

The Formation of a Thrombocytomorphic Body by a Human Granulocyte in Vitro

B. J. FORD

*Science Unit,
Mill Park House, 57 Westville Road,
Cardiff, Wales*

Abstract

This short account describes the release by a human polymorphonuclear granulocyte of a small, rounded body with a microscopical appearance identical to that of typical thrombocytes (platelets). It is postulated that this observation may account for some earlier suggestions that these bodies originate from leucocytes, and it is further evident that the possibility that thrombocytes may be produced from leucocytes from time to time cannot be definitively excluded.

Introduction

The thrombocyte is of immense importance in maintaining the proper functions of the mammalian vascular system, although as Biggs and MacFarlane¹ have pointed out, there has been much controversy over them in the past. It is, of course, well known that in frank thrombocytopenia clot retraction may be ineffective² and a working level of 200,000 per mm³ is accepted as a normal minimum value for the maintenance of normal haemostasis³. However Aggeler, Howard and Lucia⁴ have suggested that patients with normal vascular behaviour may have counts as low as 100,000 per mm³, whereas those with counts in excess of 300,000 may show poorly controlled haemostatic processes.

Although thrombocyte behaviour is still to a degree the subject of debate and conjecture, the origin of the particles themselves is considered to be unanimously accepted as the megakaryocyte (Biggs & MacFarlane), a view originated by Wright⁵ in 1906. Yet there was much debate before this phenomenon was universally accepted: Brockbanke⁶ in 1912 suggested there were no thrombocytes in circulating blood, but that they were a response to trauma. They have also been described as fission products of endothelial cells⁷ and of erythrocytes, a view revived as recently as 1932 by Watson⁸. The similarities between staining characteristics, specific gravity and nuclealbumin content of platelets and leucocyte plasma led Lilienfeld⁹ to postulate that platelets originated from the polymorphonuclear granulocyte, but this account was improved on substantially by Aynaud¹⁰ who was led to postulate a different mechanism.

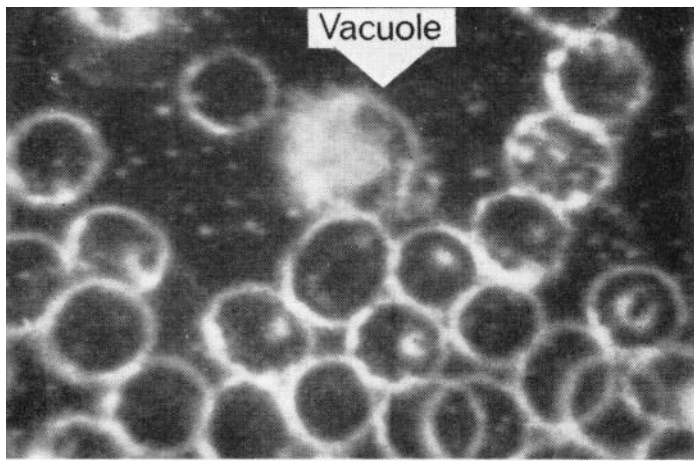
However, though Pappenheim¹¹ indicated that there was much evidence to invalidate the candidature of the leucocyte in thrombocytopoiesis, his paper did show that there tended to be fluctuating parallelism in white-cell and platelet counts.

Experimental Observations

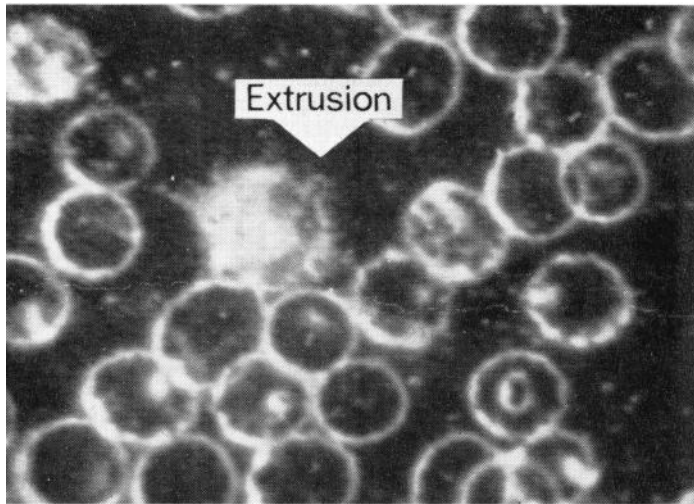
Research work on *in vitro* haemostatic mechanisms has been in progress for some years¹² and has entailed the observation of blood for prolonged period, often with a cinémicrographic facility to record events of particular interest. During 1961, in the course of these experiments, a typical polymorph was apparently seen to liberate a small platelet-like body, although the observation did not command an undue degree of attention since it had an appearance much like that of a coincidental obscuration and was additionally peripheral to the study in hand. Since this time, however, a further example has been filmed in its entirety and provides a quite unequivocal and unique record of this unexpected phenomenon. The cell concerned was sighted during routine screening of blood during a micrographic investigation; it appeared to have an appearance which was at variance with leucocytes typically observed. On a closer inspection, the disparity was seen to be due to the presence of a slightly less granular region of cytoplasm, which within minutes resolved itself as a translucent paranuclear vacuole. As ciné-filming continued, a slight protrusion was observed on the cell membrane at this point, and this extended and eventually became distinctly finger-like. Subsequently, proximal constriction occurred until the "pseudopodial" projection was rounded off and released, whence it floated away from the granulocyte in a state of pronounced Brownian agitation. Subsequently, it was observed to attach itself to the wall of a neighbouring erythrocyte. The film, which was taken at 4 frames per second, therefore shows a substantial time-lapse speed increase and enables the phenomenon to be graphically observed. Apart from short delays during the exchange of magazines in the electrical camera, the entire process is seen in entirety.

