GSC Advanced Research and Reviews

eISSN: 2582-4597 CODEN (USA): GARRC2

Cross Ref DOI: 10.30574/gscarr

Journal homepage: https://gsconlinepress.com/journals/gscarr/

(CASE REPORT)

Cutaneous small vessel vasculitis associated with palpable purpura after COVID 19 Vaccination: A case report and a literature review

Daniela Tirotta *, Francesco Girelli, Maurizio Tassinari, Vincenzo Mazzeo and Paolo Muratori

Medicina Interna, Ospedale Morgagni-Pierantoni, Forlì, AUSL Romagna, Italy.

GSC Advanced Research and Reviews, 2022, 12(03), 131–144

Publication history: Received on 10 August 2022; revised on 15 September 2022; accepted on 17 September 2022

Article DOI: https://doi.org/10.30574/gscarr.2022.12.3.0242

Abstract

Coronavirus disease 19 (Covid-19) vaccination is mostly safe and effective: adverse events following Covid-19 vaccination are generally mild and well tolerated. Adverse reactions may include cutaneous reactions and, rarely, cutaneous small vessel vasculitis associated with palpable purpura. We present the case of a small-vessel vasculitis after Covid-19 vaccination that manifested with no organ involvement or systemic symptoms, associated with self-resolution, and a review of the cases described in literature. We have collected the epidemiological and clinical features of these cases.

Keywords: Small vessel vasculitis; Covid-19 vaccination; Adverse reaction; Cutaneous reaction.

1. Introduction

Several adverse reactions of Coronavirus disease 2019 (Covid-19) vaccines have been reported, although vaccination is generally safe.

Among possible adverse events, multiple skin reactions has occasionally been reported: the most frequently is unspecific injection-site reaction, but also inflammatory reactions in dermal filler, morbilliform and erythema multiforme-like rashes (1-4), type I hypersensitivity reactions (urticaria, angio-oedema, anaphylaxis), type IV hypersensitivity (''COVID arm''), functional angiopathies (erythromelalgia), pityriasis rosea-like rashes and reactivation of herpes zoster.

Lastly, other immune-mediated skin reactions (such as leukocytoclastic vasculitis) have been reported after Covid-19 vaccination [1]. We reported a case of a palpable purpura associated with vasculitis after Covid-19 vaccination without organ involvement or systemic symptoms, associated with self- resolution.

In the end, we performed a systematic review of the cases described in literature and we collected the epidemiological and clinical features of these cases. In particular, we analyzed epidemiological features, type of vaccination, symptoms, laboratory texts, comorbidity, trigger, clinical latency, site of reaction, outcome, histology, both in our case and in literature cases.

The course of most cases is moderate and complete remission could be achieved in numerous patients [1,2]. Furthermore, small vessel vasculitis after Covid-19 vaccination does not necessarily have a causal relationship, but it is important to know possible adverse events to help improve patient safety.

* Corresponding author: Daniela Tirotta
Medicina Interna, Forlì, Ospedale Morgagni-Pierantoni, AUSL Romagna, Forlì, Italy.

2. Material and methods

We present the case of small vessel vasculitis associated with palpable purpura after Covid-19 vaccination and a systematic review of cases published in the literature.

We did accurate research on PubMed, investigating cases of small vessel vasculitis after Covid-19 vaccination (Keywords "Covid-19 vaccination" AND "cutaneous vasculitis", with detailed control of references).

We have extended our search by using other web search engines with the same keywords (Google).

Cases of cutaneous vasculitis after Covid-19 vaccination were determined on the basis of the following criteria:

- Vasculitis in healthy individuals with no active manifestations related to autoimmunity.
- Cutaneous vasculitis limited to the skin without visceral involvement.
- Temporal relationship between the Covid-19 vaccination (any vaccine) and the development of clinical manifestations.

We reported 29 cases [5-30], we excluded some articles for age limit (adult: 19+ years), language limit (English language), reporting a total of 24 cases (Table1).

