# Protective Characteristics of Platelets in Tuberculosis

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We demonstrated specific changes in platelet structure in different types of tuberculous process, in particular, shift in the proportion between α-granules, dense granules, different disorders in the mitochondrial and lysosomal apparatus, *etc.* The role of platelets in immune process is studied. Redistribution of α-granules in platelets finds a new interpretation in light of psycho- and neurotropic effects of their contents. Adhesion and aggregation processes and granule release from platelets are regulated by the content of serotonin and cyclic nucleotides in these cells.

**Key Words:** *tuberculosis; platelets; a-granules*

Platelets play a complex role in the body: they participate in allergic reactions, blood clotting and endothelial repair processes, *etc.* Platelets stimulate the release of granules by mast cells. The involvement of platelets into immune processes determines increasing interest to these cells.

## MATERIALS AND METHODS

The study was carried out on 30 patients with acute and chronic fibrous cavernous pulmonary tuberculosis (15 patients per group). Control group consisted of 10 healthy subjects (donors). The blood was collected from the finger, blood smears were stained by Andres' method and examined under a Photomicroscope-III (Opton). Venous blood (4-5 ml) was centrifuged and leukocyte film was fixed with 1% osmium, cut into small fragments, and after dehydration embedded in epon. The blocks were cut on an OmU2 ultratome and examined under a Tesla electron microscope at accelerating voltage of 80 kW.

## RESULTS

In patients with acute tuberculosis of the lungs platelets had clear-cut contours with rare pseudopodia. Round cells were the most incident in this condition. Platelets often formed aggregations. Adhesions between platelets and neutrophils were noted. Mainly α-granules were seen in platelets; solitary cells contained dense granules. Hyalomer and hyaloplasm were clearly seen on the preparations. Small mitochondria were located mainly at the platelet periphery.

In chronic tuberculosis the edges of platelets were clearly seen, but small pseudopodias were more incident. Platelets were more often elongated (but not round). Platelet aggregations were larger than in acute tuberculosis. Platelet-platelet and platelet-leukocyte adhesions were often seen. Numerous α-granules often formed giant cisterns. Dense granules were small, but numerous. The mitochondria were small with clear-cut cristae, their number was low. Numerous glycogen granules were mainly adjacent to giant α-granules. In contrast to small granules, giant granules had blurred contours. *Mycobacteria tuberculosis* were seen mainly along the edges of mitochondria. The detected morphological differences between tuberculosis forms were associated with some functional differences in platelets in acute and chronic forms of pulmonary tuberculosis. The acute form of the disease was associated with increased number of α-granules, while in chronic form the numbers of both α-granules and dense granules increased. α-Granules contain hydrolytic enzymes, including acid phosphatase and cathepsin [8], and calcium ions [4]. α-Granules are typical lyso-

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somes, their total volume reached 20%; hence, platelets possess a full-value lysosomal system capable of cleaving the agent cells getting inside.

Dense granules exhibited peroxidase activity [5], contained calcium ions, cAMP, ATP, ADP, catecholamines (epinephrine and norepinephrine) and biogenic amine (serotonin) [1]. High concentration of serotonin in dense granules is due to the presence of its high-molecular-weight complexes. Platelets circulating in the blood accumulate this biogenic amine possessing psycho- and neurotropic effects and modulating membrane permeability and vascular tone. Changes in the content of serotonin and cyclic nucleotides can be involved in the regulation of platelet aggregation and adhesion inhibition.

Serotonin release from platelet granules [6] is stimulated by high concentrations of thrombin. Release from the granules is realized by microtubules, microfilarment and submembrane filaments. Under conditions of platelet activation these substructures, together with calcium ions, can induce the production of thrombostenine which serves as receptor for thrombin, inducing the release and aggregation of platelets. Changes in platelet aggregation modify membrane permeability and change the state of organelles [3,7]. These data were obtained in studies of platelets in tuberculous meningitis.

Platelets contain much glycogen presenting in the form of granules [2] and participating in detoxication, transport, aggregation of platelets, *etc.* It was found that glycogen release from the granules was realized mainly in tuberculous meningitis and during acute stages of pulmonary tuberculosis.

Hence, acute and chronic forms of pulmonary tuberculosis are associated with different changes in the platelet morphology, resulting in their different functional activity.

## REFERENCES

1. J. Bach, *Immunology*, New York (1992).
2. P. Barnes, *Eur. Respir. Rev.*, **4**, 374-380 (1994).
3. B. Benacerraf and R. N. Germain, *Immunol. Rev.*, **38**, No. 4, 78-85 (1989).
4. H. Binz and H. Wigzell, *J. Immunobiol.*, **7**, No. 6, 113-118 (1987).
5. J. Bland, *J. Chem.*, **55**, No. 7, 151-158 (1998).
6. R. Bonicke, *Bull. Un. Ints. Tuberc.*, **29**, No. 1, 82-85 (1990).
7. A. Ciaramella, A. Martino, R. Cicconi, *et al.*, *Cell Death Differ.*, **7**, No. 12, 1270-1272 (2000).
8. D. A. Croix, S. Capuano, L. Simpson, *et al.*, *AIDS Res. Hum Retroviruses*, **16**, No. 17, 1895-1908 (2000).