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Mini-Review

Platelets Imaging

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Abstract

In recent years, an increasing number of studies have showed that platelets have highlighted their importance in various diseases. Platelets, as cellular fragments, research method is challenging due to its particularity unique functions. With the development of modern biological cell imaging technology and fluorescence labelling in recent years, platelet structure and how it changes upon platelet activation has gradually been illuminate. We will briefly introduce platelet imaging modalities based on optical Microscope, electron microscope and live cell imaging in platelet research in this article.

Keywords: Lung cancer screening, Sojourn time, Transition density, Overdiagnosis, Sensitivity

Introduction

Platelets are derived from megakaryocytes and it's the smallest member in the blood system. Since *Wright* [1,2] proposed that bone marrow are responsible for releasing platelets, researchers have been exploring the morphology, size, and function of platelets from multiple perspectives. Platelets have crucial roles in primary haemostasis. Nowadays, more and more studies have shown that platelets not only have haemostatic effects, but also play an important role in the development of many diseases. For example, platelets also play important roles in various physiological and pathological processes such as immune defence, vascular/lymphatic development, and tumour metastasis [3-5].

The structure of platelets is closely related to their function. However, due to the platelet anucleate and special characteristics, the research method for platelets is different from other blood cells. Due to the platelets' proper shape, size, and biological function are critical for function of adhesion and aggregation, imaging technology has become an important method to observe the platelets. With the development of modern biological cell imaging technology and fluorescence labelling such as biochemistry, electron microscopy can better observe the platelets. This article reviews the commonly used biological cell imaging techniques for platelets observing.

The Ultrastructure of Platelets

The average diameter of platelets is only 2 to 4 μm, but its quantity is quite considerable, with nearly 1×10^{12} platelets in the bloodstream of adults [6,7]. In order to quickly respond to stimuli such as vascular damage, platelets numerous organelles including a-granules, dense-granules, peroxisomes, lysosomes, and mitochondria can directly exert various functions of platelets [8]. The compact volume allows platelets to flexibly move through various levels of blood vessels without being obstructed or crushed, Further unleash various benefits [9-11].

Optical Microscope

Platelets can be clearly displayed through a high-power lens of optical microscope. To further clarify the structure of platelets *Frojmovic MM* [12] inferring platelet geometric data using rheo-op-

tical method from light microscopy studies of platelets freely rotating in suspension. In addition to observing the rough morphology of platelets, optical microscopy can also observe the activated state of platelets, as well as the spreading and aggregation [13].

Electron Microscope

The study of platelet biology using electron microcopy can be traced back to the early years of the invention of the electron microscope. It was not long after the advent of the electron microscope that transmission electron microscopy used to study the platelet ultrastructure [14]. Electron microscopy is particularly useful for determining basic platelet cell biology, including identification of granule subtypes, morphologic changes upon platelet activation and the important role of platelet cytoskeletal components [15]. Traditional electron microscopes can be divided into two types transmission electron microscopy (TEM) and scanning electron microscopy (SEM). In addition, electron microscopes used for platelet observation and research also include the use of electron tomography, cryo-EM, serial block face SEM, focused ion beam-SEM, and correlative light and electron microscopy (CLEM) [14]. In platelet biology, FIB-SEM can be used to obtain 3D structures of whole, isolated platelets, further to examine subcellular structures and changes that occur during the activation process [16]. In addition to exploring platelets themselves, electron microscopy further expanded to the study of the thrombosis [17]. Latest research combining with computer science using computationally based image analysis methods to open new possibilities for imaging of platelets and thrombi in 3-dimensions at nanometer level resolution [14,18,19].

Live Cell Imaging

In addition to electron microscopy, many new imaging techniques for living cells have emerged in recent years, enabling biologists to observe the internal reaction behaviour of life systems in a comprehensive and high-definition manner without damaging cell samples.

However, functional imaging of live platelets is still very challenging. These small cellular fragments present some stealthy spatio-temporal features that render molecular mechanisms underlying platelet function particularly difficult to study under the microscope. Based on the cellular characteristics of platelets, their difficult to transfect to express fluorescently labelled or optogenetically modified, light-sensitive proteins of interest [20]. To enable platelets to be labelled with corresponding proteins, the following approaches such as labelled platelets isolated from transgenic mice can be used [20,21]. In addition, fluorescent drugs, probes and ligands can also be labeled on bone marrow or megakaryocytes [22], live imaging of platelets with label free approaches, as an alternative to conventional microscopy all can be used [20,23].

Conclusion

Modern cell imaging technology has gradually diversified its application in observing platelets. More and more researches are no longer using a single platelet imaging observation technique, *Jinkyoung Chung, et al*. [24] used three-dimensional optical diffraction tomography to observe the initial state of platelets during the early adhesion process on the cover glass. Electron microscopy could be used as a fundamental technology to observe the biological behaviour of platelets interacting with other cells in the body, the distribution and mechanism of action of drugs within platelets, exploring complex molecular biological processes such as platelet internal movement, metabolism, and signal transmission. Overall, biological cell imaging technology, as an intermediary tool, has greatly enriched our understanding of platelet physiology and pathology. There is no doubt that technological advances will help us better understanding the physiological and pathological mechanisms of platelets into the foreseeable future.

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Conflict of Interest

None.

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