Table 1 Epidemiological and clinical characteristics of patients described in the literature

Table 1 Epidemiological and clinical characteristics of patients described in the literature

Case and reference	Type of vaccination	Year	Sex	Others symptoms	Lab text	Comorbdity	Other triggers	Clinical latency	Site	Outcome	Histology
1	Pfizer	84 year	Woman, caucasian	None	Slight alteration of TS, non-biological inflammation syndrome, aspecific ANA, 1/70	hypertension	Influenza vaccination, small airways flogosis	20 days following the seconde vaccine dose	Lower limbs	Spontaneous resolution after 2 weeks	Not performed
2 -4 (5)	Vaxzevria	57 year	man, Caucasian	None	Non-specific increases in VES, CRP	Hypertension	None	14 days following the first vaccine dose	Lower limbs and rapidly spreading to the abdomen, torso, and head	Resolution over 3 weeks with 1 mg/kg PD	Not performed
	Vaxzevria	58-year	Man, Caucasian	None	Non-specific increases in VES and CRP	None	None	7 days following the second dose of vaccine	Lower limbs, abdomen and trunk	0·5 mg/kg PD, with no clinical benefit, then 1 mg/kg PD, with progressive resolution of skin lesions over 10 day	Not performed
	Vaxzevria	53-year	Woman, Caucasian	None	Non-specific increases in VES and CRP	None	None	6 days following the first dose	Lower and upper limbs	1 mg/kg PD, which progressive resolution of skin lesions over 2 weeks	Mild lymphocytic perivascular infiltrate
5 (6)	Vaxzevria	71 year	woman, Caucasian	None	11,880 white blood cells/mm3. D-dimer level 806 ng/ml , CRP 5.07 mg/dL). ANA, ENA, ANCA	History of fibrocystic mastopathy and arterial hypertension treated	None	Second dose of Vaxzevria COVID-19 vaccine (AstraZeneca) five days earlier	Skin lesions associated with burning sensation that appeared one day earlier on both legs	PD 20 mg daily, tapered over 14 days, with complete clinical resolution of the skin lesions.	LCV

					negative, C3 and C4 levels respectively 83 mg/ dL and <8 mg/dL. RF 17 UI/mL .	with atenolol					
6-7 (7)	Pfeizer, first dose	6)60year	woman , , White British	None	Urine microscopy showed red cells2 × 10^6/L	Hypotiroidism	None	14 days	Legs	Rash improved significantly by day 17 (7-day course of oral PD 30 mg once daily, topical therapy)	Not performed
	Pfeizer , first dose	75 year	Woman, White British	None	None	Hypertension	None	2 Days	Legs	Fully resolved by day (5-day course of oral PD 40 mg once daily)	Not performed
8-9 (8)	Vaxzevria	55-year-old	Female, Caucasian	Fever, myalgia, left wrist swelling,	None	None	None	24 hours after first dose	Lower limbs	PD 0.5 mg/kg/day, tapered over 2 weeks with resolution of all symptoms.	LCV
	Vaxzevria	48-year-old	Male, Caucasian	fever, myalgia	None	Hypertension	None	2 days after second dose, 7 days after the first dose of vaccine that resolved within 7days	Over hands, forearms, gluteal region, and lower limbs similar lesions limited to ankles	Topical corticosteroids	LCV
10-12 (9)	Vaxzevria	57-year-old	man	None	Non-specific increases in VES and CRP	Hypertension	None	14 days following the first vaccine dose	Lower limbs and rapidly spreading to the abdomen, torso, andhead	P D 1 mg/kg, which led to progressive resolution of skin lesions over 3 weeks	Not performed

