Post-COVID Viral Reactivation: Incidence and Approaches

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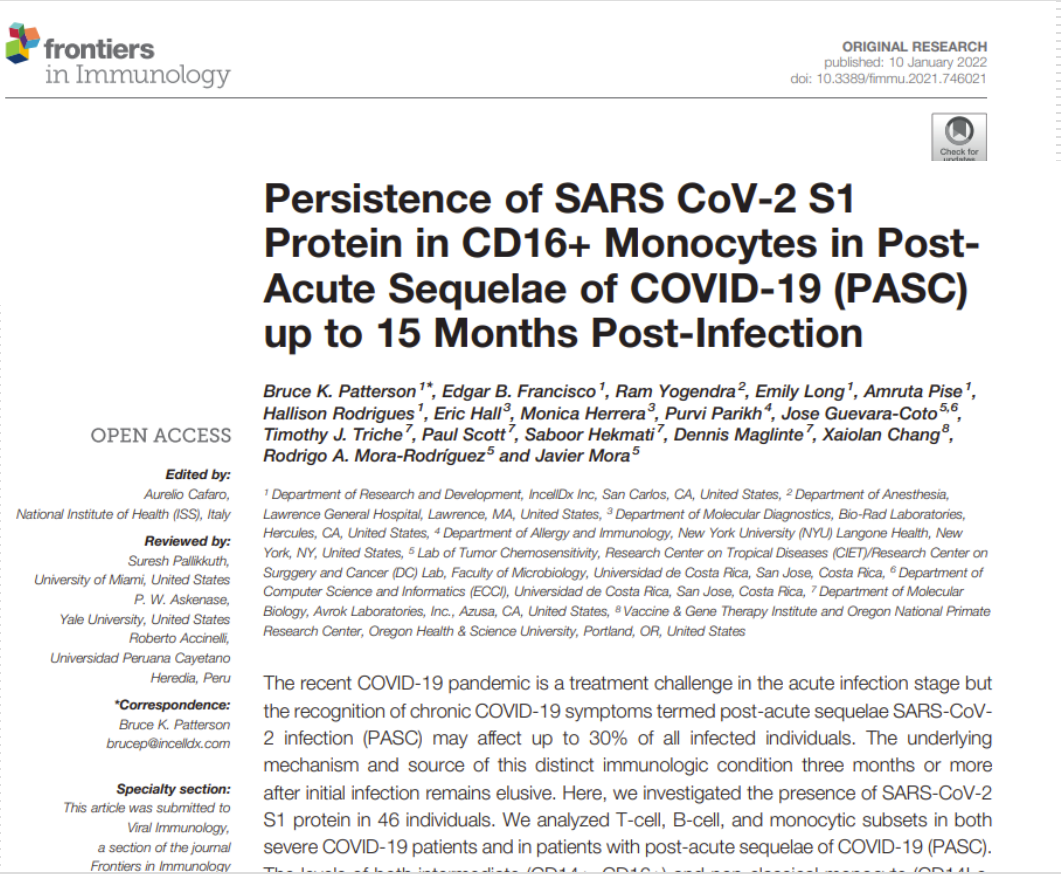
Agenda

- **How SARS-CoV-2 acts as a viral reservoir**
- Post-COVID and Herpes virus reactivation: EBV, CMV, VZV, HSV, HHV-6
- Post-COVID and Enteroviral reactivation
- Post-COVID and association of other infections that live in the mucosal membrane
- New ArminLabs Post-COVID Viral Reactivation Panels

Seminal "Frontiers" article: S1 protein in Post-COVID patients up to 15 mths post infection



frontiers in Immunology

ORIGINAL RESEARCH
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Persistence of SARS CoV-2 S1 Protein in CD16+ Monocytes in Post-Acute Sequelae of COVID-19 (PASC) up to 15 Months Post-Infection

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The recent COVID-19 pandemic is a treatment challenge in the acute infection stage but the recognition of chronic COVID-19 symptoms termed post-acute sequelae SARS-CoV-2 infection (PASC) may affect up to 30% of all infected individuals. The underlying mechanism and source of this distinct immunologic condition three months or more after initial infection remains elusive. Here, we investigated the presence of SARS-CoV-2 S1 protein in 46 individuals. We analyzed T-cell, B-cell, and monocytic subsets in both severe COVID-19 patients and in patients with post-acute sequelae of COVID-19 (PASC).

"This means the body has literally been sprayed with the virus and it spends 15 months, in a sense, trying to clean out the spike protein from our tissues. **No wonder people have Long-COVID syndrome."**
Board-certified internist and cardiologist Dr. Peter McCullough, https://www.facebook.com/watch/?v=114925050479349, minute 6.18

Source: Patterson BK, Francisco EB, Yogendra R, Long E, Pise A, Rodrigues H, Hall E, Herrera M, Parikh P, Guevara-Coto J, Triche TJ, Scott P, Hekmati S, Maglinte D, Chang X, Mora-Rodríguez RA, Mora J. Persistence of SARS CoV-2 S1 Protein in CD16+ Monocytes in Post-Acute Sequelae of COVID-19 (PASC) up to 15 Months Post-Infection. Front Immunol. 2022 Jan 10;12:746021.

The S1 segment infects monocytes that then act as a viral reservoir

These monocytes able to acquire such a proinflammatory phenotype can also act as a viral protein reservoir. "**The significance of these cells as a viral protein reservoir in PASC* is supported by our data reporting the presence of S1 protein within nonclassical monocytes.**"

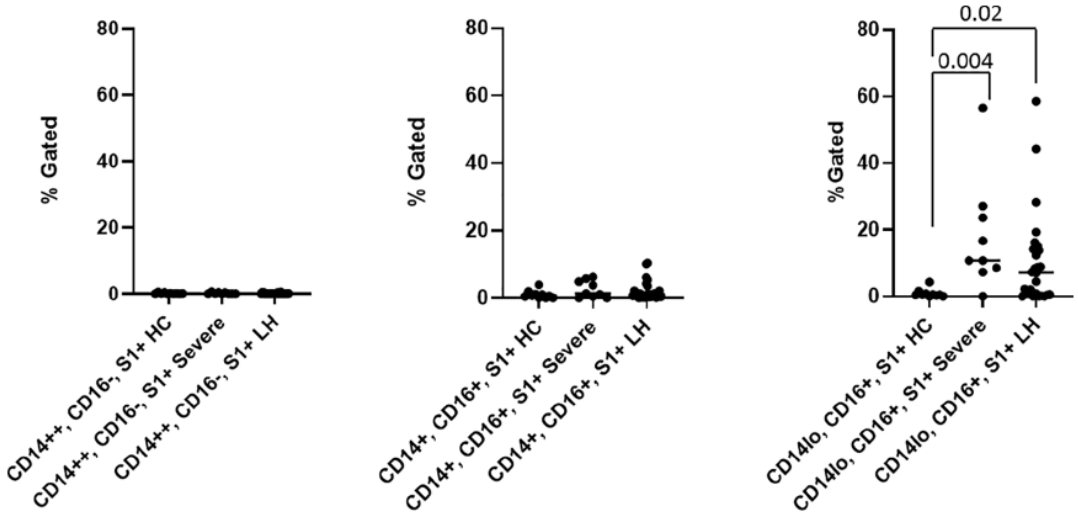


FIGURE 3 | Quantification of SARS-CoV-2 S1 protein in monocyte subsets isolated from healthy 63 controls (HC), severe COVID-19 (severe), and PASC patients (LH). SARS-CoV-2 S1 protein was expressed in non-classical monocytes in both severe and PASC individuals. Values (median value-horizontal line) for each category were based on the parental gating in **Supplementary Figure 1**. Statistical analysis was performed using the Kluskal-Wallis test. P values <0.05 are considered significant.

Source: https://pubmed.ncbi.nlm.nih.gov/35082777/

***PASC = post-acute sequelae of COVID-19**

Agenda

- How SARS-CoV-2 acts as a viral reservoir
- **Post-COVID and Herpes virus reactivation: EBV, CMV, VZV, HSV, HHV-6**
- Post-COVID and Enteroviral reactivation
- Post-COVID and association of other infections that live in the mucosal membrane
- New ArminLabs Post-COVID Viral Reactivation Panels

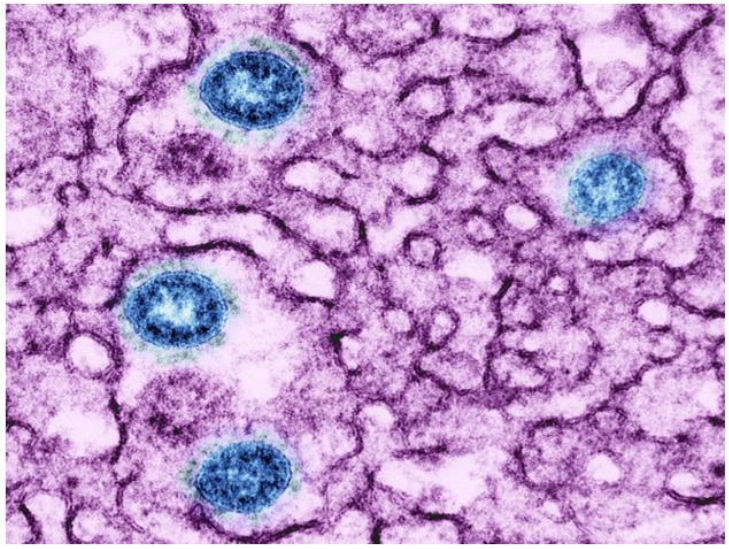
Recent study Aug. 2022 investigating the link between Long COVID and herpes viruses

NEWS | 25 August 2022

Could long COVID be linked to herpes viruses? Early data offer a hint

Low cortisol levels and herpes-virus reactivation are associated with prolonged COVID-19 symptoms, preliminary research suggests.

Emily Waltz



Particles of the SARS-CoV-2 virus (blue) inside an infected cell. Credit: NIH/SPL

"Most strikingly, the study found that in the long-COVID group, **levels of cortisol**, a stress hormone that has a role in regulating inflammation, blood sugar levels and sleep cycles, **were about 50% lower than in healthy participants**. The authors also found hints that in people with long COVID, **Epstein–Barr virus**, which can cause mononucleosis, and **varicella-zoster virus**, which causes chickenpox and shingles, might recently have been '**reactivated**'. **Both** of these viruses are in the herpes family, persist indefinitely in the body after infection and **can start to multiply again after a period of quiescence.**

Source: https://www.nature.com/articles/d41586-022-02296-5#:~:text=Low%20cortisol%20levels%20and%20herpes,19%20symptoms%2C%20preliminary%20research%20suggests.&text=Researchers%20looking%20for%20biological%20drivers,of%20a%20stress%20hormone1.

