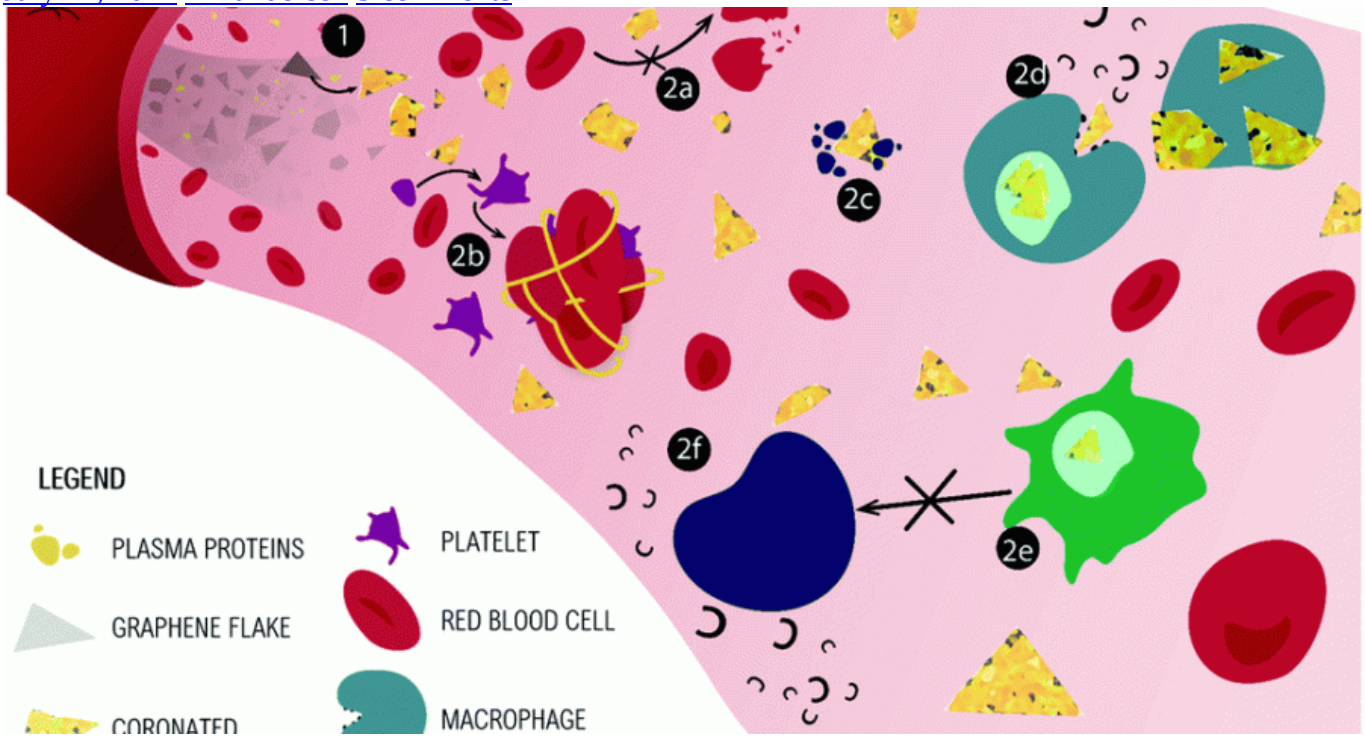
Graphene oxide in contact with blood

July 12, 2021 mikandersen 3 comments



Reference

- Palmieri, V.; Perini, G.; De Spirito, M.; Daddy, M. (2019). Graphene oxide touches blood: in vivo interactions of bio-coronated 2D materials. Nanoscale Horizons, 4(2), p. 273-290. https://doi.org/10.1039/C8NH00318A

Facts

- The article acknowledges that at least since 2010 work has been done on the design of injectable graphene nanoparticles.
- The authors describe that the graphene oxide « *GO (Graphene Oxide)* » in the blood is covered by a layer of proteins called « *Corona Biomolecular*» or « *BC Biomolecular Corona*» , which influences the interaction with cells, their absorption and bio-distribution.
- According to the authors, " *GO adsorbs a large number of proteins thanks to the highly available surface and this is generally seen as a disadvantageous feature in vivo, as the more proteins tag the foreign nanomaterial, the better it is attacked by our immune system.* " . This allows us to infer that the authors want the immune system not to eliminate the graphene oxide, since the BC serves precisely to mark the foreign body. However, on the other hand, « *it can be used to select and enrich biomarkers that are not very concentrated in the blood of patients*«. Biomarkers are substances or elements that serve to quantitatively measure the biological state of a person, forming indicators with which to detect diseases or diagnose their state. However, the use of biomarkers for other different purposes could not be ruled out (new reviews of the literature are required, therefore it is still pending verification).
- The authors seem to have recognized the dangers of GO, in fact they indicate that " *Small flakes of GO (a few hundred nm) seem to be more destructive* ". However, they put forward the thesis that protein coating using BC, among other procedures, can reduce the risk of " *red blood cell hemolysis* ", that is, the disintegration of red blood cells. Successively abounds in coating and protection strategies for GO so that it is tolerated by the human body. In relation to this section, the risk of thromboembolism is also implicitly recognized with both rGO (Reduced Graphene Oxide, known as Reduced Graphene Oxide) and GO. In fact, it is stated verbatim*When administered in vivo (250 μg kg -1 body weight), 48% of pulmonary vessels were partially*

occluded after 15 minutes " and hereafter " *This in vivo impact on the coagulation cascade may be caused by an aggregation of the nanomaterial after injection* ."