	Vaxzevria	58 year-old	man	None	Non-specific increases in VES and CRP	None	None	7 days following the second dose ofvaccine	Spreading from the lower limbs to the abdomen and trunk	0·5 mg/kg PD, to no clinical benefit, and then 1 mg/kg PD, with progressive resolution of skin lesions over 10 days.	Not performed
	Vaxzevria	53-year-old.	woman	None	Non-specific increases in VES and CRP	None	None	Purpura developed 6 days following the first dose	Lower and upper limbs.	P D 1 mg/kg , which led to a progressive resolution of skin lesions over 2 weeks	Mild lymphocytic perivascular infiltrate
13 (10)	BioNTech/Pfizer SARS – CoV-2	42-year-old	Woman, White	None	IgG and thyroid-stimulating hormone were slightly elevated	Hypertension and severe obesity	None	4 days after vaccination, first dose.	Lower limbs up to the gluteal area	PD 30 mg/day, increased to 60 mg/day due to poor response. With this treatment the rash resolved over the next 5 days	LCV
14 (11)	Vaxzevria	65-year old	African American man	None	CRP 86 mg/L and VES 34 mm/hr, serum IgG, 3310 mg/dL.	Hypertension, hyperlipidemia, and me-chanical aortic valve replacement (on warfarin)	None	7 days prior	Petechiae on the lower portion of the abdomen and palpable purpura on the left arm	Improved over the course of 4 days after initiation of oral and topical corticosteroids (PD 60 mg)	LCV
15 (12)	Vaxzevria	68-year-old	Korean woman	None	Decreased C3 and C4 levels (68.3 and 2.4 mg/dL)	None	None	7 days prior first dose	Both lower extremities	1 week, followed by 2 mg/day for 2 weeks), colchicine 1.2 mg/day, and topical methylprednisolo	LCV

										ne for 3 weeks. The lesions resolved and did not relapse after cessation of treatment. The lesion slightly recurred on the legs with the second vaccination, but resolved spontaneously in a few days.	
16 (13)	COVAXIN (India)	31-year-old	woman, Caucasian	None	None	None	None	Second dose of inactivated viral vaccine, 4 days prior to development of the lesion.	Purpura on the left leg	Rest and leg elevation, and antihistaminics for a week, after which the lesions resolved with hyperpigmentation.	Abundant upper and mid-dermal perivascular infiltrate
17 (14)	Vaxzevria	77-year-old	Woman, Caucasian	None	Slight elevation of VES, CRP	None	None	First dose, latency no specified	Lower extremities, palmar face of the hands . Several purpuric lesions on the soft palate and the tongue, with numerous pseudo- vesicles around the ankles	PD 50mg per day started, tapered by 5 mg every three days. Additionally, dapsone 50 mg daily . Vasculitis resolved, but limited residual blanching macules and patches were still present on the previously affected sites Recommended a different vaccine for the second dose	LCV

17-18(15)	Corona Vac (Sinov ac Life Science s)	23-year-old 1a 26-year-old	Caucasia n woman	None	CH50 30 U/mL (normal range, 41.8- 95.6 U/mL), slightly decreased	None	None	36 hours after CoronaVacadmi nistration 1 4 hours after CoronaVacadmi nistration	Erythematous plaques with purpura on the lower and upper extremities	2 doses of intramuscular and 4 doses of intravenous dexamethasone followed by oral PD (10 mg twice a day) for 5 days Colchicine (0.6 mg twice a day) and naproxen (250 mg twice a day) for 4 weeks only mild postinflammatory hyperpigmentatio n remained. The second CoronaVac administration was introduced in patient A without cutaneous sequalae, whereas patient B refused the further dose.	LCV
19 (16)	Pfizer-BioNT ech	83-year-old	Caucasia n wiman	None	Elevated levels of CRP, VES, RF with hypocomplement emi a and detection of cryoglobulin.	None	None	Approximately 5 days after her second dose	Bilateral palpable purpuric lesions with erythema and edema of her lower extremities	Improvement with oral antibiotics and topical corticosteroids	LCV
20 (17)	Inactiv ated COVI D-19 vaccine	33-year-old	Caucasi an man	None	None	None	None	Three days after the first dose	Erythematous macules and palpable papules on the legs, forearms, and right belly, Five days later,	Topical mometasone furoate was prescribed twice daily with partial resolution.	IgA vasculitis

