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Intracellular origin and ultrastructure of platelet-derived microparticles

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Abstract

© 2017 International Society on Thrombosis and Haemostasis Essentials Platelet microparticles play a major role in pathologies, including hemostasis and thrombosis. Platelet microparticles have been analyzed and classified based on their ultrastructure. The structure and intracellular origin of microparticles depend on the cell-activating stimulus. Thrombin-treated platelets fall apart and form microparticles that contain cellular organelles. Summary: Background Platelet-derived microparticles comprise the major population of circulating blood microparticles that play an important role in hemostasis and thrombosis. Despite numerous studies on the (patho)physiological roles of platelet-derived microparticles, mechanisms of their formation and structural details remain largely unknown. Objectives Here we studied the formation, ultrastructure and composition of platelet-derived microparticles from isolated human platelets, either quiescent or stimulated with one of the following activators: arachidonic acid, ADP, collagen, thrombin or calcium ionophore A23187. Methods Using flow cytometry, transmission and scanning electron microscopy, we analyzed the intracellular origin, structural diversity and size distributions of the subcellular particles released from platelets. Results The structure, dimensions and intracellular origin of microparticles depend on the cell-activating stimulus. The main structural groups include a vesicle surrounded by one thin membrane or multivesicular structures. Thrombin, unlike other stimuli, induced formation of microparticles not only from the platelet plasma membrane and cytoplasm but also from intracellular structures. A fraction of these vesicular particles having an intracellular origin contained organelles, such as mitochondria, glycogen granules and vacuoles. The size of platelet-derived microparticles depended on the nature of the cell-activating stimulus. Conclusion The results obtained provide a structural basis for the qualitative differences of various platelet activators, for specific physiological and pathological effects of microparticles, and for development of advanced assays.

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Keywords

blood microparticles, cellular microvesicles, electron microscopy, platelet activation, platelets

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