STUDY OF EOSINOPHILS
IN
NORMAL AND HIGH RISK NEWLY BORN BABIES

Thesis

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in Pediatrics

BY

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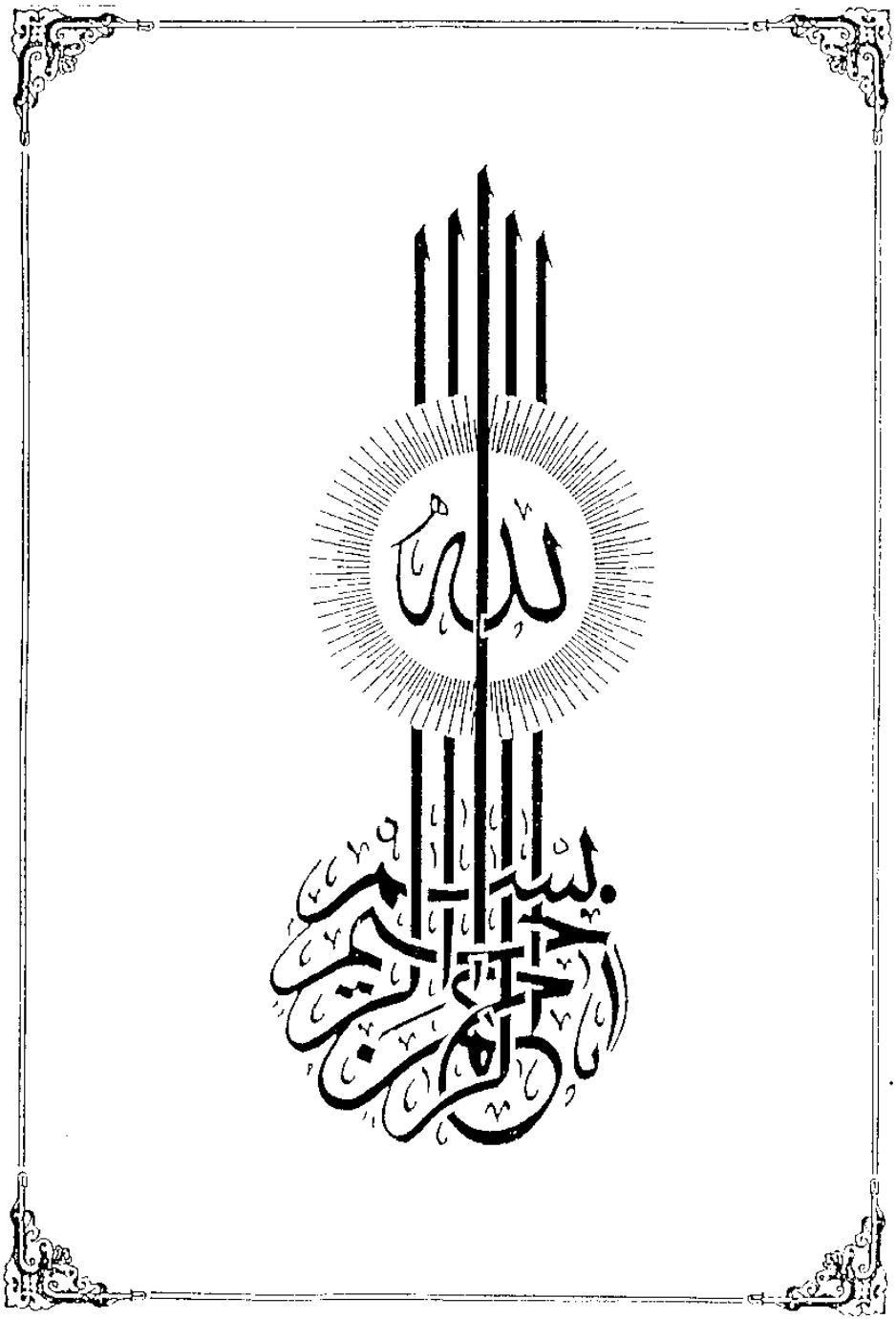

Contents

INTRODUCTION

I N T R O D U C T I O N

The eosinophil was discovered by Paul Ehrlich in 1879 (Hirsch and Hirsch, 1981). Despite this 100 years of study since Ehrlich's discovery, it was the last decade that could be considered as an entery point to the huge and often conflicting mass of observations concerning the function of this cell. All of the available information fail to point clearly to the function of this cell. Apparent contradictions stand in the way of any attempt to define consistent pattern of the eosinophil behaviour (Beeson, 1981).

The number of eosinophils in transit in the peripheral blood is exceeded several hundred-folds by the number of the eosinophils in the tissues (Rytömaa, 1960). Moreover, residence time for the eosinophil in tissues is greater than that in the blood (Foot, 1963). The predominant tissue localization of these cells suggests that the principal functions of the eosinophil are accomplished in the tissue. However, the tissue sequestration of the cells makes investigations of the function of the eosinophil difficult because of limited cell numbers and uncertainty as to the extent that the

peripheral blood eosinophil reflects the biochemical and biological characteristics of its tissue counter-part (Weller, et.al., 1981).