									cutaneous lesions purpuric palpablepapules		
21 (18)	Pfizer-BioNTech	46-year-old	Caucasian female	None	None	Past medical history of psoriasis, psoriatic arthritis, irritable bowel syndrome, and leukocytoclastic vasculitis	None	2 days	Palpable purpuric papules distributed on bilateral lower legs	The vasculitis was successfully treated with a PD taper. Within 2 days, mild exacerbation of her palpable purpuric papules on the bilateral lower legs. 2 days after the second dose of the vaccine, it exacerbated	LCV
22 (19)	Vaxzevria	62-year-old	Asian female	Headache, myalgia, and symmetrical large joint arthralgias	CRP 31 mg/L (< 5), low- titre ANA (1:80 speckled), raised FR (169 IU/mL [< 20]),depressed C4 complement	None	None	7 days after the first dose	Bilateral lower limb non-blanching petechial rash	Rapid tapering course of oral PD to good resolution	LCV
23 (20)	Pfizer BioNTech	65-year-old man	man	Not reported	None	Diabetes and hypertension for which he is on metformin and lisinopril	None	2 days after receiving his third dose (booster)	Purpuric palpable lesions of the legs	Treated with one dose of triamcinolone 60 mg (IM), oral prednisone (tapered from 60 mg/d to 10mg/d), along with topical clobetasol pro-pionate and mupirocin	LCV

24	Moderna or Pfizer , not specified	23) 23 year old man	man	Not reported	Not reported	Not reported Not reported	Not reported	12 days after receiving the COVID-19 vaccine.	Petechial macules on hands and pink blanching macules and papule on arms, chest, and legs	Recovery	Interface dermatitis with dermal edema and a superficial lymphocytic and granulomatous vasculitis

LCV: Leukocytoclastic vasculitis. TS: transaminases , VES: erythrocyte sedimentation rate, CRP: C-reactive protein , ANA: Anti- nuclear antibodies,ENA: extractable nuclear antigen , ANCA: antineutrophil cytoplasmic antibodies, RF: rheumatoid factor , prednisone: PD

3. Results

3.1. Case report

A caucasian 84-year-old woman came to our attention for the onset of petechiae and purpura in the lower limbs (Fig 1), in absence of other systemic symptoms (in particular no fever, arthomyalgia, pharyngodynia). Twenty days earlier she had vaccinated anticovid-19 (II dose). A day later the onset of symptoms she received influenza vaccination by the general practitioner. Subsequently, pain of the lower limbs associated to edema and extension of purpura appeared, for which she assumed 5 days later prophylactic heparin, because as raccomended by her family doctor. She also performed a chest x-ray, positive for thickening in the left base. Subsequently she was hospitalized.

Anamnesis showed only: no personal or family history of autoimmunity, no smoking , no drug allergies, the patient lived alone, autonomous, she had hypertension (in therapy with nebivolol ½ cp), she reported epileptic seizures (during her youth, up to the menopause).

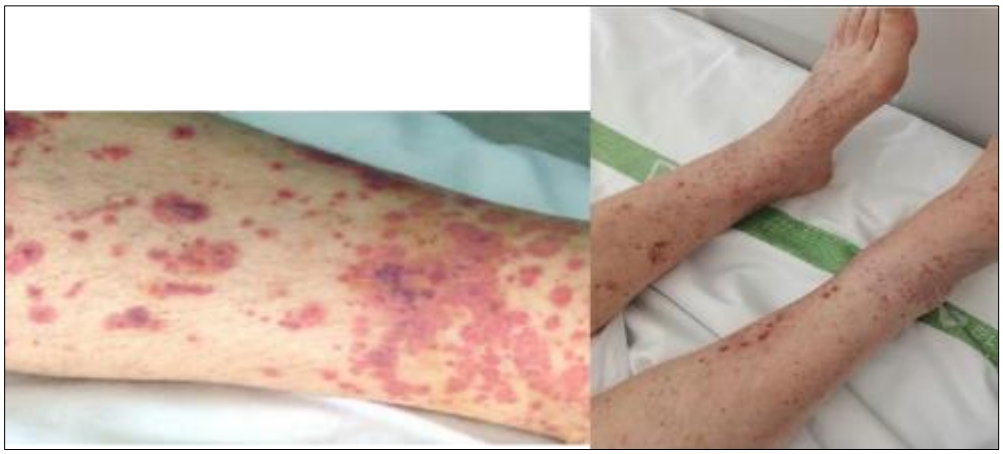

Figure 1 Petechiae and purpura in the lower limbs of the our patient

Physical examination showed purpura extended to the lower limbs (see photos 1)

