Annulate Lamellae in Erythroblasts in the Mice Splenic Colonies

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MIURA, A.B., YOSHIDA, K., YAMAGUCHI, A. and FUKUDA, M. Annulate Lamellae in Erythroblasts in the Mice Splenic Colonies. Tohoku J. exp. Med., 1978, 124 (4), 387-390 — Lethally irradiated mice received a transfusion of normal bone marrow cells from the same strain mice. The transfused colony-forming cells (stem cells) were settled in the spleen of the recipient and proliferated in it into erythroblast colonies. Some of these mice were given chloramphenicol or thiamphenicol for 7 days after marrow cell transfusion. Annulate lamellae were frequently observed exclusively in the erythroblasts of the mice received a injection of thiamphenicol. —— annulate lamellae; erythroblast; colony-forming unit in spleen; thiamphenicol

Annulate lamellae, designated by Swift (1956), have been observed in many animal and plant cells. Nevertheless, there were no reports of annulate lamellae in hematopoietic tissues including erythroblasts, except in the lymphocytes of human lymphoma (Watanabe 1977).

The purpose of this report is to describe annulate lamellae in the rapidly proliferating erythroblasts.

MATERIALS AND METHODS

8-12 week-old C57BL mice were used in all experiments. According to the method by Till and McCulloch (1961), $1 \times 10^4$ of the bone marrow cells were injected intravenously into each lethally irradiated (800 R) mouse. The mice were killed on the 7th, 9th, 11th and 14th days after marrow cell transfusion.

10 mg of chloramphenical (CAP) or thiamphenicol (TAP) a day were injected for 7 days intramuscularly into some mice from the day after marrow cell transfusion. They were sacrificed on the 9th day.

The spleens of these mice were fixed in 2.5% glutaraldehyde with subsequent fixation in 1% osmium tetroxide, dehydrated in a graded series of ethanol and embedded in Epon mixture.

Thin sections were stained with uranyl acetate and lead, and examined in a JEM 100B electron microscope.

RESULTS

In all spleens, a number of colonies of rapidly proliferating erythroblasts were recognized.

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In the erythroblasts of the TAP administered mice, annulate lamellae were frequently observed. The structural details of these cell organelles were similar to those described in other cell types. That is, they were composed of several parallel arrays of double membranes in straight or curved arrangement. The membranes were smooth surfaced and merged at intervals to form pores (Fig. 1). Transverse sections showed that the annulate lamellae were cylindrical in shape with an electron dense periphery and less dense internal portions (Fig. 2). Sometimes a dense central region appeared in them.

Although the annulate lamellae were sometimes located close to the nuclear envelope (Fig. 3), direct continuity between them was not ascertained. Nor did the annulate lamellae have any close relationship with granular endoplasmic reticulum, Golgi apparatus or mitochondria.

In contrast, the present observation has failed to find annulate lamellae in the erythroblasts of the CAP administered mice or of the mice which did not receive CAP or TAP, except for only one erythroblast of a mouse not received CAP or TAP.

**DISCUSSION**

Annulate lamellae were a unique system of cytoplasmic membranes which was first described in the Arbacia egg cytoplasm (McCulloch 1952) and so designated later by Swift (1956). They have been observed in different kinds of cell of vertebrates, invertebrates and plants under both normal and abnormal conditions. In general, they occur in rapidly differentiating or proliferating cells coincidentally with elevated protein synthesis. However, there have been no reports, to the author's knowledge, which described the presence of annulate lamellae in the erythroblast. In this study we have identified these structures in the erythroblast for the first time.

The erythroblasts in the splenic colonies were rapidly proliferating and contained numerous free ribosomes, so the appearance of annulate lamellae may have been expected. The reason why they were recognized only in the TAP administered mice remains to be known.

The significance of annulate lamellae in cell biology is poorly understood, though it has been suggested that they may be common to cells of all tissues in the early stage of differentiation (Ross 1962). It has been also suggested that the annulate lamellae are derived from the nuclear envelope and function as a nucleocytoplasmic intermediary (Swift 1956). In addition, a close spatial relationship between annulate lamellae and mitochondria (Borquist 1970), granular endoplasmic reticulum (Wischnitzer 1970), or Golgi apparatus (Maul 1970) was noted.

In the present study, the annulate lamellae were frequently observed close to the nuclear envelope, but no nuclear blebbing was recognized. Further studies are needed.

Fig. 1. Annulate lamellae in longitudinal section located close to the nucleus in the early erythroblast. × 13,000.

Fig. 2. Annulate lamellae in cross section near the cell membrane. × 27,000.

Fig. 3. Annulate lamellae in a close relation to the nuclear membrane. × 40,800.

Fig. 4. Two annulate lamellae located on both side of the Golgi apparatus. × 17,000.
required to clarify the significance and the function of annulate lamellae.

References