- The article confirms that " *Understanding the interaction of GO with immune cells is crucial for the development of biomedical technologies* ". What comes to indicate the interest in applying graphene technology despite the natural rejection of the human body and the problems it generates, see references to scientific studies on the toxicity of graphene .
- Related to the immune response of the human body, it is worth mentioning the following statement « *A recent study showed that GO induced the expression of proinflammatory cytokines in a size-dependent manner, with the smaller GO (<1 μm) being more effective than the larger (1-10 μm)* ." Cytokines, also known as « *cytokines or cytokines*» were one of the most contrasted symptoms during the COVID-19 pandemic, which allows us to infer a cause and effect relationship with what is indicated in the article. Cytokine or cytokine storm is widely documented, see (Hu, B.; Huang, S.; Yin, L. 2021 | Sinha, P.; Matthay, MA; Calfee, CS 2020 | Sun, X.; Wang, T .; Cai, D.; Hu, Z.; Liao, H.; Zhi, L.; Wang, A. 2020) and the references available in the following query «cytokine storm» «covid» .
- In section 6 on bio-distribution and biosafety, it is stated that « *Nanoparticles destined for drug delivery applications are being designed to reduce their elimination and extend systemic circulation times and, therefore, increase the opportunity for targeted administration . However, the downside of long circulation times is the increased possibility of interaction with blood components and triggering of adverse effects* ." This once again confirms the interest in graphene due to its special properties of recombination and assimilation, as well as the interest of the scientific community in advancing in this direction.
- It is stated that " *Within 48 hours after injection, GO is cleared from the bloodstream and distributed throughout various organs with a preferred accumulation in the lungs, liver, and spleen* ." While a low dose of " *(1 mg kg-1)* " does not cause appreciable harm in the first 14 days, a higher dose of " *(10 mg kg-1)* " does. This involved " *granulomatous lesions, pulmonary edema, inflammatory cell infiltration, and fibrosis in the lungs* ." The effects noted by other authors are also cited (Ema, M.; Gamo, M.; Honda, K. 2017) summarizing that «*the pathological effects on the lungs are proportional to the degree of dispersion and oxidation of GO. When injected directly into the lungs, GO induces severe long-term (21 days) lung injury* ." It has also been found that the administration of reduced graphene oxide " *rGO* " caused " *mild signs of toxicity in the blood, liver and kidneys and a lack of inflammation after 7 days* ".
- It also refers to degradation problems that can cause accumulation problems in the cells, in fact it is referred to as « *the degradation of the injected GO is an important biosafety problem. Long-term (14 days) interaction of GO with plasma causes reduction and biodegradation…biodegradable particles are digested and eliminated from the body, while non-biodegradable particles accumulate in cells over prolonged periods* ." The author does not mention the adverse effects that such accumulation can cause. The authors acknowledge that graphene is still far from being ready for safe clinical treatment in patients, as they refer «*Despite the great scientific advances, future studies for in vivo application should focus on some weaknesses in graphene research. First, graphene materials must be designed to have more than just a stable small size for rapid excretion and a degradable composition to limit toxicity* ."

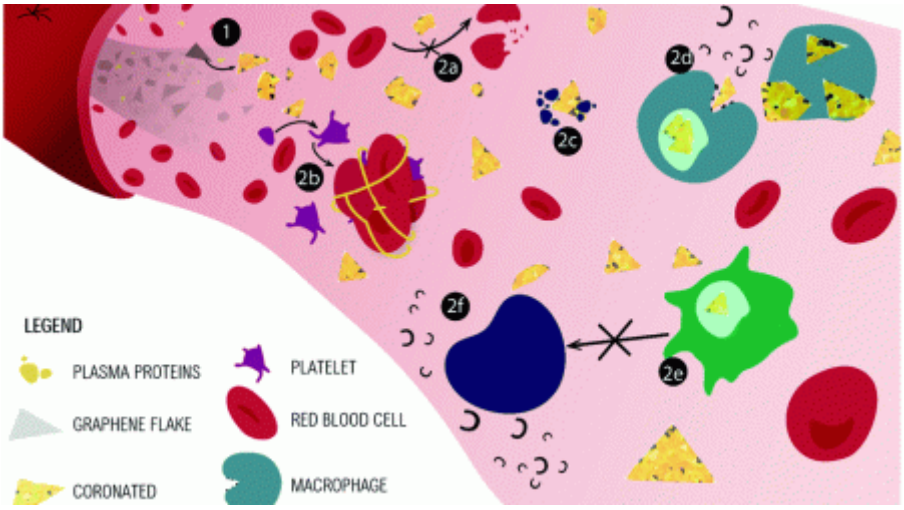


Fig.1. Interactions of graphene oxide in blood and its components. (Palmieri, V.; Perini, G.; De-Spirito, M.; Papi, M. 2019)