Laboratory tests revealed: normocytic anemia, slight alteration of transaminases (ALT 64 U / l), non-biological inflammation syndrome (WBC7670/mmc, Hb 10.7 g/dl, PLT 362000/mmc, CRP 7.8 mg/l). Coagulation parameters were normal.

HR chest CT, performed for pulmonary thickening in the absence of biological inflammation syndrome, showed ground glass opacity and tree-inbud aspects in the posterior segment of the right upper lobe, associated to mucous material in the lumen of the bronchial branches, as from small airways concomitant inflammation.

We hypothesized:

- An autoimmune etiology: in this regard systemic autoimmunity was negative: anti-neutropil cytoplasmatic antibody (C-ANCA, P-ANCA), cryoglobulins, rheumatoid factor, anti DNA (only mild and nonspecific positivity, homogeneous pattern of ANA, 1/80).
- In the infectious hypothesis, the serology for Hepatitis B virus (HBV) and hepatitis C virus (HCV) , cytomegalovirus, Epstein-Barr virus, coxsackievirus, and human immunodeficiency virus (HIV) was negative.
- Study regarding organ involvement shows a negative electromyography *(*EMG) of the lower limbs. Proteinuria, complement, hepatorenal function and electrophoresis are also within the limits.

During hospital stay, the skin lesions gradually improved in one week, with total resolution after two weeks. An antibiotic course with azithromycin was performed due to bronchial flogosis. After one week, the patient was asymptomatic.

Purpuric rash on the legs raised the possibility of cutaneous small vessel vasculitis, althougt not confirmed by skin biopsy.

Indeed the skin biopsy is not performed as the rash had fully resolved by the time the patient first presented to the dermatology team. The appearance was however highly suggestive for small vessels vasculitis.

Therefore, after dermatological evaluation, only one course of topical therapy with diprosone was performed. Due to temporal proximity with the ante covid-19 vaccination, we concluded for a small vessel vasculitis, triggered by anti Covid-19 vaccine. We interpreted influenza vaccination as intercurrent inciting events.

4. Discussion

Covid-19 vaccination are mostly safe and effective: adverse events to vaccinations are usually mild and well tolerated and may include cutaneous reactions [1-3]. From our case series, small vessel cutaneous vasculitis, not associated with organ localization, as in the case presented, is an unusual event, but described in the literature. Relationship between immunizations and vasculitis has to be determined. Cutaneous vasculitis after vaccination is reported most frequently after vaccine against influenza, hepatitis A and hepatitis B, Bacillus Calmette-Guerin (BCG), anthrax, Human Papilloma Virus *(*HPV) , measles-mumps-rubella (MMR) and pneumococci, described as triggers for vasculitis, particularly cutaneous vasculitis [20,21].

Although in our patient's purpura occurred in the absence of both thrombocytopenia and clinically apparent thrombosis an immune stimulation secondary to vaccine administration could be hypothesized (similar to vaccine-induced thrombotic thrombocytopenia). In our series, purpuric cutaneous vasculitis secondary to inactivated vaccines, as Vaxzevria COVID-19 vaccination is more frequent, but coutaneus vasculitis is also reported following mRNA vaccines (Pfeitzer more prevalent : 6/23 cases). In this regard, in a study with large number of cases (2 vasculitis following Moderna vaccination is described, but only urticarial vasculitis) [22-24].

To date, the exact mechanism of vaccine-associated cutaneous adverse reactions is unclear. It is supposed that autoreactive lymphocytes and cross-reactive antibodies due to molecular mimicry can cause autoimmune reactions, as in the case of immune thrombocytopenia (VIIT), lupus erythematosus and bullous pemphigoid after vaccination [2]. Probably RNA vaccines and inactivated vaccines share a similar adverse drug reaction profile.