Thus, the eosinophil continues to be a mystery. Its behaviour and function remain a puzzling question (Beeson, 1981).

AIM OF THE WORK

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Very scanty and incomplete studies have been done in relation to the eosinophil count in normal and high-risk neonates and the changes of this count during the neonatal period.

We decided to carry out the present work intending to study the pattern of changes of absolute eosinophil count "AEC" throughout the neonatal period in normal newborns as well as in high-risk neonates including preterms, small for gestational age "SGA", newborn infants of toxaemic mothers "ITM" and newborn infants of diabetic mothers "IDM".

The correlation between absolute eosinophil count and the clinical course of those newborns will be attempted.

REVIEW OF LITERATURE

THE EOSINOPHIL

Morphology and Structure: (Fig.i)

The eosinophil is a specialized granulocyte measuring 10-15 micrometers in size i.e similar to that of the neutrophil. The nucleus, as seen in smears stained with Wright's stain, occupies a central or eccentric position. It is purplish blue in colour, with coarse chromatin and nuclear membrane but no nucleoli. The nucleus is lobulated with 2-3 lobes but it is unusual to find more than two lobes in the mature eosinophil and these lobes are larger than those seen in neutrophils. The cytoplasm is relatively plentiful, homogenous clear pink in colour with no perinuclear zone but with clear ecto and endoplasm. It contains few spherical mitochondria but appears not to contain lysozymes or alkaline phosphatase. Of the mature granulocytes; eosinphils display the most intense staining with peroxidase, the intense eosinophilic staining appears to be due to their basic protein content (Wintrobe, et al., 1981).The eosinophil is identified by virtue of its characteristic granules which are numerous, circumscribed,uniform in shape

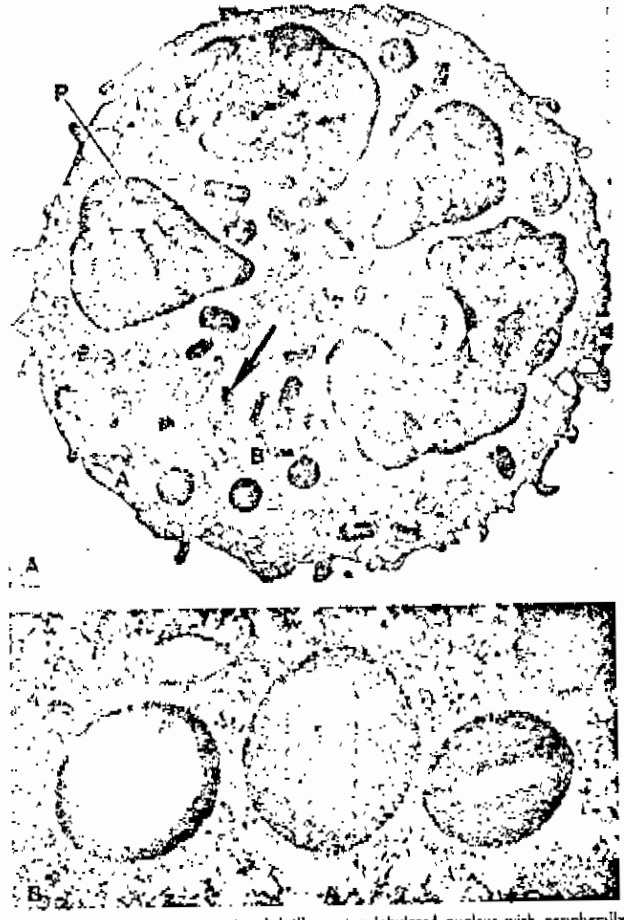
and stained red with Romanowsky stains, bright orange or yellowish-red with Wright's stain. These granules are coarse and considerably larger than those seen in the neutrophil (Wintrobe et al., 1981).The eosinophil granule appears somewhat refractile under the light microscope but when viewed by the electron microscope, consists of an electron dense core, called the crystalloid, and an electron-radiolucent matrix (Miller,et al., 1966).

Human eosinophilic granules contain:

