INTERNATIONAL MULTIDISCIPLINARY JOURNAL FOR RESEARCH & DEVELOPMENT
SJIF 2019: 5.222 2020: 5.552 2021: 5.637 2022:5.479 2023:6.563
eISSN 2394-6334 https://www.ijmrd.in/index.php/imjrd Volume 11, issue 02 (2024)

BLOOD COAGULATION: BIOCHEMICAL BASIS

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Abstract: Blood coagulation is a complex network of biochemical reactions that is activated when the integrity of the vascular system is disrupted. The purpose of coagulation is the controlled local transition of blood plasma from a liquid to a jelly-like state and, as a result, stopping bleeding. Any disturbances in the delicate balance of this system lead to serious consequences associated with thrombosis or bleeding.

Keywords: Hemostasis, blood coagulation, thrombosis, thrombin, method, fibrinogen.

INTRODUCTION

About half a billion years ago, multicellular animals began to appear on our planet, the distant descendants of which are modern mammals. One of the consequences of the achievements of multicellularity was an increase in the size of the organism. New large organisms needed efficient systems for the delivery of nutrients and oxygen, as well as for the removal of metabolic products.

MATERIALS AND METHODS

Unfortunately, the fluidity of a liquid medium also has a downside: what can flow can also leak out. Therefore, as soon as the liquid contents of the “circulatory” system of the ancient organism began to differ noticeably from the “sea” sea water, a new problem arose - a quick and reliable stop of bleeding, the problem of hemostasis (from the Greek haimatos – blood, stasis – stop).

RESULTS AND DISCUSSION

As organisms became more complex, their circulatory system also became more complex, and at the same time the hemostatic system also improved. In modern mammals, including humans, blood flows at high speeds and pressures. It is also a very complexly structured and relatively difficult to replenish environment. The need to protect it gradually led to the development of the familiar hemostasis, an extremely complex, multi-level system capable of quickly and effectively preventing bleeding [1]. The presence of numerous small vessels makes thrombosis a formidable problem, and blockage of just a few can lead to death: this led to the emergence of a complex system for regulating hemostasis processes. In addition to the cellular defense system, which has transformed into modern platelet hemostasis, a plasma coagulation system has emerged - a branched cascade of biochemical reactions, the result of which is the polymerization of the fibrin protein and the appearance of an ideal wound plug due to gelation of blood plasma. It is the coagulation cascade that will be the focus of this review.

But there is one problem: knowing the structure of the system does not at all mean understanding its functioning. When we are dealing with many dozens of proteins interacting in complex ways in hundreds of reactions with each other, with the walls of the vessel and with the blood cells, and all this happens in a real vessel in the presence of a fast flow of blood, then our ability to analyze such a system is limited. are called completely insufficient. This is best illustrated by the fact that our current methods for diagnosing bleeding disorders and treating them are very imperfect. It is for this reason that in recent years there has been an intense surge in the number of works devoted specifically to the problem of understanding the principles of functioning of

the coagulation system, and not just its structure. The purpose of our review is to highlight the current state of affairs in this area. In this first part of the review, the structure of the coagulation system will be considered. The second part will focus on current progress in understanding its regulation. The third part will be devoted to attempts to use this understanding for the successful diagnosis and treatment of coagulation disorders.

Let's take the coagulation scheme one step higher and move on to thrombin, the enzyme that cuts the fibrinogen molecule and converts it into fibrin. Thrombin belongs to the family of serine proteinases, ferropeptide bonds in proteins. They are distinguished from other proteinases by the presence of the functionally essential amino acid serine in the active site. Thus, thrombin is a close relative of the digestive enzymes trypsin and chymotrypsin (as well as elastase and the enzymes of complement and fibrinolysis).

All serine proteinases, including digestive ones, are synthesized in an inactive form: this is a necessary precaution, since the same chymotrypsin or trypsin can easily destroy the cell in which it was synthesized. In this form, called a zymogen (enzyme precursor), the protein is folded so that its active site is closed and inaccessible to other proteins. Zymogen does not have any activity and can remain quietly in a cell or in the blood. To activate it, it is necessary to cleave the peptide bond that holds the part of the protein that closes the active site. After this cutting, the squirrel can begin its work. Actually, the activation of serine proteinase is very similar to the conversion of fibrinogen to fibrin.

Fibrin is obtained from fibrinogen as a result of partial proteolysis of fibrinogen by thrombin. Thrombin is obtained from prothrombin through a similar process involving factor Xa. As can be seen from the diagram, this chain continues higher: factor X is activated by factor IXa, factor IX by factor XIa. This system of enzymes activating each other is, in fact, called a cascade. But somewhere it is necessary to put an end to it and figure out how the very first serine proteinase is activated?

The main “entrance” in the coagulation cascade is in the middle, just at the level of factor X. This system of reactions responsible for triggering the coagulation system is called the extrinsic coagulation pathway, or the tissue factor pathway. The main components of this pathway are two proteins: factor VIIa and tissue factor.

CONCLUSION

Blood coagulation is a vital mechanism that ensures the integrity of the vascular system in the event of damage, and also performs a number of other functions. It plays a key role in physiological and pathological conditions, and coagulation disorders are one of the leading causes of mortality in the world.

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