"Antibodies to SARS-CoV-2 antigens and herpesvirus lytic antigens were elevated in participants with Long COVID"

medRxiv. 2022 Aug 10;2022.08.09.22278592. doi: 10.1101/2022.08.09.22278592. Preprint

Distinguishing features of Long COVID identified through immune profiling

Jon Klein, Jamie Wood, Jillian Jaycox, Peiwen Lu, Rahul M Dhodapkar, Jeff R Gehlhausen, Alexandra Tabachnikova, Laura Tabacof, Amyn A Malik, Kathy Kamath, Kerrie Greene, Valter Silva Monteiro, Mario Peña-Hernandez, Tianyang Mao, Bornali Bhattacharjee, Takehiro Takahashi, Carolina Lucas, Julio Silva, Dayna Mccarthy, Erica Breyman, Jenna Tosto-Mancuso, Yile Dai, Emily Perotti, Koray Akduman, Tiffany J Tzeng, Lan Xu, Inci Yildirim, Harlan M Krumholz, John Shon, Ruslan Medzhitov, Saad B Omer, David van Dijk, Aaron M Ring, David Putrino, Akiko Iwasaki

PMID: 35982667 PMCID: PMC9387160 DOI: 10.1101/2022.08.09.22278592
Free PMC article

Abstract

SARS-CoV-2 infection can result in the development of a constellation of persistent sequelae following acute disease called post-acute sequelae of COVID-19 (PASC) or Long COVID [1-3]. Individuals diagnosed with Long COVID frequently report unremitting fatigue, post-exertional malaise, and a variety of cognitive and autonomic dysfunctions [1-3]; however, the basic biological mechanisms responsible for these debilitating symptoms are unclear. Here, 215 individuals were included in an exploratory, cross-sectional study to perform multi-dimensional immune phenotyping in conjunction with machine learning methods to identify key immunological features distinguishing Long COVID. Marked differences were noted in specific circulating myeloid and lymphocyte populations relative to matched control groups, as well as evidence of elevated humoral responses directed against SARS-CoV-2 among participants with Long COVID. Further, unexpected increases were observed in antibody responses directed against non-SARS-CoV-2 viral pathogens, particularly Epstein-Barr virus. Analysis of circulating immune mediators and various hormones also revealed pronounced differences, with levels of cortisol being uniformly lower among participants with Long COVID relative to matched control groups. Integration of immune phenotyping data into unbiased machine learning models identified significant distinguishing features critical in accurate classification of Long COVID, with decreased levels of cortisol being the most significant individual predictor. These findings will help guide additional studies into the pathobiology of Long COVID and may aid in the future development of objective biomarkers for Long COVID.

Extensive immune profiling: "The multi-dimensional immune profiling of Long COVID participants also revealed **elevated humoral immune responses to non-SARS-CoV-2 viral antigens, particularly EBV**."

Source: https://pubmed.ncbi.nlm.nih.gov/35982667/; https://www.nature.com/articles/d41586-022-02296-5#:~:text=Low%20cortisol%20levels%20and%20herpes,19%20symptoms%2C%20preliminary%20research%20suggests.&text=Researchers%20looking%20for%20biological%20drivers,of%20a%20stress%20hormone1.

"Long COVID Symptoms Likely Caused by Epstein-Barr Virus Reactivation"

Pathogens. 2021 Jun 17;10(6):763. doi: 10.3390/pathogens10060763.

Investigation of Long COVID Prevalence and Its Relationship to Epstein–Barr Virus Reactivation

Jeffrey E Gold [1], Ramazan A Okyay [2], Warren E Licht [3], David J Hurley [4]

Affiliations + expand

PMID: 34204243 PMCID: PMC8233978 DOI: 10.3390/pathogens10060763

Free PMC article

Abstract

Coronavirus disease 2019 (COVID-19) patients sometimes experience long-term symptoms following resolution of acute disease, including fatigue, brain fog, and rashes. Collectively these have become known as long COVID. Our aim was to first determine long COVID prevalence in 185 randomly surveyed COVID-19 patients and, subsequently, to determine if there was an association between occurrence of long COVID symptoms and reactivation of Epstein-Barr virus (EBV) in 68 COVID-19 patients recruited from those surveyed. We found the prevalence of long COVID symptoms to be 30.3% (56/185), which included 4 initially asymptomatic COVID-19 patients who later developed long COVID symptoms. Next, we found that 66.7% (20/30) of long COVID subjects versus 10% (2/20) of control subjects in our primary study group were positive for EBV reactivation based on positive titers for EBV early antigen-diffuse (EA-D) IgG or EBV viral capsid antigen (VCA) IgM. The difference was significant ($p < 0.001$, Fisher's exact test). A similar ratio was observed in a secondary group of 18 subjects 21-90 days after testing positive for COVID-19, indicating reactivation may occur soon after or concurrently with COVID-19 infection. These findings suggest that many long COVID symptoms may not be a direct result of the SARS-CoV-2 virus but may be the result of COVID-19 inflammation-induced EBV reactivation.

We found that **66.7% (20/30) of long-term long COVID subjects versus 10% (2/20) of long-term control subjects were positive** for EBV reactivation

"We found similar rates of EBV reactivation in those who had long COVID symptoms for months, as in those with long COVID symptoms that began just weeks after testing positive for COVID-19," said coauthor David J. Hurley, PhD, a professor and molecular microbiologist at the University of Georgia. "**This indicated to us that EBV reactivation likely occurs simultaneously or soon after COVID-19 infection**."

Source: https://pubmed.ncbi.nlm.nih.gov/34204243/; https://www.news-medical.net/news/20210623/Epstein-Barr-virus-reactivation-may-be-the-cause-of-long-COVID-symptoms.aspx; https://world.org/EBV/

Various phenomena contribute to EBV reactivation in COVID

- **EBV can be reactivated by SARS-CoV-2/COVID[1]**
- **Chronic EBV can be exacerbated by SARS-CoV-2/COVID[2]**
- **EBV, whether dormant or chronic and active, can increase susceptibility to COVID[3]**
- **Immune suppression plays a big role: "**Recent studies suggest the possible interaction between SARS-CoV-2 and EBV. .. One possible mechanism involves a decrease in CD8+ cells which are the primary cells responsible for immunity against EBV infection … A correlation between reduced $CD8^+$ T cells and NK counts, EBV DNA levels and COVID-19 severity was observed."
- **Drugs used in the treatment of COVID promote EBV reactivation[5]:** "Drugs used in the treatment of COVID-19 may also play a major role in altering immune responses by means of regulating intracellular signaling pathways, thus prompting the reactivation process of EBV. The use of high-dose corticosteroids has been stated as a risk factor for herpes virus reactivation"[5]

Source: 1. https://pubmed.ncbi.nlm.nih.gov/34204243/; 2. https://pubmed.ncbi.nlm.nih.gov/35872097/; *3. https://journals.asm.org/doi/pdf/10.1128/JVI.00192-21/; 4. https://pubmed.ncbi.nlm.nih.gov/35505635/; 5. https://pubmed.ncbi.nlm.nih.gov/35505635/*

July 2022 study: Impact of EBV reactivation on the development of Long COVID

medRxiv
THE PREPRINT SERVER FOR HEALTH SCIENCES
Cold Spring Harbor Laboratory BMJ Yale

Impact of Pre-Existing Chronic Viral Infection and Reactivation on the Development of Long COVID

Michael J. Peluso, Tyler-Marie Deveau, Sadie E. Munter, Dylan Ryder, Amanda Buck, Gabriele Beck-Engeser, Fay Chan, Scott Lu, Sarah A. Goldberg, Rebecca Hoh, Viva Tai, Leonel Torres, Nikita S. Iyer, Monika Deswal, Lynn H. Ngo, Melissa Buitrago, Antonio Rodriguez, Jessica Y. Chen, Brandon C. Yee, Ahmed Chenna, John W. Winslow, Christos J. Petropoulos, Amelia N. Deitchman, Joanna Hellmuth, Matthew A. Spinelli, Matthew S. Durstenfeld, Priscilla Y. Hsue, J. Daniel Kelly, Jeffrey N. Martin, Steven G. Deeks, Peter W. Hunt, Timothy J. Henrich

doi: https://doi.org/10.1101/2022.06.21.22276660

In a cohort of 280 adults with prior SARS-CoV-2 infection, we observed that LC symptoms such as fatigue and neurocognitive dysfunction at a median of 4 months following initial diagnosis were independently associated with serological evidence of recent EBV reactivation

ABSTRACT

The presence and reactivation of chronic viral infections such as Epstein-Barr virus (EBV), cytomegalovirus (CMV) and human immunodeficiency virus (HIV) have been proposed as potential contributors to Long COVID (LC), but studies in well-characterized post-acute cohorts of individuals with COVID-19 over a longer time course consistent with current case definitions of LC are limited. In a cohort of 280 adults with prior SARS-CoV-2 infection, we observed that LC symptoms such as fatigue and neurocognitive dysfunction at a median of 4 months following initial diagnosis were independently associated with serological evidence of recent EBV reactivation (early antigen-D [EA-D] IgG positivity) or high nuclear antigen IgG levels, but not with ongoing EBV viremia. Evidence of EBV reactivation (EA-D IgG) was most strongly associated with fatigue (OR 2.12). Underlying HIV infection was also independently associated with neurocognitive LC (OR 2.5). Interestingly, participants who had serologic evidence of prior CMV infection were less likely to develop neurocognitive LC (OR 0.52) and tended to have less severe (>5 symptoms reported) LC (OR 0.44). Overall, these findings suggest differential effects of chronic viral co-infections on the likelihood of developing LC and predicted distinct syndromic patterns. Further assessment during the acute phase of COVID-19 is warranted.

SUMMARY The authors found that Long COVID symptoms in a post-acute cohort were associated with serological evidence of recent EBV reactivation and pre-existing HIV infection when adjusted for participant factors, sample timing, comorbid conditions and prior hospitalization, whereas underlying CMV infection was associated with a decreased risk of Long COVID.

Source: https://www.medrxiv.org/content/10.1101/2022.06.21.22276660v1

We have indeed seen very high lytic levels of EBV post COVID

EBV EliSpot (lytic+latent)

1 EBV EliSpot (lytic) ! 657 SI

0-1 = negative
2-3 = weak positive
> 3 = positive

1 EBV EliSpot (latent) ! 65 SI

0-1 = negative
2-3 = weak positive
> 3 = positive

The result of the EliSpot test indicates current celluar activity against Epstein-Barr-Virus (EBV).