Opinions

- As indicated in the article, the researchers are aware of the adverse effects of graphene oxide and their attempts to avoid complications derived from the rejection of the immune system are clear. If we add to this the recognition in the development of vaccines for the coronavirus with graphene oxide content, see recombinant vaccine entry , the conclusion is reached that the vaccines could incur significant health risks.
- The inflammatory response of cytokines that can affect the lungs and heart has a reasonable degree of coincidence with the effects of COVID-19, see (Rizzo, P.; Dalla-Sega, FV; Fortini, F.; Marracino, L.; Rapezzi, C.; Ferrari, R. 2020) and check the available literature in the following query «cytokine storm» «covid» intitle:»lungs» .
- Since graphene oxide is considered as a carrier/vector for drug delivery, the following questions arise: What kind of drugs can it carry? Could it carry drugs or drugs harmful to health? Could it carry pathogens or viruses? It becomes clear that graphene oxide can carry vaccines according to the recombinant vaccine patent .
- From reading the article, it can be inferred that graphene oxide GO or its rGO variant are not prepared to offer the necessary safety in clinical treatment, so it is still in an experimental phase. The applications of this biotechnology are what can make the difference between a correct and well-intentioned use, this is the treatment of diseases and pathologies, or an evil use, administering drugs, neurological inhibitors, adding CRISPR biotechnology for genetic modification without consent, or any other compound, material or bio-nano technology.

Hypothesis

- Graphene oxide « *GO* » or reduced graphene oxide « *rGO* » could be the cause of the symptoms of COVID-19, which would mean that there would be graphene poisoning, by routes of administration still unknown (for example, aerosols, contamination of water, air, food, etc.) and not necessarily a virus, or at least not only.
- Derived from the first hypothesis, graphene oxide could have been designed as an adjuvant vector for the transmission and enhancement of a coronavirus in the first stage of the pandemic and not only for the administration of drugs (Li, Z.; Fan, J. ; Tong, C.; Zhou, H.; Wang, W.; Li, B.; Wang, W. 2019).

Bibliography

1. Emma, M.; Gamo, M.; Honda, K. (2017). A review of toxicity studies on graphene-based nanomaterials in laboratory animals. Regulatory Toxicology and Pharmacology, 85, p. 7-24. https://doi.org/10.1016/j.yrtph.2017.01.011

2. Hu, B.; Huang, S.; Yin, L. (2021). The cytokine storm and COVID-19 = The cytokine storm and COVID-19. Journal of medical virology, 93(1), p. 250-256. https://doi.org/10.1002/jmv.26232
3. Li, Z.; Fan, J.; Tong, C.; Zhou, H.; Wang, W.; Li, B.; Wang, W. (2019). A smart drug-delivery nanosystem based on carboxylated graphene quantum dots for tumor-targeted chemotherapy. Nanomedicine, 14(15), p. 2011-2025. https://doi.org/10.2217/nnm-2018-0378
4. Palmieri, V.; Perini, G.; De Spirito, M.; Daddy, M. (2019). Graphene oxide touches blood: in vivo interactions of bio-coronated 2D materials. Nanoscale Horizons, 4(2), p. 273-290. https://doi.org/10.1039/C8NH00318A
5. Rizzo, P.; Dalla-Sega, F.V.; Fortini, F.; Marracino, L.; Rapezzi, C.; Ferrari, R. (2020). COVID-19 in the heart and lungs: could we get through the inflammatory storm? = COVID-19 in the heart and the lungs: could we "Notch" the inflammatory storm? Basic Research in Cardiology, 115(31). https://doi.org/10.1007/s00395-020-0791-5
6. Sinha, P.; Matthay, MA; Calfee, CS (2020). Is a cytokine storm relevant to COVID-19? = Is a cytokine storm relevant to COVID-19? JAMA internal medicine, 180(9), p. 1152-1154. http://jamanetwork.com/article.aspx?doi=10.1001/jamainternmed.2020.3313
7. Sun, X.; Wang, T.; Cai, D.; Hu, Z.; Liao, H.; Zhi, L.; Wang, A. (2020). Cytokine storm intervention in the early stages of COVID-19 pneumonia = Cytokine storm intervention in the early stages of COVID-19 pneumonia. Cytokine & growth factor reviews, 53, pp. 38-42. https://doi.org/10.1016/j.cytogfr.2020.04.002