Fragments of erythrocyte membranes are not only able to stop the bleeding, but also are able to prevent the spread of thrombosis

Red blood cells (RBCs), also called erythrocytes, are the most common type of blood cell and principal means of delivering oxygen to body tissues. Human erythrocytes develop from stem cells into mature erythrocytes in about 7 days. When matured, in a healthy individual these cells stay in blood circulation for about 100 to 120 days, much longer than other blood cells.

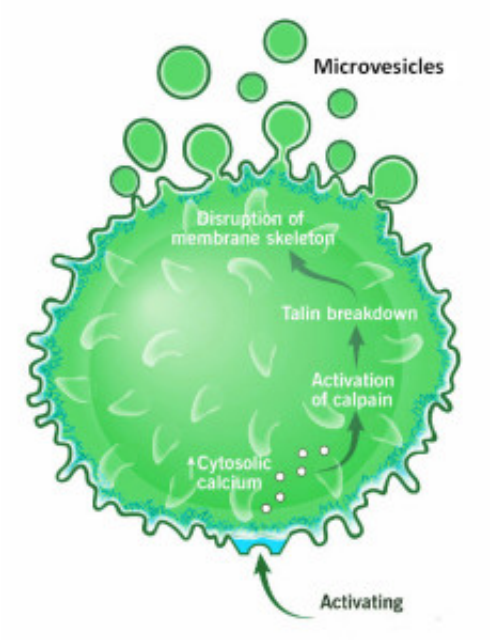

Fig. 1. Fig. Schematic representation of mechanism of realisation of microvesicles from red blood cell.

During RBCs storage, many biochemical changes happen, referred to as “storage lesions”. These changes include RBC membrane modifications (they become more rigid) and other biochemical and morphologic changes. In addition, stored packed RBC units (pRBCs) contain increased numbers of red blood cells - derived microvesicles. Microvesicles (MVs) are small vesicles released from the membrane of RBCs which protect them from early destruction. MVs are small structures (100–1,000 nm in diameter) surrounded by membrane; their size range overlaps that of bacteria and immune complexes. MVs were first described decades ago as a factor in platelet free plasma. For a long time they were considered merely as cell fragments or "dust" and not considered to have any specific biological role. Although initially met with skepticism, the existence of membrane vesicles is now well established, and compelling evidence supports the significance

of MVs in a broad range of physiological and pathological processes. However, additional research is still necessary in order to better understand the storage lesions of erythrocyte concentrates in blood banks. It could be suggested that erythrocytes' mivrovesicles are mediators of post-transfusion complications.

Microvesicles contribute to the activation of the coagulation system. Microvesicles activation results in the formation of a thrombotic plug which acts to stem the flow of blood from the broken vessel. Activation of coagulation in is a forceful innate defense mechanism which may be an evolutionary adaptation to injury in order to prevent bleeding and death. However, excessive activation of coagulation results in vascular thrombosis, which may contribute to multiple organ failure. It is essential that blood clotting is activated only at the site of a broken vessel and not expand beyond the boundaries of the injury. Blood clots can be life-threatening if they form in critical locations, leading to severe complications such as heart attack and stroke.

Excessive clotting is inhibited because the organisms have several mechanisms to inhibit it. The most important of these is the fibrinolytic system (a complex of specific enzymes), which is able to dissolve blood clots in the early stages of their formation and to prevent uncontrollable growth of the thrombus. This ensures that clotting will only occur at the site of injury and not progress down the vessel.

Recent data indicate that use of older stored blood in resuscitation from hemorrhage is associated with the activation of the coagulation system in the recipient. Recent studies suggest that MVs which exist in older units of stored pRBCs can cause adverse events after transfusion. However, relatively little is known about the possible fibrinolytic activity of microvesicles. We demonstrated that erythrocyte microparticles derived from RBCs' membranes activate the coagulation system and display prominent fibrinolytic activity which significantly decreases during the storage of red blood cells. This decreased fibrinolytic activity may contribute to the development of so-called post-transfusion complications. Consequently, removing MPs from RBCs which have been stored for long time before use for transfusion or resuscitation might prove to be beneficial.

Nowadays, the study of the biology of microvesicles is a fascinating field of research. This domain is rapidly growing and the medical applications of such studies are at our doorstep.

Publication

Impact of microparticles derived from erythrocytes on fibrinolysis.
Levin G, Sukhareva E, Lavrentieva A.
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