Explanation of EBV antigens:
EBV-lytic antigen: sign for replication of infectious EBV virions
EBV-latent antigen: sign for EBV latency with no production of infectious EBV virions

Positive above 1:
2-3 is weak positive
Over 3 is positive

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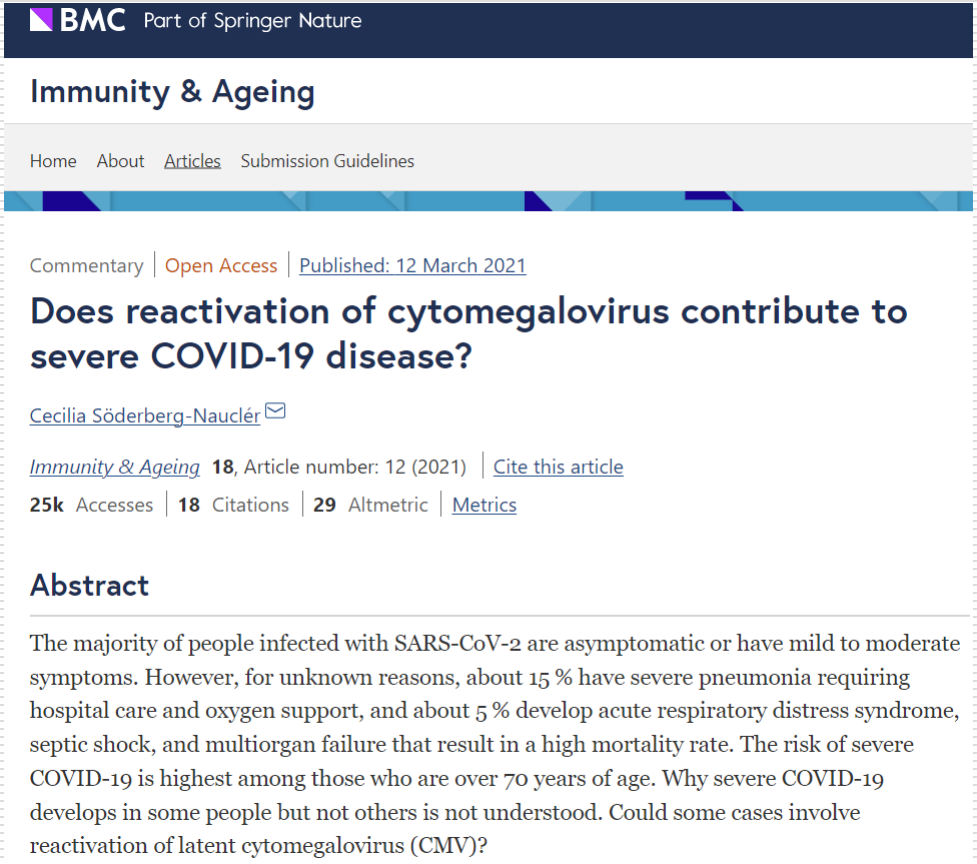
"CMV reactivation and virus-induced immune dysfunction may be underestimated as a driver"[1]



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Commentary | Open Access | Published: 12 March 2021

Does reactivation of cytomegalovirus contribute to severe COVID-19 disease?

Cecilia Söderberg-Nauclér

Immunity & Ageing **18**, Article number: 12 (2021) | Cite this article

25k Accesses | **18** Citations | **29** Altmetric | Metrics

Abstract

The majority of people infected with SARS-CoV-2 are asymptomatic or have mild to moderate symptoms. However, for unknown reasons, about 15 % have severe pneumonia requiring hospital care and oxygen support, and about 5 % develop acute respiratory distress syndrome, septic shock, and multiorgan failure that result in a high mortality rate. The risk of severe COVID-19 is highest among those who are over 70 years of age. Why severe COVID-19 develops in some people but not others is not understood. Could some cases involve reactivation of latent cytomegalovirus (CMV)?

"CMV reactivation and virus induced immune dysfunction may be under-estimated as a driver of immuno-pathogenesis in patients with severe COVID-19."[1]

"… diagnosing CMV in COVID-19 patients could be well worth the effort." [1]

"Intriguingly, severe acute respiratory syndrome coronavirus 2 and cytomegalovirus may potentiate each other, since they share some innate immune pathways."[2]

Source: 1. *Söderberg-Nauclér, C. Does reactivation of cytomegalovirus contribute to severe COVID-19 disease?. Immun Ageing* ***18,*** *12 (2021). https://doi.org/10.1186/s12979-021-00218-z; 2. https://pubmed.ncbi.nlm.nih.gov/35101103/*

Labs are seeing a definite correlation between COVID/Long COVID and CMV reactivation

CMV EliSpot

1 CMV EliSpot ! 13 SI

0-1 = negative
2-3 = weak positive
> 3 = positive

The result of the EliSpot test indicates current cellular activity against Cytomegalo-Virus.

May 2019, before COVID diagnosis

CMV EliSpot

1 CMV Lytisch ! 279 SI
0-1 = negative
2-3 = weak positive
> 3 = positive

1 CMV Latent ! 79 SI
0-1 = negative
2-3 = weak positive
> 3 = positive

The result of the EliSpot test indicates current cellular activity against Cytomegalo-Virus.

Explanation of CMV antigens:
CMV-lytic antigen: sign for replication of infectious CMV virions

June 2020, after COVID

Source: ArminLabs results, with permission

Varicella Zoster virus reactivation evidenced following both the virus and the vaccine

European Journal of Internal Medicine 104 (2022) 73–79

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journal homepage: www.elsevier.com/locate/ejim

Original article

Varicella-Zoster virus reactivation following severe acute respiratory syndrome coronavirus 2 vaccination or infection: New insights

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ARTICLE INFO

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ABSTRACT

Introduction: Varicella zoster virus (VZV) reactivation has been reported following vaccination for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), but the real extent remains unknown.
Methods: We conducted a systematic review to summarize evidence of VZV reactivation or infection following SARS-CoV-2 vaccination. Episodes after coronavirus disease-2019 (COVID-19) were also identified. Related articles were identified in PubMed and EMBASE databases till December 31, 2021 using the terms "varicella zoster" and "COVID-19". PROSPERO Register Number: CRD42021289399.
Results: The search revealed 314 articles, of which 55 met the inclusion criteria. VZV manifestations were documented in 179 (82.1%) subjects following SARS-CoV-2 vaccination and in 39 (17.9%) patients with COVID-19. Among the vaccinated, median (IQR) age was 56.5 (42–70) years, and 56.8% were female. Twenty-one (16.8%) were immunosuppressed. The median (IQR) latency time after vaccination was 6 (3–10) days, and 84.4% received mRNA vaccines. VZV reactivation occurred following a first dose (68.2%), a second dose (12.8%) or a booster (0.6%). The most important VZV manifestation was dermatome herpes zoster rash, which accounted for 86.4% of events in vaccinated subjects. Twenty patients (11.3%) presented serious VZV events after vaccination, with *Herpes Zoster ophthalmicus* (5.6%) and post-herpetic neuralgia (3.4%) predominating. No VZV

"COVID-19 can potentially cause reactivation of VZV and subsequently have an additive effect in neurologic complications"[2]

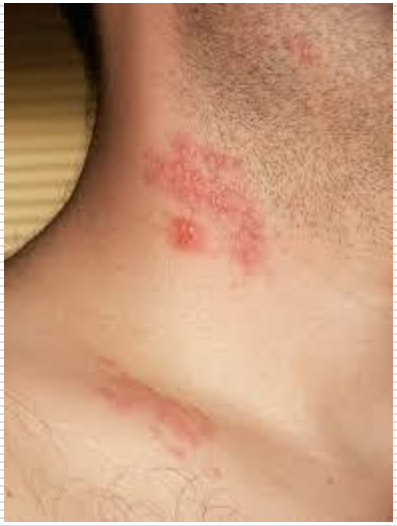


Image free to use under Commons License from Wikipedia, https://en.wikipedia.org/wiki/Shingles

Source: *1. https://pubmed.ncbi.nlm.nih.gov/35931613/; 2. https://cp.neurology.org/content/neurclinpract/11/2/e219.full.pdf; https://www.rheumatologyadvisor.com/home/general-rheumatology/herpes-zoster-reactivation-covid19-vaccination-autoimmune-inflammatory-rheumatic/*

Herpes Simplex Virus reactivation with COVID-19

microorganisms

MDPI

Article

Herpes Simplex Virus Re-Activation in Patients with SARS-CoV-2 Pneumonia: A Prospective, Observational Study

Erica Franceschini [1,*], Alessandro Cozzi-Lepri [2], Antonella Santoro [1], Erica Bacca [3], Guido Lancellotti [3], Marianna Menozzi [1], William Gennari [4], Marianna Meschiari [1], Andrea Bedini [1], Gabriella Orlando [1], Cinzia Puzzolante [1], Margherita Digaetano [1], Jovana Milic [3], Mauro Codeluppi [5], Monica Pecorari Federica Carli [1], Gianluca Cuomo [1], Gaetano Alfano [6], Luca Corradi [1], Roberto Tonelli [7], Nicola Stefano Busani [9], Emanuela Biagioni [9], Irene Coloretti [9], Giovanni Guaraldi [3], Mario Sarti [4], Mari Enrico Clini [7], Massimo Girardis [9], Inge C. Gyssens [11,12] and Cristina Mussini [1,3,*]

"Conclusions: our study shows a high incidence of HSV-1 re-activation both virologically and clinically in patients with SARS-CoV-2 severe pneumonia"[1]

Rheumatology International (2022) 42:1523–1530
https://doi.org/10.1007/s00296-022-05146-9

Rheumatology
INTERNATIONAL

OBSERVATIONAL RESEARCH

Herpesvirus infections and post-COVID-19 manifestations: a pilot observational study

Svitlana Zubchenko[1] · Iryna Kril[1] · Olena Nadizhko[1] · Oksana Matsyura[1] · Valentyna Chopyak[1]

Received: 17 March 2022 / Accepted: 5 May 2022 / Published online: 1 June 2022

Abstract
The global spread of SARS-CoV-2 points to unrivaled mutational variation of the virus, contributing to a variety of post-COVID sequelae in immunocompromised subjects and high mortality. Numerous studies have reported the reactivation of "sluggish" herpes virus infections in COVID-19, which exaggerate the course of the disease and complicate with lasting post-COVID manifestations CMV, EBV, HHV6). This study aimed to describe clinical and laboratory features of post-COVID manifestations accompanied by the reactivation of herpes virus infections (CMV, EBV, HHV6). 88 patients were recruited for this study, including subjects with reactivation of herpes viruses, 68 (72.3%) (main group) and 20 (27.7%) subjects without detectable DNA of herpesviruses (control group): 46 (52.3%) female and 42 (47.7%) male; median age was 41.4 ± 6.7 years. Patients with post-COVID manifestations presented with reactivation of EBV in 42.6%, HHV6 in 25.0%, and EBV plus HHV6 in 32.4%. Compared with controls, patients with herpes virus infections presented with more frequent slight fever temperature, headache, psycho-neurological disorders, pulmonary abnormalities and myalgia ($p < 0.01$), activation of liver enzymes, elevated CRP and D-dimer, and suppressed cellular immune response ($p \leq 0.05$). Preliminary results indicate a likely involvement of reactivated herpes virus infections, primarily EBV infections in severe COVID-19 and the formation of the post-COVID syndrome. Patients with the post-COVID syndrome and reactivation of EBV and HHV6 infections are at high risk of developing various pathologies, including rheumatologic diseases.

Keywords COVID-19 · Herpes virus · Epstein–Barr virus · Rheumatology · An autoimmune disease

Source: 1. *https://pubmed.ncbi.nlm.nih.gov/34576791/; https://pubmed.ncbi.nlm.nih.gov/34202515*

Recent, August 2022: Reactivation of HHV-6, too

Viruses. 2022 Aug 25;14(9):1872. doi: 10.3390/v14091872.