Conclusion

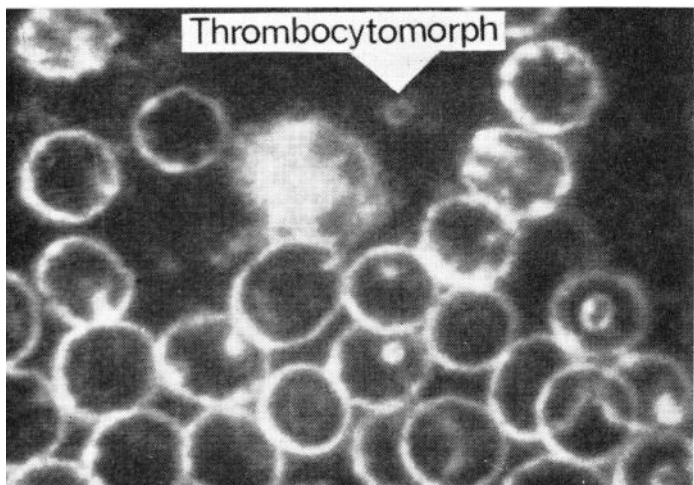
Clearly, there are many questions posed by this unprecedented observa-



1a
*Leucocyte with the
vacuole visible.*



1b
*Leucocyte with an
extrusion produced to
an almost finger-like
extent.*



1c
*The liberated
thrombocytomorph.*

Figure 1
*A series of time-lapse
direct frame
enlargements from the
cinemicrographic
record, showing the
changes in the same
cell.*

tion; cytochemical and statistical evidence would be necessary before an assertion could justifiably be made as to the exact nature of the particle released. However, it must be delineated from the earlier accounts of cytoplasmic fragmentation, since the process here described takes the form of a sequential extrusion of an unmistakable character.

Furthermore, it is clearly seen to be distinct from pseudopodial proliferation *per se*; there is no forward migration of cytoplasmic granules and indeed the clear area of the extruded vacuole is quite characteristically different from these alternative explanations.

Perhaps most interesting is an observation by Bierman¹³, who states: "the polymorphonuclear leucocyte as a source of platelet-like bodies is represented as questionable" and who includes, in a diagram of leucopoiesis, a suggestion of the mechanism described in this paper.

Thus we have an interesting record of a phenomenon which, though postulated in the literature in the past, has not previously been so recorded. In the absence of a detailed investigation it would not be possible to draw definitive conclusions but the observation must be accepted as an interesting additional datum in an increasingly complex disciplinary study.

REFERENCES

- ¹ Biggs, R. and MacFarlane, R. G., (1962). *Human Blood Coagulation and its disorders*. Blackwell, Oxon.
- ² MacFarlane, R., (1939). *A method of measuring clot retraction*, *Lancet*, **1** 1199.
- ³ Sloane, A., (1951). *J. Clin. Path.* **4** 37.
- ⁴ Aggeler, P. M., Howard, J. and Lucia, S. P., (1964). *Platelet counts and Platelet function*, *Blood*, **1** 472.
- ⁵ Wright, J., (1906). *Boston Med. and Surg. J.*, **154** 643.
- ⁶ Brockbank, E. M., (1912). *Clinical notes on blood platelets*, *Lancet*, **1** 1526.
- ⁷ Lowit, M., (1889). *Virchow Arch.*, **117** 545.
- ⁸ Watson, C. H., (1932). *The genesis of blood platelets, etc.*, *Edin. med. J.*, **39** 229.
- ⁹ Lilienfeld, L., (1892). *Arch. F. Physiol.*, **115**.
- ¹⁰ Aynaud, M., (1909). *Le Globulin des Mammifères*. Thèse de Paris.
- ¹¹ Pappenheim, A., (1902). *Berlin Klin. Wochens.*, **39** 1095.
- ¹² Ford, B. J., (1967). *The concept of "antipoint" applied to submicroscopic fibrillar structures*, *Proc. Roy. Micr. Soc.*, **3** (1) 14.
- ¹³ Bierman, H. R., (1961). *Functions of the Blood*. Ed. McFarlane, R. G. and Robb-Smith, A.H.T., Acad. Press, London and N.Y.