines9050502.

Kuether, G., Dietrich, B., Smith, T., Peter, C., & Gruessner, S. (2011). Atraumatic osteonecrosis of the humeral head after influenza A-(H1N1) v-2009 vaccination. *Vaccine, 29*(40), 6830–6833.

MacDonald, N.E., Eskola, J., Liang, X., Chaudhuri, M., Dube, E., Gellin, B., Goldstein, S., Larson, H., Manzo, M.L., Reingold, A., et al. (2015). Vaccine hesitancy: Definition, scope and determinants. *Vaccine, 33*, 4161–4164.

Martín Arias, L.H., Sanz Fadrique, R., Sáinz Gil, M., & Salgueiro-Vazquez, M.E. (2017). Risk of bursitis and other injuries and dysfunctions of the shoulder following vaccinations. *Vaccine, 35*, 4870–4876. https://doi.org/10.1016/j.vaccine.2017.07.055.

Majumder, M. A. A., Singh, K., Johnson, W. M. S., Rajasundaram, A., Gupta, S., Gaur, U., ... & Razzaque, M. S. (2023). Evaluation of short-term side effects following the first dose of COVID-19 vaccines among physicians and dentists: a cross-sectional study from India. *Journal of Multidisciplinary Healthcare, 16*, 161-174.

Mercier, G., Arquizan, C., & Roubille, F. (2020). Understanding the effects of COVID-19 on health care and systems. *Lancet Public Health, 5*, e524.

Riad, A., Boccuzzi, M., Pold, A., & Krsek, M. (2020). The alarming burden of non-communicable diseases in COVID-19 new normal: Implications on oral health. *Oral Dis, 27*, 791–792.

Sadoff, J., Gray, G., Vandebosch, A., Cárdenas, V., Shukarev, G., Grinsztejn, B., ... & Douoguih, M. (2022). Final analysis of efficacy and safety of single-dose Ad26. COV2. S. *New England Journal of Medicine, 386*(9), 847-860.

Strategic Advisory Group of Experts on Immunization (SAGE). Vaccine Hesitancy Survey Questions Related to SAGE Vaccine Hesitancy Matrix. WHO: Geneva, Switzerland.

Troiano, G. & Nardi, A. (2021). Vaccine hesitancy in the era of COVID-19. *Public Health, 194*, 245–51.

Voysey, M., Clemens, S. A. C., Madhi, S. A., Weckx, L. Y., Folegatti, P. M., Aley, P. K., ... & Bijker, E. (2021). Safety and efficacy of the ChAdOx1 nCoV-19 vaccine (AZD1222) against SARS-CoV-2: an interim analysis of four randomised controlled trials in Brazil, South Africa, and the UK. *The Lancet, 397*(10269), 99-111.

Wharton, B. R., Doan, K. C., & Wolcott, M. L. (2022). Shoulder injury related to COVID-19 vaccine administration: a case report. *JSES Reviews, Reports & Techniques, 2*(2), 178-181. https://doi.org/10.1016/j.xrrt.2021.10.005.

Yuen, W.L.P., Loh, S.Y.J., & Wang, D.B. (2022). SIRVA (Shoulder Injury Related to Vaccine Administration) following mRNA COVID-19 Vaccination: case discussion and literature review. *Vaccine, 40*(18), 2546–2550. https://doi.org/10.1016/j.vaccine.2022.03.037.