Epstein–Barr Virus and Human Herpesvirus–6 Reactivation in Acute COVID–19 Patients

Bailey Brooks [1 2], Christina Tancredi [2], Yufeng Song [2], Alemu Tekewe Mogus [2], Meei-Li W Huang [3], Haiying Zhu [3], Tuan L Phan [4 5], Harrison Zhu [5 6], Alexandra Kadl [7 8], Judith Woodfolk [7 9], Keith R Jerome [3 10], Steven L Zeichner [2 9]

Affiliations + expand

PMID: 36146679 PMCID: PMC9504756 DOI: 10.3390/v14091872

Free PMC article

Abstract

Beyond their pulmonary disease, many COVID-19 patients experience a complex constellation of characteristics, including hyperinflammatory responses, autoimmune disorders, and coagulopathies. However, the pathogenesis of these aspects of COVID-19 is obscure. More than 90% of people are latently infected with the lymphotropic herpesviruses Epstein-Barr Virus (EBV) and/or Human Herpesvirus-6 (HHV-6). Some of the inflammatory features of COVID-19 resemble clinical syndromes seen during EBV and HHV-6 infection, and these latent viruses can be reactivated by inflammatory mediators. We hypothesized that EBV and HHV-6 reactivation might be a common feature of early COVID-19, particularly in patients with more inflammation. We tested for EBV and HHV-6 reactivation in 67 patients acutely hospitalized with COVID-19 using previously validated quantitative PCR assays on the plasma. In our cohort, we found that 15/67 (22.4%) patients had detectable EBV and 3/67 (4.5%) had detectable HHV-6. This frequency of activation is somewhat more than the frequency reported for some healthy cohorts, such as blood donors and other healthy control cohorts. There was no association between EBV or HHV-6 and markers indicative of more inflammatory disease. We conclude that EBV and HHV-6 activation at about day 7 of hospitalization occurred in a modest fraction of our cohort of COVID-19 patients and was not associated with high levels of inflammation. In the modest fraction of patients, EBV and HHV-6 reactivation could contribute to some features of acute disease and pre-disposition to post-acute sequelae in a subset of patients.

Cohort of 67: "**We found that 15/67 (22.4%) patients had detectable EBV and 3/67 (4.5%) had detectable HHV-6**"

Source: https://pubmed.ncbi.nlm.nih.gov/36146679/

Agenda

- How SARS-CoV-2 acts as a viral reservoir
- Post-COVID and Herpes virus reactivation: EBV, CMV, VZV, HSV, HHV-6
- **Post-COVID and Enteroviral reactivation**
- Post-COVID and association of other infections that live in the mucosal membrane
- New ArminLabs Post-COVID Viral Reactivation Panels

Persistent enteroviral infection long known to be found in ME – especially B1

"There is now substantial evidence for a persistent enterovirus infection, particularly Coxsackie B viruses in many cases of ME. Patients with ME appear to have a higher prevalence of antibodies against Coxsackie B viruses than matched controls."[1]

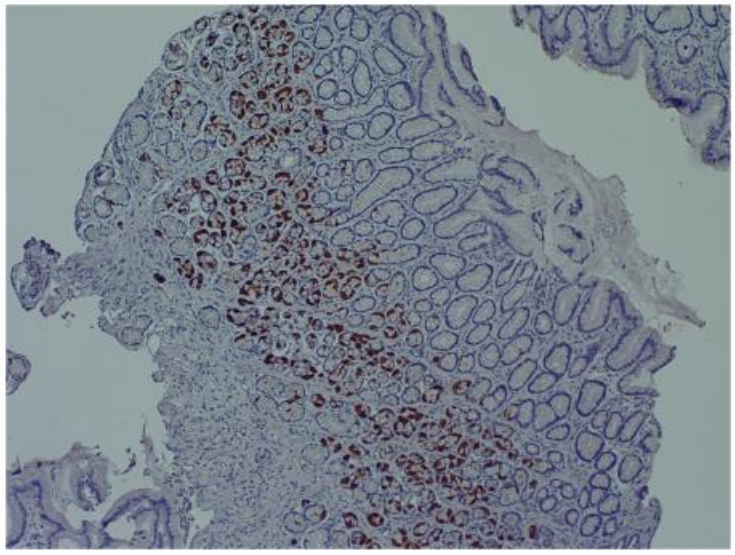


FIGURE 2 | Enteroviral capsid protein 1 in the stomach biopsy of an ME/CFS patient by immunoperoxidase staining (100×) (Chia et al., 2015). This type of chronic viral infection is difficult to identify without the use of special techniques such as antibody staining or nucleic acid amplification of biopsies taken from symptomatic areas, since viral cultures are rarely positive. Original image courtesy of Dr. John Chia.

"Chia and Chia found enterovirus VP1 protein and RNA in stomach biopsy specimens obtained from 165 ME/CFS patients with chronic abdominal complaints. 82% of ME/CFS specimens stained positive for enterovirus VP1 protein, compared to 20% of control specimens."[2]

Source: 1. http://virology-online.com/viruses/Enteroviruses5.htm; 2. https://pubmed.ncbi.nlm.nih.gov/34248921/

Coxsackie and myocarditis/pericarditis in coinfections with COVID-19

Fulminant myocarditis as an early presentation of SARS-CoV-2

Tamara Naneishvili,[1] Arsalan Khalil,[1] Ryan O'Leary,[2] and Neeraj Prasad[1]

Abstract

Myocarditis is well known to be caused by viral infections such as Coxsackie virus group B, human herpes virus 6 and parvovirus B19. However, during the current emerging outbreak of SARS-CoV-2, there have been few case reports describing myocarditis as a possible presentation. In our case re-

"**Myocarditis** is well known to be caused by viral infections such as **Coxsackie virus group B**, human herpes virus 6 and parvovirus B19."[1]

"Both types of **[Coxsackie]** viruses (A and B) can cause meningitis, myocarditis, and pericarditis"[2]

Journal List > Elsevier Public Health Emergency Collection > PMC8503119

Elsevier Public Health Emergency Collection

Public Health Emergency COVID-19 Initiative

Chest. 2021 Oct; 160(4): A976. PMCID: PMC8503119

Published online 2021 Oct 11. doi: 10.1016/j.chest.2021.07.909

COVID-19 AND COXSACKIE B COINFECTION: A RARE CASE OF ACUTE PERICARDITIS

AMANDA ENG, NIKISHA PANDYA, and RATTAN PATEL

… this is the first case presenting **pericarditis caused by COVID 19 and Coxsackieviruses B (CV-B) coinfection**.

Source: 1. https://pubmed.ncbi.nlm.nih.gov/32928810/; 2. https://www.medicinenet.com/coxsackie_virus/article.htm; https://www.ncbi.nlm.nih.gov/labs/pmc/articles/PMC8503119/; https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8330013/pdf/IETT_0_1952985.pdf

Reactivation of Enteroviruses (Coxsackie, Echovirus) also evident in many cases

Analysis		Result	Units	Reference Range	Chart
EBV-latent antigen: sign for EBV latency with no production of infectious EBV virions					
Coxsackie IgG-/IgA-antibodies					
4 Coxsackie-IgG Typ A7 (IFT)	**+**	**1:10000**		**< 1:100**	**[..... *>**
4 Coxsackie-IgG Typ B1 (IFT)	**+**	**1:10000**		**< 1:100**	**[..... *>**
7 Coxsackie-Virus IgA A7 (IFT)	**+**	**1:10**		**< 1:10**	**[..... *>**
7 Coxsackie-Virus IgA B1 (IFT)	**+**	**1:100**		**< 1:10**	**[..... *>**
The specific positive Coxsackie-Virus Type A7/B1-IgG-/IgA-antibodies indicate current humoral immune responses against Coxsackie-Virus Type A7 and Coxsackie-Virus Type B1 (recent infection with Coxsackie-Virus Type A7/B1?). The test system is highly specific for Coxsackie Virus antibodies. Other Enterovirus antibodies (for example Echovirus IgG/IgA-antibodies) are not detectable.					
(for example Echovirus IgG/IgA-antibodies) are not detectable.					
validated by					
Dr.Armin Schwarzbach					

Source: ArminLabs results, with permission

Agenda

- How SARS-CoV-2 acts as a viral reservoir
- Post-COVID and Herpes virus reactivation: EBV, CMV, VZV, HSV, HHV-6
- Post-COVID and Enteroviral reactivation
- **Post-COVID and association of other infections that live in the mucosal membrane**
- New ArminLabs Post-COVID Viral Reactivation Panels

Chlamydia pneumoniae and Mycoplasma both contribute to persistence

Comment > J Infect. 2021 Apr;82(4):e4-e7. doi: 10.1016/j.jinf.2021.01.009. Epub 2021 Jan 19.

Co-infection of chlamydia pneumoniae and mycoplasma pneumoniae with SARS-CoV-2 is associated with more severe features

Maria Antonia De Francesco [1], Claudio Poiesi [2], Franco Gargiulo [2], Carlo Bonfanti [2], Patrizia Pollara [2], Simona Fiorentini [2], Francesca Caccuri [2], Valentina Carta [2], Lucia Mangeri [2], Simone Pellizzeri [2], Damiano Rizzoni [3], Paolo Malerba [3], Massimo Salvetti [4], Maria Lorenza Muiesan [4], Federico Alberici [5], Francesco Scolari [5], Andrea Pilotto [6], Alessandro Padovani [6], Michela Bezzi [7], Raffaella Chiappini [7], Chiara Ricci [8], Maurizio Castellano [9], Marialma Berlendis [10], Giulia Savio [10], Giovanni Montani [11], Maurizio Ronconi [12], Sergio Bove [13], Emanuele Focà [14], Lina Tomasoni [14], Francesco Castelli [14], Angelo Rossini [15], Riccardo Inciardi [16], Marco Metra [16], Arnaldo Caruso [2]

Affiliations + expand

PMID: 33482238 PMCID: PMC7816623 DOI: 10.1016/j.jinf.2021.01.009

Free PMC article

Here, we present a retrospective study with the aim to evaluate the prevalence of co-infections with atypical pathogens in SARS-CoV-2 infected patients compared to non-infected patients.

We included 721 hospitalized patients who underwent testing for SARS-CoV-2, *Mycoplasma pneumoniae*, *Chlamydia pneumoniae* and *Legionella pneumophyla* over a two months period between 6 March 2020 and 12 May 2020 to the Spedali Civili's Hospital, Montichiari's Hospital and Gardone Val-Trompia's Hospital, Brescia, Italy. A real time reverse polymerase chain reaction was used to detect SARS-CoV-2. Chemiluminescence immunoassays and immunoenzymatic assays were used to detect IgM antibodies for *Mycoplasma pneumoniae* and IgM/IgA/IgG for *Chlamydia pneumoniae* in the serum of patients. Legionella diagnosis was made by urinary antigen testing.

Definition of pneumonia or severe pneumonia was done according to the WHO guidelines and included clinical signs of pneumonia (fever, cough, dyspnea, fast breathing).

Categorical variables are the number (percentage), and continuous variables are the median (interquartile range [IQR]). Categorical data were compared by using the χ^2 test or the Fisher exact test, as appropriate. The data in different groups were compared with the ANOVA or independent *t*-test for normally distributed variables.

