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Covid-19 vaccination and IgG antibody kinetics

Case report

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Abstract

Background:

A novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemics is still doing great damage.

Methods:

In follow up, the behaviour of Covid-19 vaccine induced IgG antibodies of a 30-40 year young and healthy women have been investigated.

Results:

The natural decline of Covid-19 vaccine induced IgG antibodies of a healthy young woman is very impressive.

Conclusion:

Today's Covid-19 vaccination strategy should be re-considered.

Keywords: Covid-19; Vaccination; Cause; Effect; Causal relationship k; Causality; Causation

1. Introduction

Coronavirus disease 2019 (Covid-19), which causes various, very serious damage to human health, culture and economy, was first reported in Wuhan (China), the capital of Hubei in the year 2019.[1] Meanwhile, the global coronavirus disease 2019 pandemic has still not come to an end. As of 5:37pm CEST, 3 June 2022, there have been 6.294.969 deaths of COVID-19, including 528.816.317 confirmed cases, reported to WHO. As of 1 June 2022, a total of 11.947.644.522 vaccine doses have been administered. [2] Vaccination against Covid-19 is one of the many ways to counter this very dangerous disease. However, how effective are these Covid-19 vaccinations (see Barukčić, 1989, 2016, 2020, 2021a,b, 2022), and how often should the same be repeated?

[1] Ahn DG, Shin HJ, Kim MH, Lee S, Kim HS, Myoung J, Kim BT, Kim SJ. Current Status of Epidemiology, Diagnosis, Therapeutics, and Vaccines for Novel Coronavirus Disease 2019 (COVID-19). J Microbiol Biotechnol. 2020 Mar 28;30(3):313-324. doi: 10.4014/jmb.2003.03011. PMID: 32238757.

[2] WHO Coronavirus (COVID-19) Dashboard

2. Material and methods

2.1. Material

2.2. Methods

Definitions should help us to provide and assure a systematic approach to a scientific issue. It also goes without the need of further saying that a definition as such need to be logically consistent and correct.

2.2.1. Kinetics of antibodies

Human immunoglobulin G (IgG) is very heterogeneous and determined by four distinct species of molecules designated IgG 1, IgG 2, IgG 3 and IgG 4. All four of these IgG subclasses are present in normal human serum and are subject to very subtly kinetics. The detailed kinetics of antibody production and of the regulation of the immune response can be found in secondary literature. [3] , [4] In point of fact, antibodies of all classes and subclasses except IgD posses the capacity as originally described by the first Nobel laureate in physiology Emil von Behring to feedback regulate the production of themselves. [5] Moreover, the IgG antibody-mediated suppression of IgM synthesis is of further importance, IgG antibodies are able to suppress IgM responses (negative feedback regulation). [6]

> "In der ersten Phase werden vorwiegend Antikörper vom IgM-Typ produziert. Später treten IgG-produzierende Zellen auf. In dem Maße, wie die IgG-Antikörperproduktion zunimmt, wird die IgM-Antikörperproduktion reduziert, d. h. es besteht ein negativer Feedback-Mechanismums zwischen der IgM- und der IgG-Antikörperproduktion. "
>
> (see Warnatz, 1982, p. 543)

Translated into broken English: 'In the first phase, mainly antibodies of the IgM type are produced. Later, IgG-producing cells appear. As IgG antibody production increases, IgM antibody production is reduced, i. e. there is a negative feedback mechanism between IgM and IgG antibody production.'

[3] Uhr JW, Finkelstein MS. The kinetics of antibody formation. Prog Allergy. 1967;10:37-83. PMID: 5333338.

[4] Nossal GJ. Kinetics of antibody formation and regulatory aspects of immunity. Acta Endocrinol Suppl (Copenh). 1975;194:96-116. doi: 10.1530/acta.0.080s096. PMID: 1092122.

[5] Heyman B. Feedback regulation by IgG antibodies. Immunol Lett. 2003 Aug 5;88(2):157-61. doi: 10.1016/s0165-2478(03)00078-6. PMID: 12880686.

