APPLICATION NOTE

New insights into blood disorders

How imaging technology helps investigation in blood research

Blood is an essential component of the body, supplying necessary oxygen to all organs and tissues and eliminating unwanted metabolites from cells. However, in addition to transporting oxygen, blood protects the body from a variety of diseases using the immune cells and platelets present in it. These blood cells also play a role in bleeding disorders.

Researchers across the world are showing interest in understanding the nature of blood cell interactions, such as clotting and binding to different fibers in particular. This article discusses the effective role that integrated correlative light and electron microscopy (CLEM) and scanning electron microscopes (SEMs) can play in laboratories involved in blood research.

Blood contains various types of cells in a solution known as plasma. Plasma consists mainly of water, with approximately 45% of the volume made up of blood cells, but it also contains hormones, proteins such as clotting factors, and ions.

The human plasma consists of three types of blood cells: Red blood cells (RBCs) or erythrocytes; white blood cells (WBCs) or leukocytes; and platelets or thrombocytes. RBCs are the most abundant blood cells, transporting oxygen between lungs and the organs by attaching to iron-containing proteins called hemoglobins.

WBCs are present in five different types and form the body's immune system to fight all types of pathogens. Platelets are tiny cell fragments that play a vital role in blood clotting.

What makes blood diseases dangerous?

Skin injuries, bacterial infections, and sexually transmitted diseases (STDs) expose blood to all types of pathogens. The body's immune system combats these diseasesvby activating a specific type of WBC, depending on the kind of pathogen encountered.

Blood disorders are a different class of blood diseases that occur due to insufficient blood clotting caused by a lack of thrombocytes or other components involved in the clotting process. Normally, in the case of an injury, clotting factors and fibrin present in the blood allow binding of thrombocytes with each other to form a plug at the affected site to avoid further hemorrhage and facilitate healing of the injured tissue.

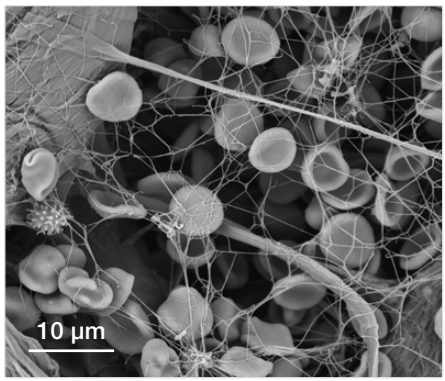

Figure 1.
Each wound causes a reaction by the body. This is an example of a fibrin network with blood cells imaged with a SEM.

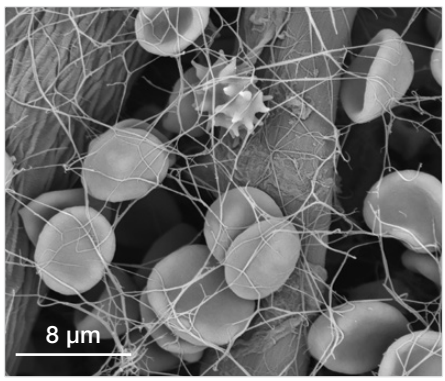

Figure 2.
High-resolution SEM image of blood cells.

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Persons with a clotting disorder can suffer excessive bleeding. This condition not only causes damage to tissues, but can also be potentially fatal. The presence of an excess number of clotting factors and thrombocytes is as equally detrimental as their absence. This condition can cause several kinds of maladies, such as cardiac arrest or brain strokes.

New approaches to better understand blood disorders

Blood research is an increasingly popular research field for gaining insights into the interactions taking place during clot formation. For this purpose, the SEM has been shown to be very useful, enabling scientists to easily observe the 3D structures of blood clots and the interactions taking place between the blood cells and different fibers.

In the coming years, many blood clotting disorders, such as the Von Willebrand disease, will be explored. The latest advancements in integrated CLEM will allow fluorescent-marked components to be observed using light microscopy while the cell environment's 3D structure will be observed using the integrated SEM. The combined image provides a clear picture of the interactions, thereby yielding readily available and reliable results.

The significance of fast research results

Addressing malaria, an infectious disease caused by mosquitoes, is another objective of blood research. Parasitic protozoans, a kind of Plasmodium, cause this disease, which has an equally deleterious effect on both humans and animals.

Generally, symptoms of malaria can be observed in patients only after 10 to 15 days of infection. Improper treatment of malaria leads to the recurrence of the disease. Approximately 214 million malaria-affected cases were reported across the globe in 2015, of which 438,000 cases were fatal; 90% reported in Africa.

To create potential vaccines or medications, significant studies have been carried out. The combination of Thermo Scientific™ Phenom Desktop SEM and an integrated correlative solution, such as the Thermo Scientific™ Delphi Microscope, will be very useful, as it allows you to easily examine the direct interactions between the parasite and the surrounding cells and tissues.

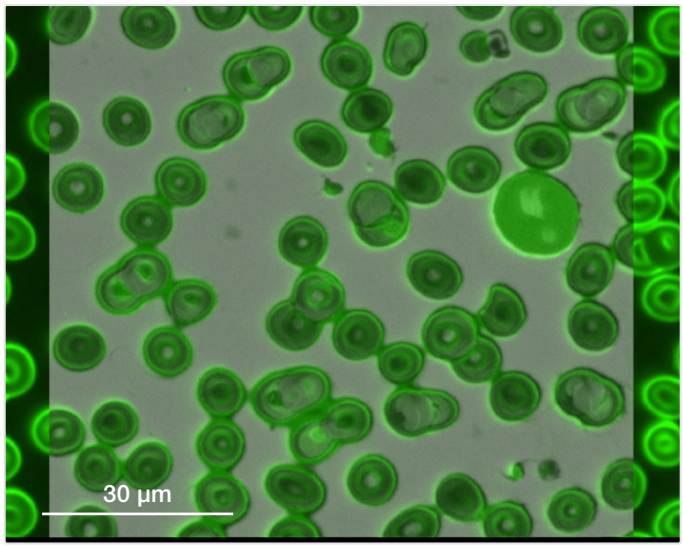

Figure 3. CLEM image of of red blood cells stained with a hydrophilic fluorescent dye.

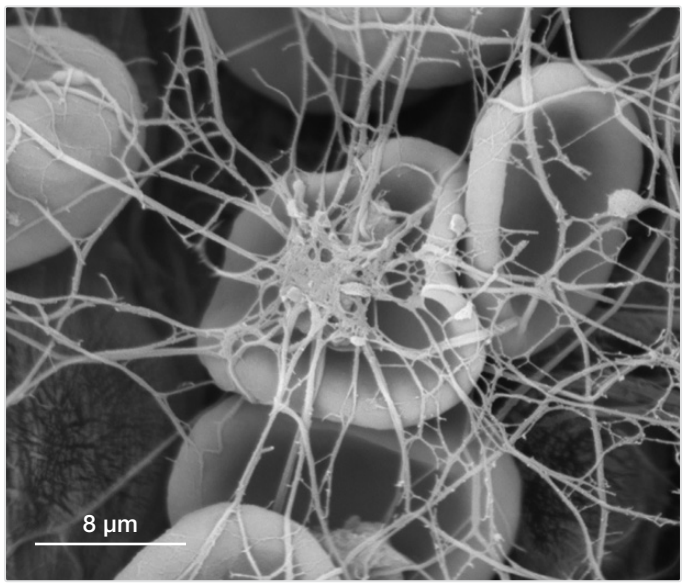

Figure 4. Insights into blood clot formation using a SEM.

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