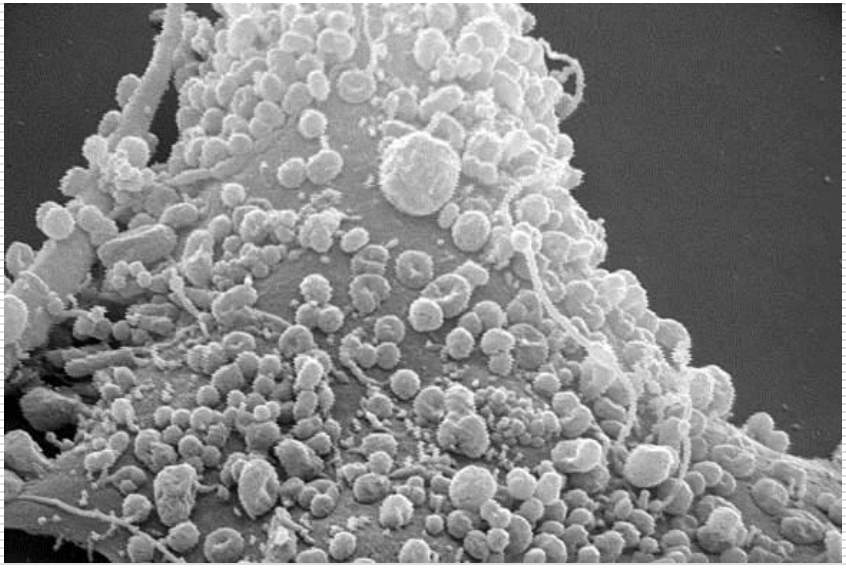
Logistic regression was used in order to perform univariate and multivariate analysis for determination of risk factors [odds ratios (ORs) and 95% CIs] associated with the presence of *Chlamydia pneumoniae* and *Mycoplasma pneumoniae* infection in SARS-CoV-2 positive patients after adjusting for confounders.

"Out of 721 subjects, 443 individuals were infected with SARS-CoV-2 and 278 subjects were negative. All individuals were negative for Legionella antigen. **Of the 443 patients with a SARS-CoV-2 infection, 242 individuals had an antibody positivity against Mycoplasma and/or Chlamydia**, while of the 278 negative for SARS-CoV-2, only 97 showed Mycoplasma and/or Chlamydia pneumoniae antibody positivity ($p < 0.0001$)."

Source: https://pubmed.ncbi.nlm.nih.gov/33482238/

Mycoplasma in ~70% of ME patients in Professor Nicolson's (large) cohort studies

Mycoplasmas are the stealthiest of all stealth microbes. They are the smallest free-living organisms on the planet (150 – 250 nm), and lack a cell wall. No. 1 coinfection in Lyme patients – ~ 70%. As far back as 2002, Professor Garth Nicolson found that 70% of a cohort of ME patients were infected with at least one strain of Mycoplasma. They generally prefer low-oxygen environments, and stimulate reactive oxygen species (ROS), which cause damage to cell membranes – membrane potential is lost.



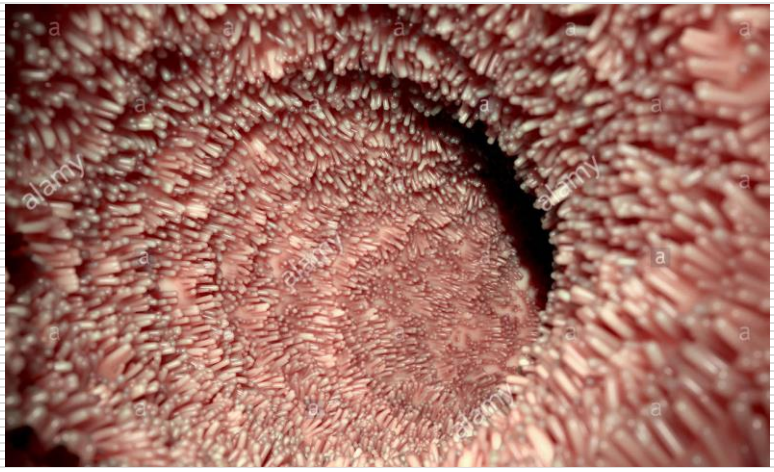
Mycoplasma on the surface of a fibroblast

Source: Nicolson GL et al. Chronic Fatigue Syndrome Patients Subsequently Diagnosed with Lyme Disease Borrelia burgdorferi: Evidence for Mycoplasma Species Coinfections. Journal of Chronic Fatigue Syndrome, Volume 14, 2007 - Issue 4

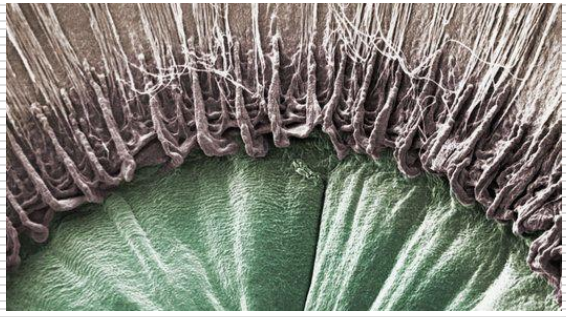
Mycoplasma: huge affinity for mucous membranes

Mycoplasmas populate mucous membrane systems associated with ciliary structures:

- **Entire respiratory system**
- **Small intestine**
- **Vagina, fallopian tubes and uterus**
- **Vesicles of the brain that circulate cerebrospinal fluid,**
- **Cilia of the eyes' photoreceptors**
- **Synovial tissues in the joints**



Most mycoplasmal symptoms come from infection and damage of cilia. Mycoplasma use inflammation to make epithelial and endothelial structures more porous, penetrating to deeper cilia, giving access even to the mitochondria.



Source: Ciliary and Flagellar Membranes. Bloodwood, E (Ed.), 1990, Springer; Prince OA et al. In Vitro Spatial and Temporal Analysis of Mycoplasma pneumoniae Colonization of Human Airway Epithelium. Infect Immun. 2014 Feb; 82(2): 579–586

Chlamydia pneumoniae lives in the mucosal membranes, but can also act as a reservoir of chronic infection

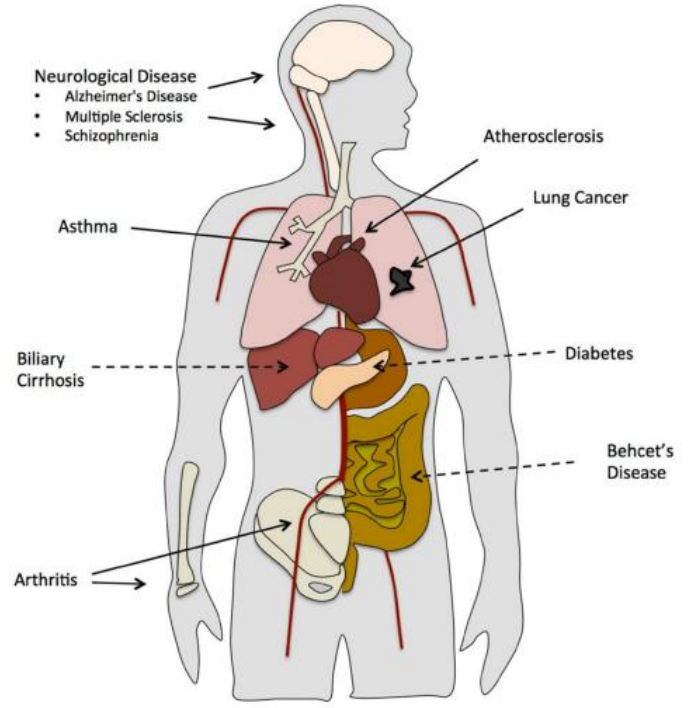


FIG. 1:
C. pneumoniae infection and inflammatory disease. In addition to pneumonia, *C. pneumoniae* infection may contribute to a range of inflammatory diseases including asthma and lung cancer. Dissemination of *C. pneumoniae* from the lung throughout the body can possibly lead to atherosclerosis, arthritis, and neurological diseases. Some evidence suggests that *C. pneumoniae* may also be associated with biliary cirrhosis, diabetes, and Bechet's disease.

1

"Chlamydia pneumoniae has long been found to be a clinically relevant coinfection … **causes arthritis** but **also affects the nervous system and the heart**, which renders the differential diagnosis difficult…[2]

Specifically, C. pneumoniae has been demonstrated to elicit ROS overproduction by upregulating NOX and cyclooxygenase (COX-2) and downregulating antioxidant enzyme systems, such as catalase, SOD-1, and thioredoxin-1 [65]. There is also evidence that C. pneumoniae-induced oxidative stress may contribute to **endothelial dysfunction** by decreasing eNOS expression and, hence, nitric oxide synthesis in endothelial cells [66,67]. … C. pneumoniae is able to survive in monocytes/macrophages, considered as **a reservoir of chronic infection**.[3]

Source: 1. https://pubmed.ncbi.nlm.nih.gov/30687565/; 2. Berghoff W. Chronic Lyme Disease and Co-infections: Differential Diagnosis. Open Neurol J. 2012; 6: 158–178. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3565243/table/T3/; Kashyap S, Sarkar, M. Mycoplasma pneumonia: Clinical features and management. Lung India. 2010 Apr-Jun; 27(2): 75–85; 3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8301438/pdf/biomedicines-09-00723.pdf

CPn: Oxidative stress, inflammation, associated with cardiovascular disease

Review > Biomedicines. 2021 Jun 24;9(7):723. doi: 10.3390/biomedicines9070723.

Oxidative Stress and Inflammation in SARS-CoV-2- and *Chlamydia pneumoniae*-Associated Cardiovascular Diseases

Simone Filardo [1], Marisa Di Pietro [1], Fabiana Diaco [1], Silvio Romano [2], Rosa Sessa [1]

Affiliations + expand

PMID: 34202515 PMCID: PMC8301438 DOI: 10.3390/biomedicines9070723

Free PMC article

Abstract

Throughout the years, a growing number of studies have provided evidence that oxidative stress and inflammation may be involved in the pathogenesis of infectious agent-related cardiovascular diseases. Amongst the numerous respiratory pathogens, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a novel coronavirus responsible for the global ongoing pandemic, and *Chlamydia pneumoniae*, a widely known intracellular obligate bacteria, seem to have an essential role in promoting reactive oxygen species and cytokine production. The present review highlights the common oxidative and inflammatory molecular pathways underlying the cardiovascular diseases associated with SARS-CoV-2 or *C. pneumoniae* infections. The main therapeutic and preventive approaches using natural antioxidant compounds will be also discussed.

Amongst the numerous respiratory pathogens, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a novel coronavirus responsible for the global ongoing pandemic, and *Chlamydia pneumoniae*, a widely known intracellular obligate bacteria, seem to have an essential role in promoting reactive oxygen species and cytokine production.