[6] Bergström JJ, Heyman B. IgG Suppresses Antibody Responses in Mice Lacking C1q, C3, Complement Receptors 1 and 2, or IgG Fc-Receptors. PLoS One. 2015 Nov 30;10(11):e0143841. doi: 10.1371/journal.pone.0143841. PMID: 26619292; PMCID: PMC4664261.

2.2.2. Half-life of antibodies

The notion **half-life** is defined as the amount of time it takes a given quantity to decrease to half of its initial value. The term half-life is commonly used in relation to radioactive decay (see also Rutherford, 1904, Rutherford and Soddy, 1903). However, the same notion can be used to describe other processes of decay too, whether exponential or not. In this context, the kinetic and metabolic properties of human immunoglobulins were investigated by several authors [7] i.e. by turnover studies using IgG isolated from normal human serum. The average biologic half-life of IgG 1, IgG 2, and IgG 4 has been found to be 21 days, while that of IgG 3 was only 7.1 days. [8] , [9]

There are several equivalent mathematical formulas describing exponential decay.

$$N_t \equiv N_0 \times (e)^{-(\lambda \times t)} \tag{1}$$

$$N_t \equiv N_0 \times \left(\frac{1}{2}\right)^{-\left(\frac{t}{t_{1/2}}\right)} \tag{2}$$

where

N_0 is the initial quantity, N_t is the remaining quantity after time t, $t_{1/2}$ is the half-life, τ is the mean lifetime, λ is the decay constant, e is Leonhard Euler's (1707-83) number [10] (discovered by the Swiss mathematician Jacob Bernoulli (1655-1705) (see also Bernoulli, 1697) too), approximately equal to 2.718281828459045235 (see also Euler, 1748). It is

$$\tau = \frac{t_{1/2}}{ln(2)} \tag{3}$$

where ln indicates logarithmus naturalis. It is

$$\tau \times \lambda = 1 \tag{4}$$

2.2.3. Carbon-14 dating

A well-known application of the half-life method is radiocarbon-14 dating. Cosmic rays generate neutrons in the upper atmosphere, which interact with nitrogen-14 in the air to produce carbon-14. [11] Based on this effect, Willard Frank Libby (1908 - 1980) developed the half-life radiocarbon-14 dating

[7] Morell A, Terry WD, Waldmann TA. Metabolic properties of IgG subclasses in man. J Clin Invest. 1970 Apr;49(4):673-80. doi: 10.1172/JCI106279. PMID: 5443170; PMCID: PMC322522.

[8] Morell A, Terry WD, Waldmann TA. Metabolic properties of IgG subclasses in man. J Clin Invest. 1970 Apr;49(4):673-80. doi: 10.1172/JCI106279. PMID: 5443170; PMCID: PMC322522.

[9] SOLOMON A, WALDMANN TA, FAHEY JL. Clinical and experimental metabolism of normal 6.6s gamma-globulin in normal subjects and in patients with macroglobulinemia and multiple myeloma. J Lab Clin Med. 1963 Jul;62:1-17. PMID: 13978063.

[10] Coolidge, J. L. (1950). The Number e. The American Mathematical Monthly, 57(9), 591–602. https://doi.org/10.2307/2308112

[11] S.A. Korff, On the contribution to the ionization at sea-level produced by the neutrons in the cosmic radiation, Journal of the Franklin Institute, Volume 230, Issue 6, 1940, Pages 777-779, ISSN 0016-0032, https://doi.org/10.1016/S0016-0032(40)90838-9.

method. [12] , [13] As outlined before, carbon-14 is constantly being produced in earth's atmosphere and is incorporated into plants i.e. through photosynthesis. Animals consume plants. Once a plant or an animal dies, the same cease to ingest fresh carbon-14 and carbon-14 undergoes radioactive decay while the half-life of carbon-14 is approximately 5,730±40 years. [14] As a consequence, measuring the amount of carbon-14 in a specimen conveys information about when an animal or a plant died. Several equivalent formulas describing exponential decay might be found in secondary literature.

