

The Effect of Covid-19 on Blood Clots

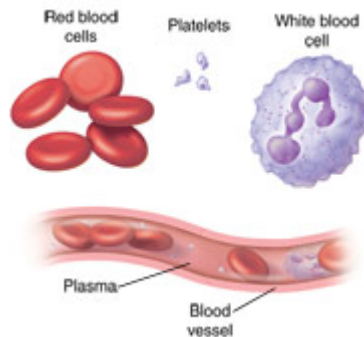
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1 Introduction

Covid-19 and blood are both pertinent aspects of our daily lives. Covid-19, the recent cause of a global pandemic, has affected millions of people by interfering with work, school, extracurriculars, and arguably most important of all, well-being and health. Blood keeps us alive by circulating throughout the body and providing crucial materials to our cells; simply put, it is the foundation of our health. A virus that affects our immune system, Covid-19 leads to the question of how it might affect the rest of our body, more specifically, the blood clotting system. After studying the correlation between the blood clotting system and Covid-19, it can be concluded that Covid-19 can lead to the proliferation of blood clots.

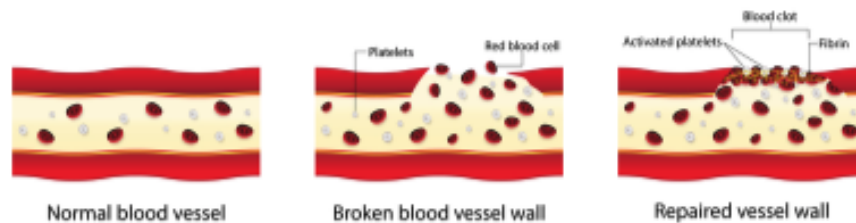
In order to connect the coronavirus to the blood clotting system, each element must be broken down. The blood clotting system falls under the circulatory system, which transports blood throughout the body to deliver necessary oxygen and nutrients to various mechanisms of the body [1]. Red blood cells, white blood cells, and platelets are different types of blood cells that perform specialized functions within the bloodstream (Image 1). Red blood cells are the carriers of oxygen, which gives them their bright red color. When red blood cells circulate, the hemoglobin within these cells releases oxygen as needed [1]. White blood cells primarily fight germs and make antibodies to combat foreign materials and infection, and platelets are the cells that aid in the process of clotting. When there is a rupture in a blood vessel, platelets concentrate in this section and help stop leakage. The bleeding is restrained with the assistance of other clotting materials, such as proteins.

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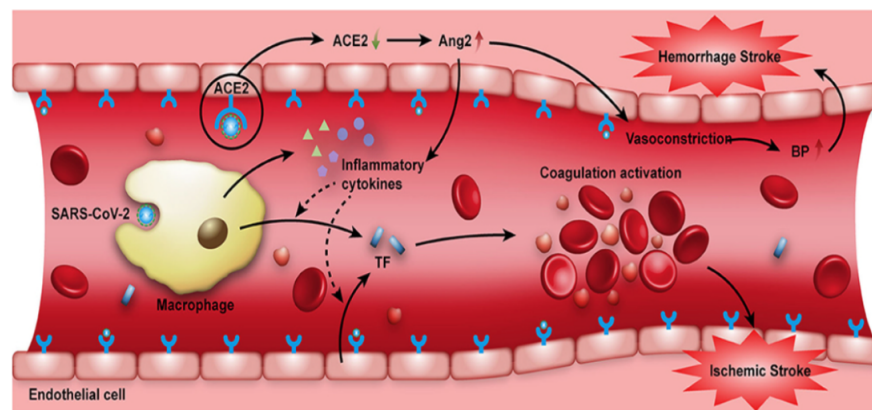
Blood clots are principally triggered by an injury that results in the blood thickening as blood vessels rupture [2] (Image 2). After the first clots form, they can travel to various other body parts, possibly resulting in more severe blood clots. Conditions such as deep vein thrombosis, heart failure, antiphospholipid syndrome, and Covid-19 can all cause blood clots.

Formation of blood clots



The general relationship between the coronavirus and blood clotting is the proliferation of clotting occurring in the body. As Yogen Kanthi, an assistant professor at Michigan Medicine says, “With Covid-19, we continue to see a relentless, self-amplifying cycle of inflammation and clotting in the body. . . autoantibodies could be a culprit in this loop of clotting” (Image 3). This reasoning can be attributed to an autoimmune antibody that Covid-19 introduces to the body. This autoimmune antibody becomes a foreign invader which circulates in the blood just as healthy blood cells do. Then, these antibodies proceed to attack the cells which triggers blood clots [3]. These clots are often minuscule but can lead to larger consequences and even death. A great majority of these clot-causing antibodies are present in victims of the disease antiphospholipid, which worsens blood clotting. A discovery that surprised Dr. Knight, a rheuma-