"Particularly important are the molecular studies that have **highlighted oxidative stress and inflammation** as the most likely pathogenic mechanisms by which C. pneumoniae may contribute to the early as well as late stages of the atherosclerotic process by **promoting endothelial dysfunction, foam cell formation, platelet activation, and thrombus formation**."[2]

Source: https://pubmed.ncbi.nlm.nih.gov/34202515; 2. https://pubmed.ncbi.nlm.nih.gov/30687565/;

"CPn promotes endothelial dysfunction, platelet activation, thrombus formation": obviously a pernicious combination alongside/following COVID

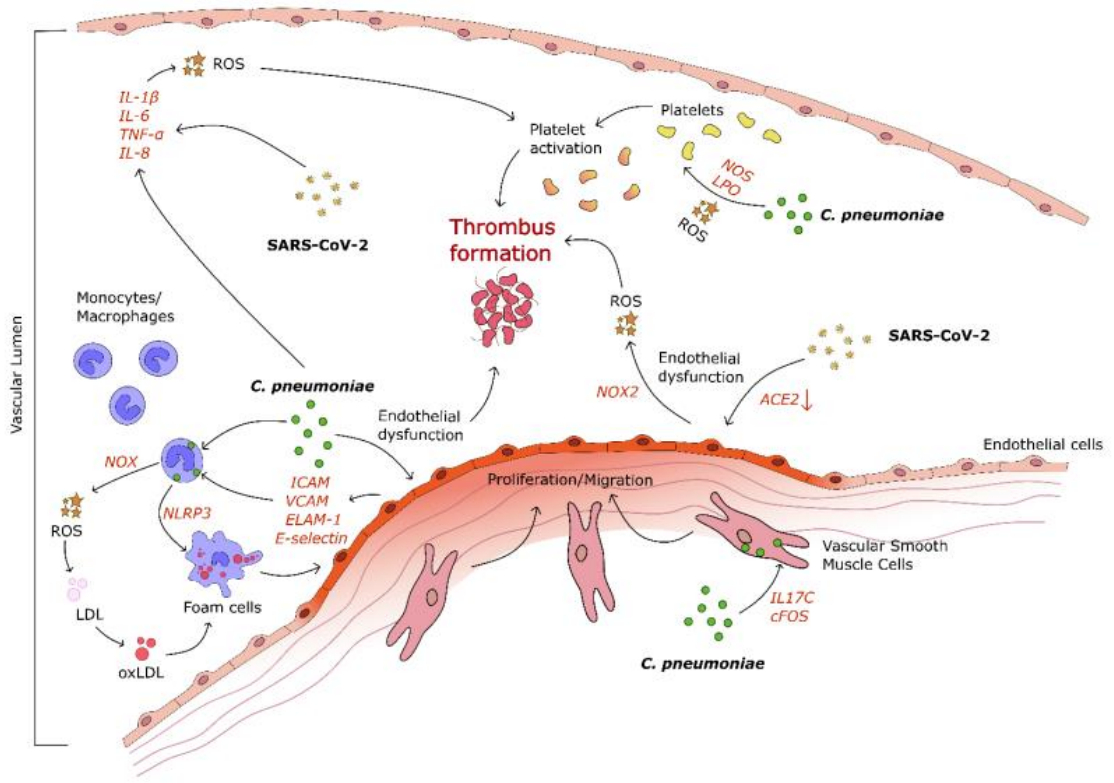


Figure 1. Cellular and molecular pathways involved in SARS-CoV-2- and *C. pneumoniae* -mediated vascular diseases. SARS-CoV-2 contributes to increased inflammation, endothelial dysfunction, and, ultimately, thrombus formation. *C. pneumoniae* induces inflammatory cytokine production, endothelial dysfunction, foam cell formation, vascular smooth muscle cell (VSMC) migration, and proliferation to intima, leading to thrombus formation. ACE-2, angiotensin converting enzyme-2; ROS, reactive oxygen species; NOX-2, nicotinamide adenine dinucleotide phosphate (NAPDH) oxidase-2; IL, interleukin; TNFα, tumor necrosis factor; NOS, nitric oxide synthase; LOS, lipoxygenase; LDL, low-density lipoprotein; NLRP-3, nod-like receptor family pyrin domain-containing 3; ICAM, intercellular adhesion molecule; VCAM, vascular cell adhesion molecule; ELAM-1, endothelial-leukocyte adhesion molecule-1. The red arrow indicates decrease in marker's levels.

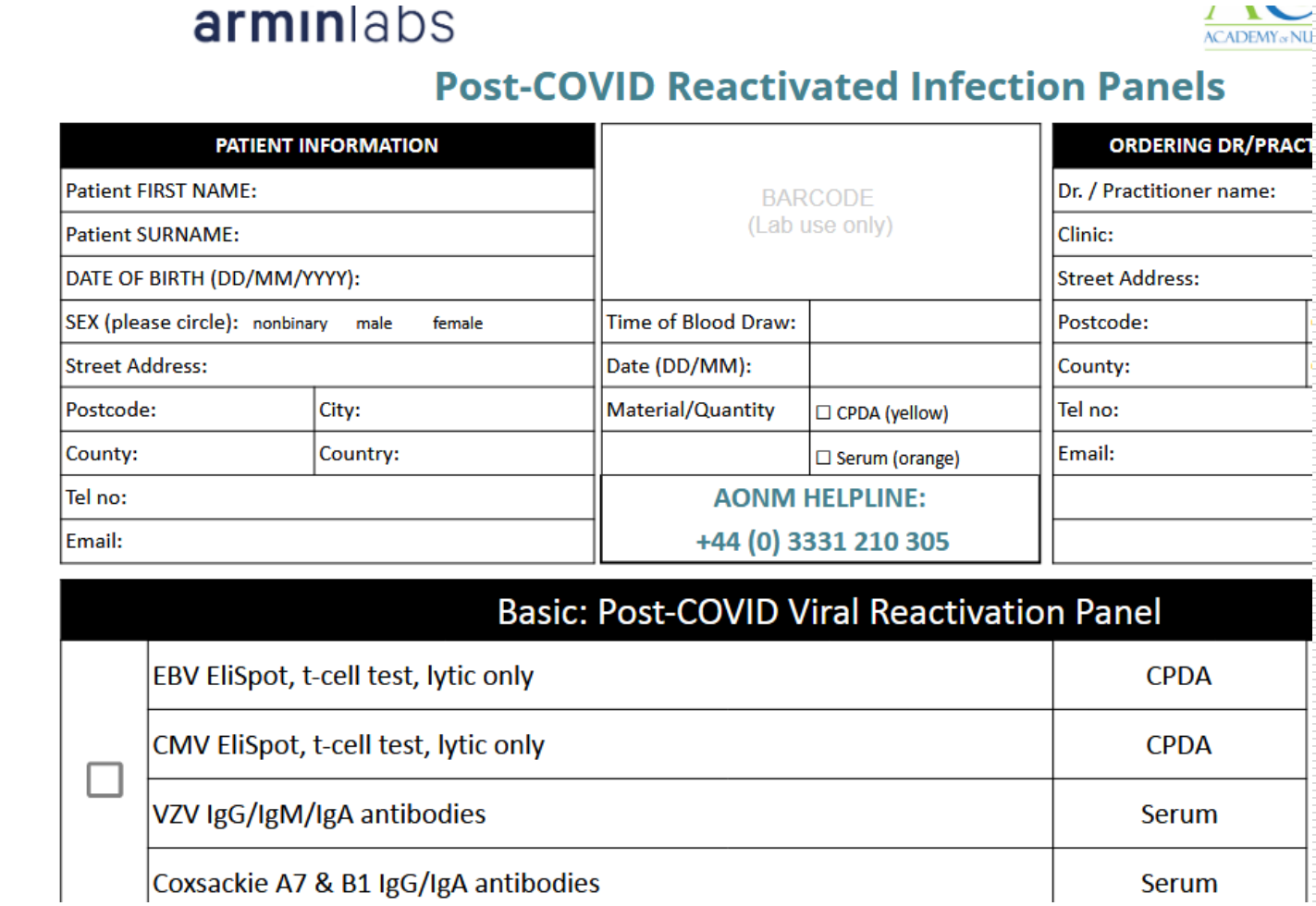
SARS-CoV-2 contributes to increased inflammation, endothelial dysfunction, and, ultimately, thrombus formation. C. pneumoniae induces inflammatory cytokine production, endothelial dysfunction, foam cell formation, vascular smooth muscle cell (VSMC) migration, and proliferation to intima, leading to thrombus formation

Source: https://pubmed.ncbi.nlm.nih.gov/34202515

Agenda

- How SARS-CoV-2 acts as a viral reservoir
- Post-COVID and Herpes virus reactivation: EBV, CMV, VZV, HSV, HHV-6
- Post-COVID and Enteroviral reactivation
- Post-COVID and association of other infections that live in the mucosal membrane
- **New ArminLabs Post-COVID Viral Reactivation Panels**

NEW: ArminLabs Post-COVID Viral Reactivation Panel



arminlabs

ACADEMY of NUTRITIONAL MEDICINE

Post-COVID Reactivated Infection Panels

PATIENT INFORMATION			BARCODE (Lab use only)		ORDERING DR/PRACT
Patient FIRST NAME:					Dr. / Practitioner name:
Patient SURNAME:					Clinic:
DATE OF BIRTH (DD/MM/YYYY):					Street Address:
SEX (please circle): nonbinary male female			Time of Blood Draw:		Postcode:
Street Address:			Date (DD/MM):		County:
Postcode:	City:		Material/Quantity	☐ CPDA (yellow)	Tel no:
County:	Country:			☐ Serum (orange)	Email:
Tel no:			AONM HELPLINE: +44 (0) 3331 210 305		
Email:					

	Basic: Post-COVID Viral Reactivation Panel	
☐	EBV EliSpot, t-cell test, lytic only	CPDA
	CMV EliSpot, t-cell test, lytic only	CPDA
	VZV IgG/IgM/IgA antibodies	Serum
	Coxsackie A7 & B1 IgG/IgA antibodies	Serum

Advanced reactivated infection panel available, too

	Advanced: Post-COVID Reactivated Infection Panel	
☐	EBV EliSpot, t-cell test, lytic only	CPDA
	CMV EliSpot, t-cell test, lytic only	CPDA
	VZV IgG/IgM/IgA antibodies	Serum
	Coxsackie A7 & B1 IgG/IgA antibodies	Serum
	HSV 1 & 2 IgG/IgM/IgA antibodies	Serum
	HHV6 EliSpot, t-cell test	CPDA
	Chlamydia pneumoniae IgG/IgA antibodies	Serum
	Mycoplasma pneumoniae IgG/IgA antibodies	Serum

Testing the other arm of the immune system: T-cells

Using T-cells to show a cellular response against antigens is much more sensitive, and is more likely to **indicate active infection (in contrast to IgG antibodies, which can remain for months or years long after an infection is gone, and IgM a/bs, which generally do not persist very long)**. EliSpot (enzyme-linked immunosorbent spot) technology has long been used in Germany to do exactly this: it quantifies T-cells that secrete signature proteins (such as a given cytokine) against a specific antigen. The Borrelia EliSpot evaluates the number of spot-forming units using a stimulation index (SI) based on IGRA (Interferon Gamma Release Assay).