2.2.4. Carbon-14 dating: Example

An investigation has found a fossil sample that contained 25% carbon-14 in comparison to a sample living today. How can we determine the time of the fossil sample's death?

It is very helpful to consider that $N_0 = 100$ %, the initial quantity, $N_t = 25$ %, the remaining quantity after time t and the half-life $t_{1/2} = 5730$ years are known parameters. Rearranging equation 2, it is

$$\frac{N_t}{N_0} \equiv \left(\frac{1}{2}\right)^{-\left(\frac{t}{t_{1/2}}\right)} \tag{5}$$

or

$$ln\left(\frac{N_t}{N_0}\right) \equiv -\left(\frac{t}{t_{1/2}}\right) \times ln\left(\frac{1}{2}\right) \tag{6}$$

The fossil age t follows as

$$t \equiv \frac{t_{1/2} \times ln\left(\frac{N_t}{N_0}\right)}{-ln(2)} \tag{7}$$

or in more detail

$$t \equiv \frac{5730 \times ln\left(\frac{25}{100}\right)}{-0.693} = 11460 \tag{8}$$

There is some evidence that the fossil investigated is about 11,460 years old.

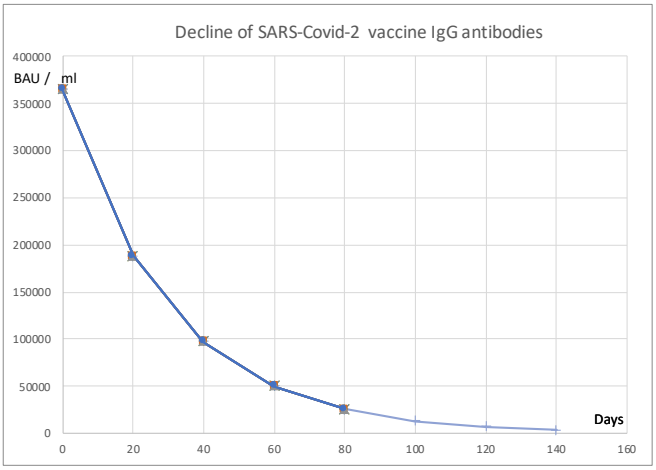
[12] W.F. Libby (1946). Atmospheric Helium Three and Radiocarbon from Cosmic Radiation. Physical Review. 69 (11–12): 671–672. doi:10.1103/PhysRev.69.671.2

[13] Anderson EC, Libby WF, Weinhouse S, Reid AF, Kirshenbaum AD, Grosse AV. Radiocarbon From Cosmic Radiation. Science. 1947 May 30;105(2735):576-7. doi: 10.1126/science.105.2735.576. PMID: 17746224.

[14] GODWIN, H. Half-life of Radiocarbon. Nature 195, 984 (1962). https://doi.org/10.1038/195984a0

3. Results

Several types of COVID-19 vaccines (Pfizer-BioNTech [Comirnaty], Moderna, CureVac, Janssen-Johnson & Johnson, Astra-Zeneca, Sputnik-V, and CanSino) and other [15] have been developed and are more or less effective. A 30-40 year-old, healthy woman has been vaccinated by 3 doses of a Covid-19 vaccine: AstraZeneca and Pfizer-BioNTech [Comirnaty]. Finally, the third dose has been a Pfizer-BioNTech [Comirnaty] vaccine and was given on December, 3 2021. SARS-CVODID-19 S protein IgG antibodies were checked in serum on January 10, 2022 and 141 days later on May 31, 2022. SARS-CVODID-19 S protein IgG antibodies were found to be $>$ 25720 (BAU/ml) on January 10, 2022 and 3475,3 (BAU/ml) on May 31, 2022. Figure 3 is illustrating the kinetic of **SARS-CVODID-19 S protein IgG antibodies** in the serum of this young woman. The average biologic half-life of IgG has been set to 21 days. [16] , [17]



$$N_t = N_0 \times \left(\frac{1}{2}\right)^{t / t_{1/2}}$$

where
$t_{1/2}$ is the half-life of IgG (about 21 days)
N_t is the remaining quantity after time, t
N_0 is the initial quantity