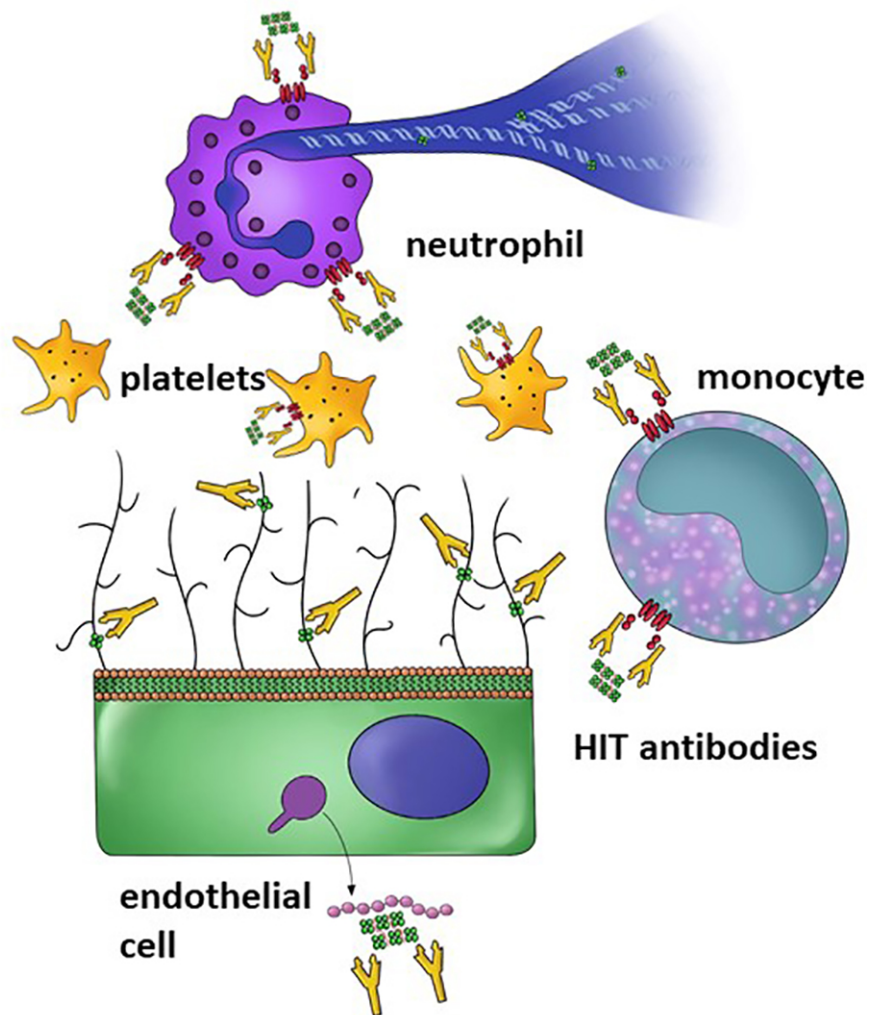
tologist in Michigan Medicine, was that “half of the patients hospitalized with Covid-19 were positive for at least one of the antibodies.” In the Science Translational Medicine publication, it was discovered that not only were the antibodies found in the Covid-19 patients, but over 50% had super-activated neutrophils, or in other words, exploding white blood cells. Further studies are still being performed on whether the combination of the antibodies with super-activated neutrophils was the cause for the extreme blood clotting. Additional connections were also made through the discovery of this antibody; these nanoscopic clots will restrict blood flow in the lungs, which can impair or prevent oxygen exchange [4]. In addition, the blood clots may interfere with the blood being circulated to the heart, resulting in heart damage and heart failure; this is because Covid-19, unlike other viruses, targets smaller blood vessels such as those in the heart.



After introduction of the vaccine into many different regions, an interesting outcome with individuals who took the Johnson and Johnson vaccine was found; “a combination of blood clots and alarmingly low levels of platelets” was observed in these young people, which is usually extremely rare [5]. Furthermore, vaccine-induced immune thrombotic thrombocytopenia, a condition mainly recorded with the Johnson and Johnson vaccine which results in increased blood clotting and decreased platelet count, also developed amongst some young people, though this only affected 1 in 50,000 [6]. Further research was done on the syndrome Heparin-Induced Thrombotic Thrombocytopenia (HIT) which can be

also recognized by these low levels of platelets and the presence of blood clots (Image 4). Scientists and doctors were hoping to find a connection between these two conditions. After further research, the probability of a correlation between the

MULTI-CELLULAR ACTIVATION BY HIT ANTIBODIES



Covid-19 vaccine and increased blood clots was low and the probability of a clotting disorder for a reason unrelated to the vaccination was high [5]. For this reason, the vaccine was re-released onto the market but with a warning

concerning the 28 cases of severe blood clotting out of the 9 million who took the Johnson and Johnson vaccine.

Since Covid-19 can cause blood complications during and post testing negative for the virus, it has been important to find solutions to battle this. Doctors have recommended blood-thinning treatments which combat clots to continue being administered to individuals even after the virus has left the body. Furthermore, “a large clinical trial conducted worldwide shows that treating moderately ill hospitalized COVID-19 patients with a full-dose blood thinner reduced their need for organ support. . . and improved their chances of leaving the hospital” [7]. It is extremely important to combat the thickening of the blood since it has been found that even the smallest clots in blood vessels resulted in death [8]. Another solution is being developed and provided to patients with Covid-19 prophylaxis, which are measures taken to prevent thrombosis, to make the dismissal from the hospital quicker; it prevents further harm from the virus. This also tied into a solution for individuals with Covid-19 who have not been admitted to the hospital. Some doctors are not utilizing VTE (venous thromboembolism) prophylaxis to treat patients or recovering individuals at home because they would “rather...use it as an opportunity to reassess whether they should have been on blood thinner already, such as in the case of a patient who has a history of VTE” [3](Barnes). Continued research is being done to create newer vaccines that do not have as many drastic repercussions on the body in the form of blood clots.

Overall, from studying the relation of Covid-19 and blood clots, the vaccine’s impact on blood clots, and the solution to fighting these blood clots, the effects of Covid-19 on the coagulation system are better understood. The research demonstrates the severity of even the smallest blood clots and the larger consequences we have associated with this virus such as heart failure and death. These main takeaways from the research during the pandemic will allow people to better understand and combat the virus, while also comprehending the significance of its connection to blood clots.

Acknowledgments

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