It is known that that molecular mimicry exists between Covid -19 and human components (e.g. the spike-protein sequences used to design the vaccines) , but the question is if skin complications after COVID-19 vaccination is true or related to causality.

Our review, with the limitations of the small number of cases, seems to show:

- From an epidemiological perspective, a vasculitis of small vessel after Covid-19 vaccination associated to purpuric manifestation without other organ involvement, has an average age of onset of 57.2 years (range 23-84 years), female sex is slightly prevalent (65% of cases).
- Rarely, in the absence of organ involvement, post-vaccine coutaneus small-vessel vasculitis is associated with systemic symptoms (13% of cases).
- Patients often do not have comorbidities and, among comorbidities, hypertension is not uncommon (41.6% % of cases). The association, however, could be linked to the confounding bias of the high prevalence of hypertension in the general population (the prevalence *of* hypertension in general population ranged from 13% to 41%) [31].
- Intercurrent inciting events are never described, except in our clinical case, in which the influenza vaccination could have triggered the petechiae (this could only due to a temporal bias or a molecular mimicry mechanism?). Indeed in a retrospective cohort study, compared with administration of COVID-19 mRNA booster vaccines alone, simultaneous administration of COVID-19 mRNA booster and seasonal influenza vaccines was associated with significant increases in reports of systemic reactions during days 0 to 7 following vaccination (32). However, in this study, vaccines were co-administered and adverse reactions were moderate and systemic. Other studies should be designed to evaluate the association between double, even deferred, vaccination and autoimmune reactions.
- From the laboratory point of view, a modest biological inflammation syndrome may be present (52% of cases), while very rarely a positive autoimmune serology or a complement consumption are observed.
- From a clinical point of view, the average latency of presentation is 6.7 days (range 4 hours-20 days) and manifestations of the lower limbs prevail (present in all cases).

- From our systematic review, it seems to emerge that post-vaccine cutaneous small-vessel vasculitis are more frequent for inactivated vaccines, however our clinical case is secondary to vaccination with mRNA vaccine, described in literature.
- In all cases examined, however, coutaneus vasculitis observed after COVID-19 vaccination have a good prognosis and are self-limited. In particular, no therapy or only steroid therapy (sometimes topical, sometimes systemic, sometimes in combination), is sufficient.

5. Conclusion

The case described presents the particularity of the onset of small vessels cutaneous vasculitis after Covid-19 and influenza vaccination.

The emergence of coutaneus vasculitis purpura post Covid-19 vaccination generally suggests a good prognosis with self-resolution, though the low number of cases examined in the literature does not allow to draw conclusions. Also our case presented a favorable course with clinical resolution with the help of topical steroid therapy only, confirming the apparent good prognosis.

Further investigations are essential both in the etiopathogenetic field , both in the clinical setting, to confirm the association between cutaneous vasculitis and vaccination and to confirm the favorable prognosis. Indeed it is important to know any possible adverse events of Covid vaccination to improve mostly patient safety.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest/ Competing interests.

Statement of informed consent

Patients gave written consent to the publication.

Availability of data and material (data transparency)

Yes.

Authors' contributions

All authors contributed equally

References

[1] Gambichler T, Boms S, Susok L,. Dickel H, Finis C, Rached N A, ,Barras M, Stücker M, Kasakovski D. Cutaneous findings following COVID-19 vaccination: review of world literature and own experience. J Eur Acad Dermatol Venereol 2022, feb; 36,172–180

[2] Wollina U, Chiriac A, Kocic H, Koch A, Brzezinski P. Cutaneous and hypersensitivity reactions associated with COVID-19 vaccination—a narrative review. Wien Med Wochenschr 2022 Mar; 172: 63–69

[3] McMahon DE, Amerson E, Rosenbach M, Lipoff JB, Moustafa D, Tvagi A, Desai RS, French LE, Lim HW, Thiers BH,Hruza JG, Blumenthal KG, Fox LP, Freeman EE . Cutaneous reactions reported after Moderna and Pfizer COVID-19 vaccination: A registry-based study of 414. J AM ACAD DERMATOL 2021, Jul; 85 (1) : 46-55