Through 141 days of follow-up, the decline in severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) IgG antibodies [18] induced by vaccination has been investigated. A healthy, young woman with a normal immune system is presented with a dramatic drop in IgG antibodies in a very short time. However, even if the binding and neutralizing SARS-CoV-2 antibodies elicited by vaccination persist for more than 6 months, their concentration decreases over time and much more than this. Dimeglio et al. [19] measured the antibody titers in 8758 healthcare workers (HCWs), vaccinated and unvaccinated, in France (10 June–10 July, 2020) with a quantitative enzyme-linked immunosorbent assay (ELISA) (Wantai Biological Pharmacy Enterprise Co., Ltd, China). Dimeglio et al. found that

[15] Drugs and Lactation Database (LactMed) [Internet]. Bethesda (MD): National Library of Medicine (US); 2006–. COVID-19 vaccines. 2022 May 15. PMID: 33355732.

[16] Morell A, Terry WD, Waldmann TA. Metabolic properties of IgG subclasses in man. J Clin Invest. 1970 Apr;49(4):673-80. doi: 10.1172/JCI106279. PMID: 5443170; PMCID: PMC322522.

[17] SOLOMON A, WALDMANN TA, FAHEY JL. Clinical and experimental metabolism of normal 6.6s gamma-globulin in normal subjects and in patients with macroglobulinemia and multiple myeloma. J Lab Clin Med. 1963 Jul;62:1-17. PMID: 13978063.

[18] Eberhardt KA, Dewald F, Heger E, Gieselmann L, Vanshylla K, Wirtz M, Kleipass F, Johannis W, Schommers P, Gruell H, Brensing KA, Müller RU, Augustin M, Lehmann C, Koch M, Klein F, Di Cristanziano V. Evaluation of a New Spike (S)-Protein-Based Commercial Immunoassay for the Detection of Anti-SARS-CoV-2 IgG. Microorganisms. 2021 Mar 31;9(4):733. doi: 10.3390/microorganisms9040733. PMID: 33807490; PMCID: PMC8067155.

[19] Dimeglio C, Herin F, Martin-Blondel G, Miedougé M, Izopet J. Antibody titers and protection against a SARS-CoV-2 infection. J Infect. 2022 Feb;84(2):248-288. doi: 10.1016/j.jinf.2021.09.013. Epub 2021 Sep 21. PMID: 34560135; PMCID: PMC8452591.

only a concentration of IgG Covid-19 titres of 1700 binding antibody units per ml (BAU/ml) and above provided full protection against Covid-19. [20] When viewed as a whole, there is some evidence that in about **6 months** after a third Covid-19 vaccine (see fig. 3), there is not enough Covid-19 vaccine induced protection against Covid-19 infection any more.

[20]Dimeglio C, Herin F, Martin-Blondel G, Miedougé M, Izopet J. Antibody titers and protection against a SARS-CoV-2 infection. J Infect. 2022 Feb;84(2):248-288. doi: 10.1016/j.jinf.2021.09.013. Epub 2021 Sep 21. PMID: 34560135; PMCID: PMC8452591.

4. Discussion

Vaccination contributes to the decline in mortality and morbidity of various vaccine-preventable (infectious) diseases (VPD) and is still one of the greatest achievements [21] of public health. Particularly worth mentioning is the direct protection for vaccinated individuals. However, high vaccination coverage rates might lead to herd immunity [22] and an indirect protection for the overall community and other valuable effects too. However, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) vaccine induced Cvoid-19 IgG are subject to a certain natural kinetic. Even if this effect as illustrated by figure 3 is scientifically not really that much surprising, the same effect should have an influence on the frequency of Cvoid-19 re-vaccinations. Otherwise, an unjustified lack of confidence in vaccines might induce a threat to the success of vaccination programs. Nonetheless, under conditions, where the titres of the protective Covid-19 IgG antibodies either do not rise quickly enough or drop too quickly and to too low, an adequate protection against Covid-19 is presumably no longer given. It seems to be that a Covid-19 vaccination more and earlier is much better than a Covid-19 vaccination later or none Covid-19 vaccination at all. The question also arises whether the amount of vaccine administered per vaccination is sufficient?