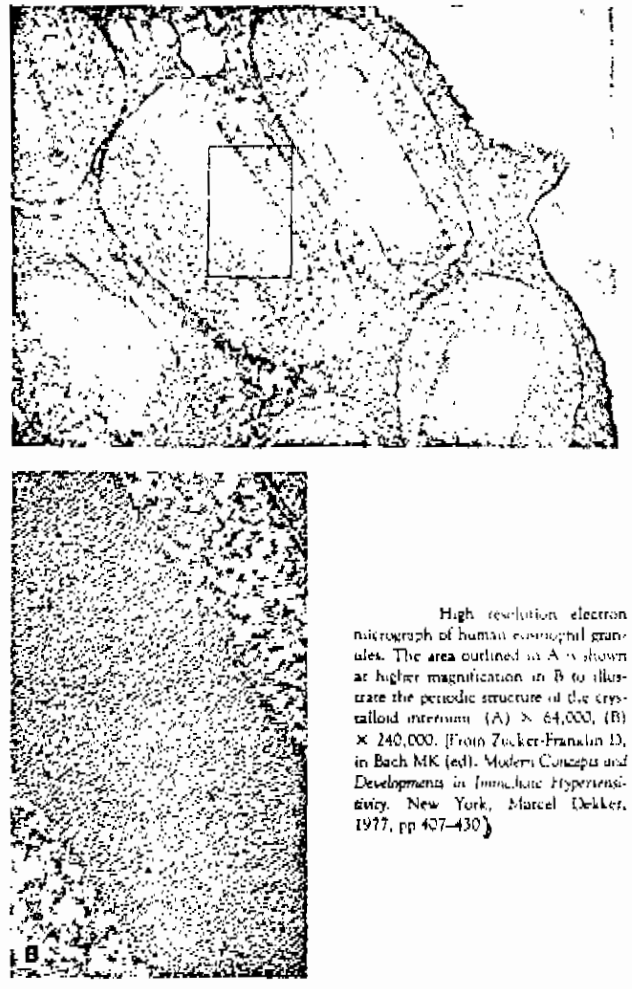
1) Several cationic proteins as the major basic protein (MBP) which is an arginine rich protein that accounts for more than 50% of the protein content of the eosinophilic granules (Gleich, et al.,1981), the eosinophil cationic protein "ECP" (Olssen, et al., 1977) and several other proteins such as the one forming Charcot-Leyden crystals (Gleich, et al., 1976).

2) Myeloperoxidase enzyme which is distinct from neutrophil myeloperoxidase both biochemically and genetically (West, et al., 1975).

3) Many other enzymes such as: aryl sulfatase B; B-glucuronidase and acid B- glycerophosphatase enzyme (West, et al., 1975).



Mature human eosinophil illustrating lobulated nucleus with peripherally distributed electron dense heterochromatin, few nuclear pores (P), and loss of the nucleolus. Note that in the mature cell the typical granule is football shaped (arrow) and the crystalline core extends parallel with its long axis. When more than one crystal has [illegible], as in granules A and B, the contour of the granule becomes distorted. The ap-



High resolution electron micrograph of human eosinophil granules. The area outlined in A is shown at higher magnification in B to illustrate the periodic structure of the crystalloid interior. (A) × 64,000, (B) × 240,000. [From Zucker-Franklin D, in Bach MK (ed). *Modern Concepts and Developments in Immediate Hypersensitivity*. New York, Marcel Dekker, 1977, pp 407–430.]

pearance of the granule matrix among different granules is seen to better advantage in B. This may reflect the differences in the type or concentration of their enzyme content. (A) × 13,000, (B) × 54,000.

Fig.(i)Mature human eosinophil.
(From Zucker-Franklin D.in Bach MK(ed):Modern Concepts and Developments in Immediate Hypersensitivity.New York:Marcel Dekker,p.407-430,1977)

The eosinophils show irregular repeated pseudopodia formation and they are at least as motile as neutrophils (Anderson, et al., 1969).

Eosinophilopoiesis:-

The production of eosinophils occurs only in the bone marrow in human beings (Wintrobe, et al., 1981).

The process of eosinophilopoiesis involves four bone marrow compartments or pools; a stem cell pool, a mitotic pool, a maturation pool and a storage pool (Mahmoud, 1981).

The stem cell pool includes a common precursor cell or a pleuripotent stem cell which is not committed to develop into a specific cell line but divides to produce the differentiated formed elements of the blood (Schofield, 1979). There is a stage of development, between the common pleuripotent stem cell and the differentiated cell,in which the cells although still primitive, are committed to one line of differentiation i.e a committed granulocyte stem cell which is specific for each cell line (Stohlman, et al., 1973).

The mitotic pool includes eosinophilic promyelocytes and myelocytes (Spry, 1971a).

The metamyelocytes and more mature forms are regarded as postmitotic stages undergoing maturation (Hudson, 1968 and Archer, 1970). Eosinophils exhibit the same maturation phenomena as neutrophils including condensation in nuclear chromatin, decrease in size and ultimate disappearance of nucleoli, reduction in the size of Golgi apparatus and formation of the characteristic granules (Boll and Kuhn, 1965 and Parwaresch, et al., 1976).Maturation of eosinophils in the bone marrow takes 3-6 days (Bellanti, 1978).

The storage pool consists of the substantial marrow reserve of mature cells which can be mobilized on demand. In the guinea pig, it was estimated that there are 300 to 400 marrow eosinophils for each eosinophil in the blood (Spry, 1971a).

Under normal conditions, eosinophil production in vivo maintains the number of circulating cells within a narrowly defined range. The importance of this regulatory function can be appreciated by recognizing the short, 3-4 hours, half life of the mature eosinophil in the peripheral blood(Bellanti, 1978). In addition, the eosinophilopoietic system