[4] Magro C, Crowson AN , Frank s L, Schaffer PR , Whelan P , Nuovo G. The histologic and molecular correlates of COVID-19 vaccine-induced changes in the skin. MD. Clinics in Dermatology , Nov–Dec 2021, Vol 39, Issue 6, : 966-984

[5] Giulio Cavalli, Serena Colafrancesco, Giacomo De Luca, Nathalie Rizzo, Roberta Priori, Fabrizio Conti, Lorenzo Dagna. Cutaneous vasculitis following COVID-19 vaccination. Lancet Rheumatol. 2021 Nov, 3(11): e743–e744.

[6] Fiorillo G , Pancetti S, Cortese A, Toso F , Manara S , Costanzo A, Borroni RG . Leukocytoclastic vasculitis (cutaneous small-vessel vasculitis) after COVID-19 vaccination J Autoimmun . 2021 Dec 28,127:102783

[7] Lam M, Egail M, Bedlow AJ, Tso S. Ribonucleic acid COVID-19 vaccine-associated cutaneous adverse drug events: a case series of two patients. Clin Exp Dermatol 2021, 46: 1131–1134

[8] Sandhu S, Bhatnagar1 A, Kumar H, Dixit PK , Paliwal G, |Suhag DK, Patil C, Mitra D. Leukocytoclastic vasculitis as a cutaneous manifestation of ChAdOx1 nCoV-19 coronavirus vaccine (recombinant) Dermatologic Therapy. 2021,e15141.

[9] Cavalli G, Colafrancesco S, De Luca G, Rizzo N, Priori R, Conti F, Dagna L. Cutaneous vasculitis following COVID-19 vaccination. Lancet Rheumatol. 2021 Nov,3(11):e743-e744

[10] Erler A, Fiedler J, Koch A, Heldmann F, Schütz A . Leukocytoclastic Vasculitis After Vaccination With a SARS-CoV-2 Vaccine. Arthritis Rheumatol. 2021 Dec,73(:2188

[11] Berry CT, Eliliwi M, Gallagher S, Panaccione S, Klein WM, Healy AL, Stoecker B, Kallas R. Cutaneous small vessel vasculitis following single-dose Janssen Ad26.COV2.S vaccination. JAAD Case Rep. 2021 Sep,15:11-14

[12] Jin WJ, Ahn SW, Jang SH, Hong SM, Seol JE, Kim H. Leukocytoclastic vasculitis after coronavirus disease 2019 vaccination. J Dermatol. 2022 Jan,49(1):e34-e3515

[13] Kharkar V, Vishwanath T, Mahajan S, Joshi R, Gole P. Asymmetrical cutaneous vasculitis following COVID-19 vaccination with unusual eosinophil preponderance. Clin Exp Dermatol. 2021

[14] Shahrigharahkoshan S, Gagnon LP, Mathieu S. Cutaneous Leukocytoclastic Vasculitis Induction Following ChAdOx1 nCoV-19 Vaccine. Cureus. 2021 Oct 24,13(10):e19005

[15] Bencharattanaphakhi R, Rerknimitr P. Sinovac COVID-19 vaccine-induced cutaneous leukocytoclastic vasculitis. JAAD Case Rep. 2021 Dec,18:1-3

[16] Larson V, Seidenberg R, Caplan A, Brinster NK, Meehan SA, Kim RH. Clinical and histopathological spectrum of delayed adverse cutaneous reactions following COVID-19 vaccination. . J Cutan Pathol. 2022 Jan,49(1):34-41

[17] Bostan E, Gulseren D, Gokoz O. New-onset leukocytoclastic vasculitis after COVID-19 vaccine. Int J Dermatol. 2021 Oct,60(10):1305-1306.

[18] Cohen SR, Prussick L, Kahn JS, Gao DX, Radfar A, Rosmarin D. Leukocytoclastic vasculitis flare following the COVID-19 vaccine. Int J Dermatol. 2021 Aug,60(:1032-1033.