Humana Press; 3rd ed. 2018 edition (14 July 2018)

The Elispot technique reflects the current T-cellular activity of bacteria and viruses

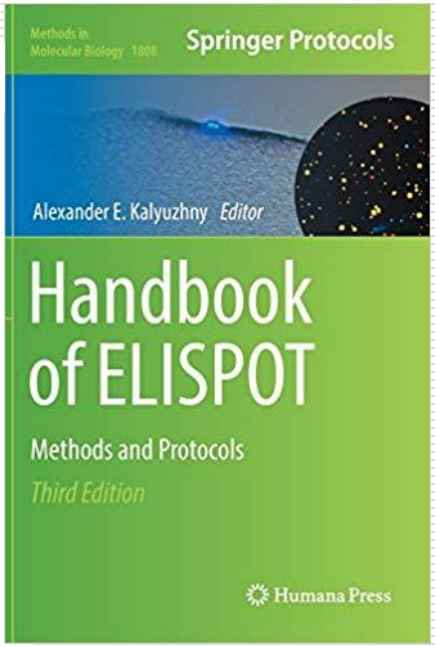
Chapter 1

Unique Strengths of ELISPOT for T Cell Diagnostics

Paul V. Lehmann and Wenji Zhang

Abstract

The T cell system plays an essential role in infections, allergic reactions, tumor and transplant rejection, as well as autoimmune diseases. It does so by the selective engagement of different antigen-specific effector cell lineages that differentially secrete cytokines and other effector molecules. These T cell subsets may or may not have cytolytic activity, can preferentially migrate to different tissues, and display variable capabilities to expand clonally. The quest of T cell immune diagnostics is to understand which specific effector function and T cell lineage is associated with a given clinical outcome, be it positive or adverse. No single assay can measure all of the relevant parameters. In this chapter, we review the unique contributions that ELISPOT assays can make toward understanding T cell-mediated immunity. ELISPOT assays have an unsurpassed sensitivity in detecting low frequency antigen-specific T cells that secrete effector molecules, including granzyme and perforin. They provide robust, highly reproducible data – even by first time users. Because
cytometry, ELISPOT is ideally su
ditions. These include defining (
establishing the fine–specificity
concentrations of the antigen in se
secretory products released by T
because T cells survive ELISPOT



"The quantification of single cell interferon-gamma (IFN-γ) release for assessing cellular immune responses using the Enzyme-linked immunospot (ELISPOT) assay is an invaluable technique in immunology."[1]

Source: 1 Sedegah M. The Ex Vivo IFN-γ Enzyme-Linked Immunospot (ELISpot) Assay Methods Mol Biol. 2015;1325:197-205; Humana Press; 3rd ed. 2018 edition (14 July 2018)

References for the Elispot: examples

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Immunoglobulin A antibodies are found in the mucous membranes of the lungs, sinuses, stomach and GI tract

IgA is an excellent immunoglobulin as it indicates current, ongoing or very recent infection, as well as chronic persistent infection, reactivation or reinfection

Am J Kidney Dis. 1988 Nov;12(5):384-7.

The IgA mucosal immune system.

Lamm ME[1].

Author information

"The major antibodies found on mucous membranes are secretory IgA, which function primarily by binding microorganisms and thereby preventing their contact with the host tissues."[2]

Abstract

This report reviews the immunophysiology of the mucosal immune system, the principal antibody of which is a special form of IgA, termed secretory IgA. This IgA is produced locally by mucosal plasma cells that are descended from precursors initially stimulated in organized, mucosal lymphoid organs designed for antigen sampling. After the initial triggering, the precursor cells pass via regional lymph nodes, lymph, and blood to disseminate widely among mucosal sites. After secretion from a local plasma cell, IgA binds to an epithelial cell surface receptor and the complex passes through the epithelial cell into the secretions where it serves as a nonphlogistic immunologic barrier to inhibit uptake of antigens. The production of IgA is facilitated by particular regulatory T cells. At the same time, the synthesis of other classes of antibody, such as the phlogistic IgG, is dampened. This differential regulation of individual antibody classes after exposure to mucosal antigen plus the interrelatedness of the various mucous membranes of the body have important implications for host defense, pathogenesis of a variety of diseases including IgA nephropathy, and strategies of immunization.

PMID: 3055963

Source: 1. Mucosal Immunity, Stephen P. James, in Encyclopedia of Immunology (Second Edition), 1998, https://www.sciencedirect.com/topics/neuroscience/immunoglobulin-a; 2. Hanson, L., Andersson, B., Carlsson, B. et al. Infection (1985) 13(Suppl 2): S166.

The difficulties of evidencing chronic (continuing) disease using IgG and IgM

In chronic disease, IgG may be there, but will be discounted as "past"; IgM probably will not be

ENDOCRINOLOGY

Cytomegalovirus Ab(IgG)	183.0	AU/ml
	< 6.0 AU/mL is considered non-reactive	
	>=6.0 AU/mL is considered reactive	
Cytomegalovirus Ab(IgM)	Negative	
Comment	Result suggestive of previous CMV infection.	

IMMUNOLOGY

Epstein-Barr virus screen			
EBNA IgG antibody	* 36	U/ml	(< 5 U/ml Negative)
EBV Early Ag ab.(IgG)	<5	U/ml	(<10 U/ml Negative)
EBV VCA ab.(IgM)	<10	U/ml	(<20 U/ml Negative)
Comment	Results suggestive of past (latent) EBV infection.		

"IgG is produced in a delayed response to an infection and can be retained in the body for a long time …. Detection of IgG usually indicates a prior infection or vaccination."

Source: http://www.microbiologybook.org/mayer/Ab%20formation2000.htm

IgA antibodies can indicate active infections with Chlamydia pneumoniae, Mycoplasma, HSV1/2, VZV, Coxsackie and Echovirus

Chlamydia pneum. IgG-/IgA-AB

4	Chlam.pneum. IgG-AB (ELISA)	negative 0,130 Ratio	negative

Ratio < 0,8 = negative
Ratio 0,8 - 1,1 = weak
Ratio >= 1,1 = positive

4	**Chlam.pneum. IgA-AB (ELISA)**	**positive ! 7,028 Ratio**	**negative**

Ratio < 0,8 = negative
Ratio 0,8 - 1,1 = weak
Ratio >= 1,1 = positive

The positive Chlamydia pneumoniae-IgA-antibodies indicate current humoral immune responses against Chlamydia pneumoniae (recent infection with Chlamydia pneumoniae?). Please look at the Chlamydia pneumoniae-EliSpot for the current cellular activity.

Analysis		Result Units	Reference Range
4	Mycopl.pneum. IgA-AB (ELISA)	positive ! 10,052 Ratio	negative

Ratio < 0,8 = negative
Ratio 0,8 - 1,1 = weak
Ratio >= 1,1 = positive

The specific positive Mycoplasma pneumoniae-IgG- and specific positive -IgA-antibodies indicate humoral immune response against Mycoplasma pneumoniae (recent infection with Mycoplasma pneumoniae?).
We recommend to look at the current cellular activity by the Mycoplasma pneumoniae-EliSpot.

The ArminLabs Immunoarray for EBV is exceptionally broad: it has the full array of markers

9 markers including viral capsid antigen (VCA), early antigen (EA), & Epstein-Barr Nuclear Antigen (EBNA)

Epstein-Barr-Virus Immuno-Array			
EBV VCA p18 IgG	+	positive	negative
EBV VCA p23 IgG	+	positive	negative
EBV EA p54 IgG		negative	negative
EBV EA p138	+	positive	negative
EBV EBNA-1 IgG	+	positive	negative
EBV VCA p18 IgM		negative	negative
EBV VCA p23 IgM		negative	negative
EBV EA p54 IgM	+	positive	negative
EBV EA p138 IgM		negative	negative

The specific EBV-IgG/IgM-, EBV-Early Antigen-antibodies and EBV-EBNA-antibodies indicate humoral immune response against Epstein Barr Virus (former or reactivated or EBV-infection in convalescence?).

Electronic checklist helps decide which coinfections to test for in Post-COVID; fills automatically

Post-Covid Checklist

arminlabs

Name, first name ..... Date (DD/MM/YYYY) .....

	Your current and former symptoms Please click on the boxes next to the symptoms that you suffer from	X
1	Stomach ache, gut problems	☐
2	Anaemia	☐
3	Diarhoea intermittent, intestinal crampings/pain	☐
4	Fever or feverish feeling	☐
5	Lack of concentration, memory loss, forgetfulness	☒
6	Encephalitis/Inflammation of the brain	☐
7	Yellowish colour of the skin/eyes	☐
8	Painful joints or swollen joints	☒
9	General aches and pains, tendon problems	☐
10	Flu-like symptoms	☒
11	Rash(es), striae, exanthema	☐
12	Small red/purple spots of the skin	☐
13	Heart problems, disturbed cardiac rhythm	☐
14	Cough, expectoration, "air-hunger"	☐
15	Headache, dizziness	☐
16	Impaired liver function/ liver laboratory values	☐
17	Pneumonia, bronchitis	☐
18	Swollen lymph nodes	☒
19	Enlargement of the spleen	☐
20	Fatigue / exhaustion, intermittent or chronic CFS	☒
21	Muscle pain, muscle weakness	☐
22	Shivering, chill	☐
23	Blurred, foggy, cloudy, flickering, double vision	☐
24	Nausea, vomiting	☐
25	Dark urine	☐
26	Itching or pain when urinating	☐
27	Tingling, numbness, "burning" sensations	☐
28	Neck pain, neck stiffness	☐
29	Shoulder pain	☐

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W W W . A O N M . O R G

AONM ACADEMY of NUTRITIONAL MEDICINE

Ranked in order of priority:
CPn, Mycoplasma and the Herpesviruses draw for first place here ↓

Below you'll find the number of the symptoms for each of the infections that we test for and the ranking, in which order you should test for them

Ranking of the infections	No. of symptoms	Rank
Chlamydia pneumoniae	4	1
Mycoplasma pneumoniae	4	1
Yersinia	2	3
Campylobacter	2	3
HSV 1/2	4	1
EBV	4	1
CMV	4	1
VZV	3	2
HHV 6	4	1
Parvovirus	3	2
Coxsackie-Virus	3	2
Echovirus	2	3

Special discounts available

	Basic: Post-COVID Viral Reactivation Panel	
☐	EBV EliSpot, t-cell test, lytic only	CPDA
	CMV EliSpot, t-cell test, lytic only	CPDA
	VZV IgG/IgM/IgA antibodies	Serum
	Coxsackie A7 & B1 IgG/IgA antibodies	