5. Conclusion

As long as we, the people, have to wait for vaccines which hopefully might ensure vaccination induced protection for years or even for life, a vaccination strategy should consider among other the mathematical formula: $dosage\ per\ vaccination \times frequency\ of\ vaccination = 'constant'$.

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6. Patient consent for publication

Patient consent for publication has been given.

[21] Centers for Disease Control and Prevention (CDC). Ten great public health achievements–United States, 1900-1999. MMWR Morb Mortal Wkly Rep. 1999 Apr 2;48(12):241-3. PMID: 10220250.

[22] Fine P, Eames K, Heymann DL. "Herd immunity": a rough guide. Clin Infect Dis. 2011 Apr 1;52(7):911-6. doi: 10.1093/cid/cir007. PMID: 21427399.

Conflict of interest statement

No conflict of interest to declare.

Private note

The definition section of a paper need not and does not necessarily contain new scientific aspects. Above all, it also serves to better understand a scientific publication, to follow every step of the arguments of an author and to explain in greater details the fundamentals on which a publication is based. Therefore, there is no objective need to force authors to reinvent a scientific wheel once and again unless such a need appears obviously factually necessary. The effort to write about a certain subject in an original way in multiple publications does not exclude the necessity simply to cut and paste from an earlier work, and has nothing to do with self-plagiarism. However, such an attitude cannot simply be transferred to the sections' introduction, results, discussion and conclusions et cetera.

References

Ilija Barukčić. *Die Kausalität*. Wiss.-Verl., Hamburg, 1. aufl. edition, January 1989. ISBN 3-9802216-0-1. ISBN: 978-3-9802216-0-1.

Ilija Barukčić. The Mathematical Formula of the Causal Relationship k. *International Journal of Applied Physics and Mathematics*, 6 (2):45–65, January 2016. doi: 10.17706/ijapm.2016.6.2.45-65. IJAPM. Free full text: IAP.

Ilija Barukčić. Causal relationship k. *International Journal of Mathematics Trends and Technology IJMTT*, 66(10):76–115, 2020. URL http://www.ijmttjournal.org/archive/ijmtt-v66i10p512. IJMTT.

Ilija Barukčić. Mutually exclusive events. *Causation*, 16(11):5–57, November 2021a. doi: 10.5281/zenodo.5746415. URL https://doi.org/10.5281/zenodo.5746415. Zenodo.

Ilija Barukčić. Index of relationship. *Causation*, 16(8):5–37, April 2021b. doi: 10.5281/zenodo.5163179. URL https://doi.org/10.5281/zenodo.5163179. Zenodo.

Ilija Barukčić. Conditio per quam. *Causation*, 17(3):5–86, March 2022. doi: 10.5281/zenodo.6369831. URL https://doi.org/10.5281/zenodo.6369831. Zenodo.

Johann Bernoulli. Principia calculi exponentialium seu percurrentium. *Acta Eruditorium*, pages 125–133, 1697.

Leonhard Euler. *Introductio in analysin infinitorum*. apud Marcum-MIchaelem Bousquet & socios, 1748. doi: 10.3931/e-rara-8740. Free full text: e-rara, Zurich, CH.

Ernest Rutherford. LXIII. Slow transformation products of radium. *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, 8(47):636–650, 1904. doi: 10.1080/14786440409463234. URL https://doi.org/10.1080/14786440409463234.

Ernest Rutherford and Frederick Soddy. LX. Radioactive Change. *The London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, 5(29):576–591, 1903. doi: 10.1080/14786440309462960. URL https://doi.org/10.1080/14786440309462960.

H. Warnatz. Immunsystem. In Walter Siegenthaler, editor, *Klinische Pathophysiologie*, pages 542–587. Georg Thieme Verlag, Stuttgart, 1982.

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[j] https://twitter.com/ilijabarukcic?lang=de
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