[19] Liang I, Swaminathan S, Lee AYS. Emergence of de novo cutaneous vasculitis post coronavirus disease (Covid-vaccination. Clin Rheumatol. 2021 Oct 2:1-2

[20] Dicks AB and Gray BH. Images in Vascular Medicine: Leukocytoclastic vasculitis after Covid-19 vaccine booster. Vasc Med 2021 Nov 1

[21] Cao S, Sun D. Leucocytoclastic vasculitis following influenza vaccina-tion. BMJ Case Rep 2017,2017:bcr- 2016-217755

[22] Zanoni G, Girolomoni G, Bonetto C, et al. Single organ cutaneous vas- culitis: case definition & guidelines for data collection, analysis, and presentation of immunization safety data. Vaccine. 2016,34:6561-6571.

[23] McMahon DE, Amerson E, Rosenbach M, Lipoff JB, Moustafa D, Tyagi A, Desai SR, French LE, Lim HW, Thiers BH, Hruza GJ, Blumenthal KG, Fox LP, Freeman EE. J Cutaneous reactions reported after Moderna and Pfizer COVID-19 vaccination: A registry-based study of 414 cases. Am Acad Dermatol. 2021 Jul,85(1):46-55

[24] T. Gambichler,S. Boms,L. Susok,H. Dickel,C. Finis,N. Abu Rached,M. Barras,M. St€ucker,D. Kasakovski. Cutaneous findings following COVID-19 vaccination: review of world literature and own experience. J Eur Acad Dermatol Venereol. 2021 Nov 2 , Feb;36(2):172-180

[25] McMahon DE, Kovarik CL, Damsky W, Rosenbach M, Lipoff JB, Tyagi A, Chamberlin G, Fathy R, Nazarian RM, Desai SR, Lim HW, Thiers BH, Hruza GJ, French LE, Blumenthal K, Fox LP, Freeman EE.Clinical and pathologic correlation of cutaneous COVID-19 vaccine reactions including V-REPP: A registry-based study. J Am Acad Dermatol. 2022 Jan,86(1):113-12

[26] Ireifej B, Weingarten M, Dhamrah U, Weingarten M, Hadi S. Leukocytoclastic Vasculitic Rash Following Second Dose of Moderna COVID-19 Vaccine. J Investig Med High Impact Case Rep. 2022 Jan-Dec,10:1-3.

[27] Gambichler T, Abu Rached N, Scholl L, Behle B, Mansour R, Nick M, Susok L. Reproducible leukocytoclastic vasculitis following severe acute respiratory syndrome coronavirus 2 vaccination.J Dermatol. 2022 Apr,49(4):145-146

[28] Ungari M, Pezzarossa E. Cutaneous Lymphocytic Vasculitis After Administration of the Second Dose of AZD1222 (Oxford-AstraZeneca) Severe Acute Respiratory Syndrome Coronavirus 2 Vaccination: Casuality or Causality? Am J Dermatopathol. 2022 Jan 1;44(1):80-82

[29] Oskay T, Isık M. Leukocytoclastic vasculitis after the third dose of CoronaVac vaccination. Clin Rheumatol. 2022 Jun,41(:1931-193

[30] Criado PR, Giordani LP, Yoshimoto TA, Vieira IC, Landman G, Pincelli TP. Vasculitis in the setting of COVID-19: From the disease to the vaccine. Report of a case of cutaneous vasculitis after immunization. Dermatol Ther. 2022 May,35(5):e15367.

[31] Zeng Z, Chen J, Xiao C, Chen W. A Global View on Prevalence of Hypertension and Human Develop Index. Global View on Prevalence of Hypertension and Human Develop Index. Annals of Global Health. 2020, 86(1): 67, 1–6.

[32] Hause AM, Zhang B, Yue X. Reactogenicity of Simultaneous COVID-19 mRNA Booster and Influenza Vaccination in the US. JAMA Network Open. 2022,5(:e2222241 July 15, 2022 1/8.