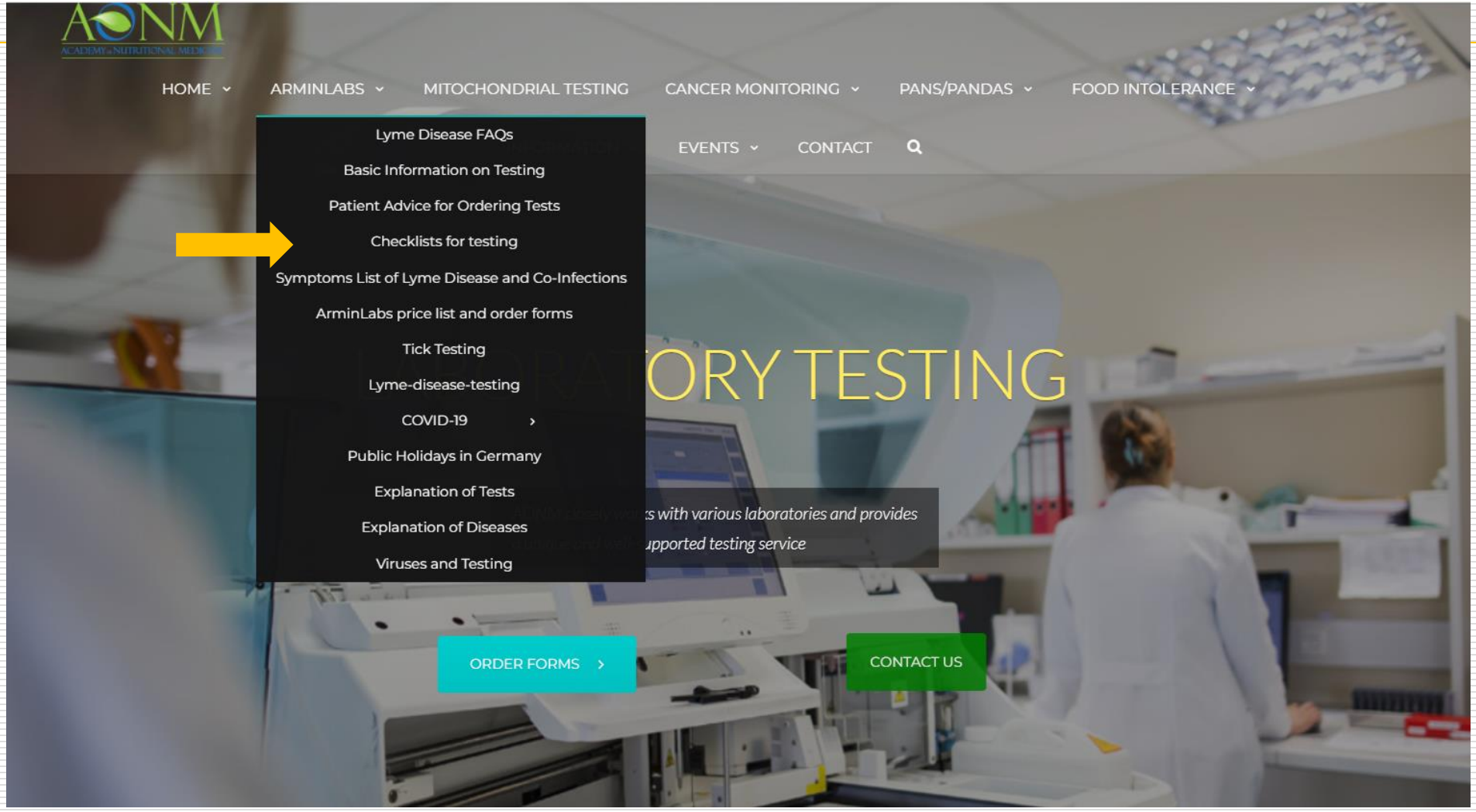
	Advanced: Post-COVID Reactivated Infe	
☐	EBV EliSpot, t-cell test, lytic only	
	CMV EliSpot, t-cell test, lytic only	CPDA
	VZV IgG/IgM/IgA antibodies	Serum
	Coxsackie A7 & B1 IgG/IgA antibodies	Serum
	HSV 1 & 2 IgG/IgM/IgA antibodies	Serum
	HHV6 EliSpot, t-cell test	CPDA
	Chlamydia pneumoniae IgG/IgA antibodies	Serum
	Mycoplasma pneumoniae IgG/IgA antibodies	Serum

15% discount for anyone paying for the Post-COVID test before 23rd December*

* **though the test can be sent in the New Year**

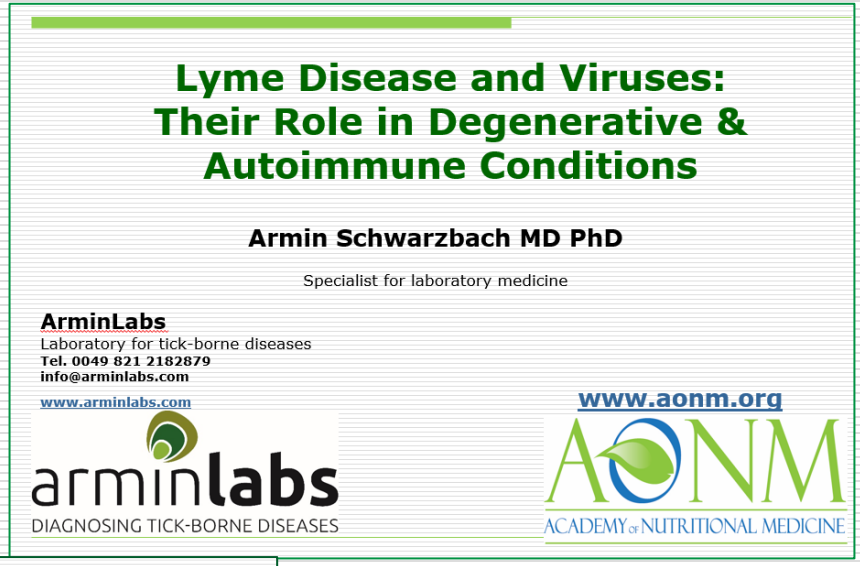
Where to find the checklist:

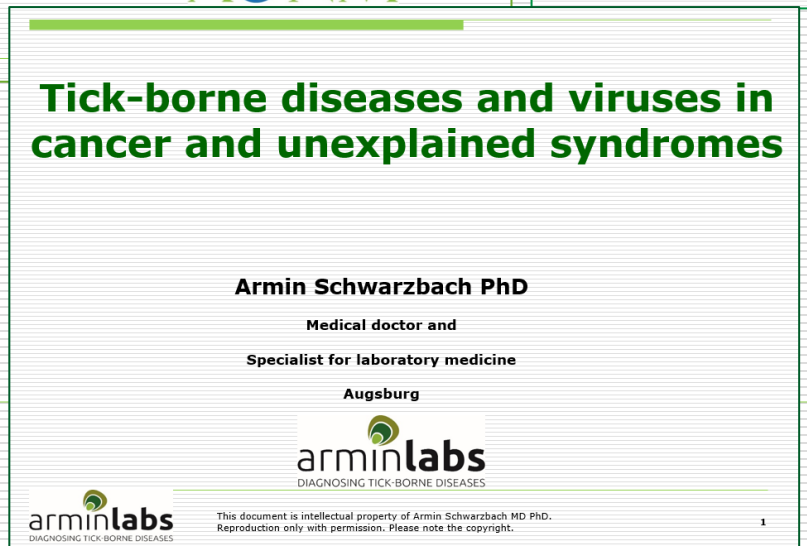
www.aonm.org – ArminLabs tab



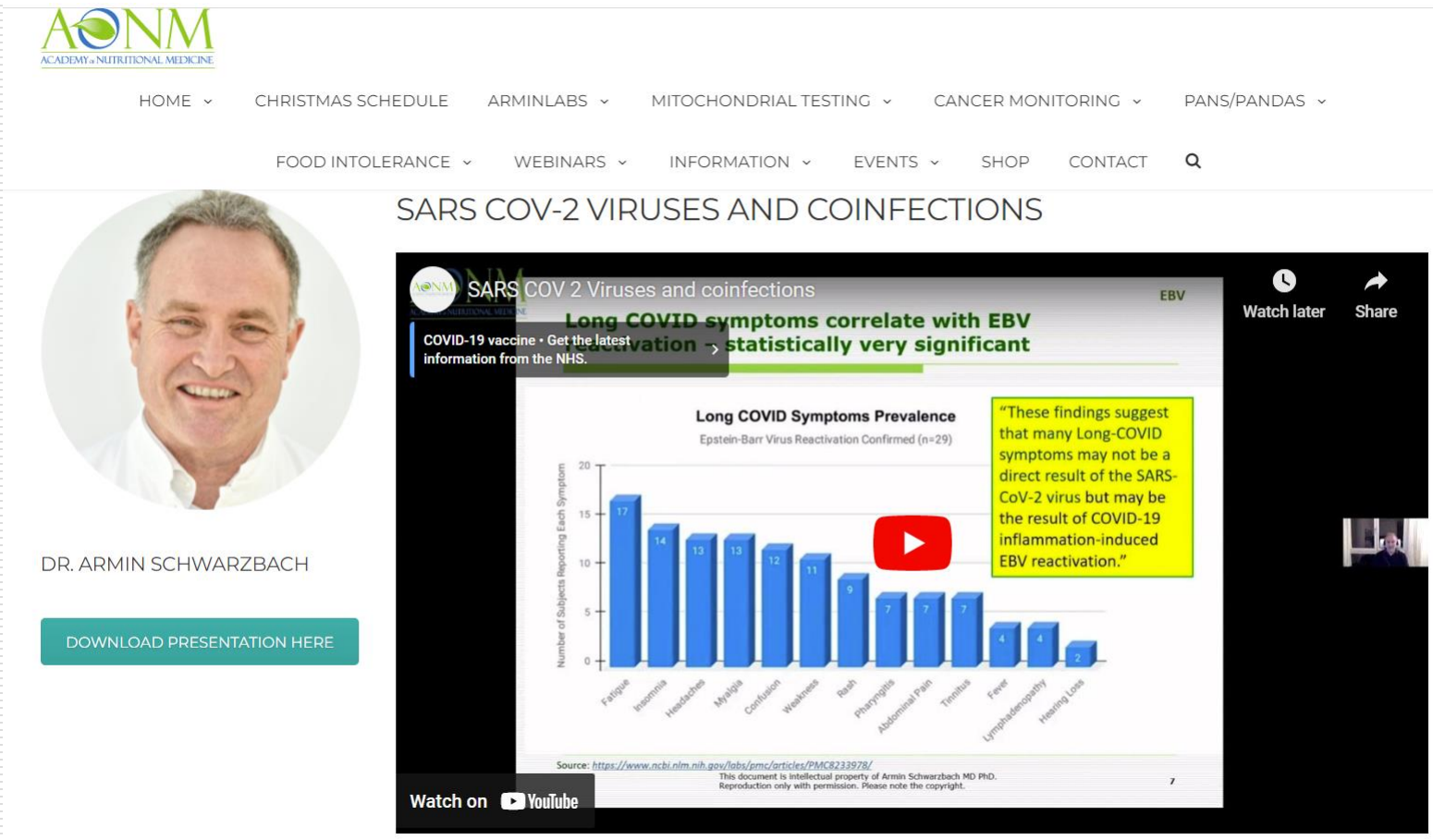
Links to more detailed ArminLabs virus presentations on the AONM website …

https://aonm.org/viruses-and-testing/





… as well as a March 2022 webinar of Dr. Schwarzbach's on SARS-CoV-2 and viral coinfections



Source: https://aonm.org/viruses-and-testing/

Thank you very much!
Q&A/Discussion

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