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Ultrastructure of the Crystalloid Structure in the Rat Oviductal Epithelium

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Introduction

Crystalloid inclusion has long been recognized by light microscopists as normal constituents of certain cell types, such as Sertoli cells and Leydig cells of the human testis, rabbit oocytes, and the nuclei of liver cells of dogs, foxes, and jackalls.[3] Moreover, the crystals of one kind or another have been reported to occur freely in the cytoplasmic matrix and in nearly all cell compartments such as the nucleus, the mitochondria, the endoplasmic reticulum, the Golgi complex and the secretory granules.[3,11]

Several investigators, on the other hand, have demonstrated the occurrence of intramitochondrial inclusion in a number of animal cell types which include both the normal and pathological tissues[1,2,4,7,8,9,11], and in plant cells.[5]

However, the occurrence of the mitochondrial crystalloid structures in the rat oviductal epithelium has not been reported up to date. The present report described the occurrence and fine structure of crystalloid structures within the mitochondria of the oviductal epithelium, especially in the ciliated cells, on the normal and hormone treated rats.

Materials and Methods

Fifteen white Wistar normal cycling rats aged 3 to 5 months were used as materials; five rats were daily injected subcutaneously with 1 μg of 17β-estradiol (Sigma Chemical Co. Ltd.) dissolved in 0.5 ml propylen glycol for ten days. Other five rats were similarly injected with 2.5mg of progesterone (Nakarai Chemical Ltd.) The remaining five were injected with 0.5 ml propylen glycol only as controls. Each oviducts were sampled within 12 hours after the last injection.

Some pieces of the oviducts were fixed with 3% glutaraldehyde and 1% osmic acid, and embedded in epoxy resin. Thin sections were stained with uranyl acetate and lead citrate and observed under an HU-12A electron microscope.

Results

The mitochondrial crystalloid structures were only observed in the cytoplasm of ciliated cells on the rat oviductal epithelium. In the control group, mitochondrial crystalloid structures were presented in the estrous and metestrous stage. Crystalloid structures were rectangular in shape and measured 0.1-0.2μm in width and 0.5-1.2 μm in length (Fig. 1). A crystalloid lattice was formed the appearance of regular alternating dense and light band with a repeat of approximately 8nm. Each dense line and light interspace measured 10 nm in width (Figs. 2, 3.). These structures were located within the mitochondria and bounded with mitochondrial double membrane (Figs. 1, 3, 4.) These crystalloid structures were classifid into two types. Type I structures was oblique to the long axis of mitochondria (Figs. 1, 2, 3, 6.). Type II structure is parallel to the long axis of the mitochondria (Figs. 1, 3, 4, 5, 7-10).

In the hormone treated group, the crystalloid structures were found much more after estradiol than after progesterone treatment in the cytoplasm of cili-

ated cells (Figs. 5-10), but no morphological differences were observed in comparison to normal group.

Discussion

In the present studies, mitochondrial crystalloid structures of the ciliated cells on the rat oviductal epithelium were about 0.1-0.2 μm in width and 0.5-1.2 μm in length, and crystalloid lattice was formed the appearance of regular alternating dense and light band with a repeat of approximately 8 nm. Each dense line and light interspace measured 10 nm in width, and these structures were located within the mitochondriae and bounded with mitochondrial double membrane.

According to the morphological features, the crystalloid structures could be distinguished into two types; Typy I and Type II which were oblique and parallel to the long axis of the mitochondria respectively. On the other hand, these structures appeared much more after estradiol than after progesterone treatment.

With regard to the occurrence of the mitochondrial inclusion, a number of reports of normal and pathologic animal tissues were reported[1,2,4,7-11], and also in the plant cells[5], but mitochondrial crystalloid structures of ciliated cell on the oviductal epithelium were not reported so far. According to these reports, these structures were named crystalline structure, intramitochondrial crystal, crystalloid inclusion, only crystalloid and hexagonal crystalline structure. The morphology of the mitochondrial crystalloid structures here described differed from the intramitochondrial crystals reported on a number of normal or pathologic tissues and plant cells.[1,2,4,5,7-11] Massover[6] reported two types of intramitochondrial crystals; one is intramitochondrial yolk-crystal and the other is hexagonal crystalloid which is bounded by a single membrane contained crystal; a narrow electron lucid zone is interposed between the limiting membrane and the crystal. The maximal length or diagonal of the observed hexagonal crystalloid has ranged from 0.5 μm up to 3.5 μm.

The crystalloid structures observed in the present study were very similar to those observed in the Meristematic cells of Pisum sativum[5] and frog oocytes.[6] However no structures of hexagonal type could be found. The crystalloid structure was bounded with mitochondrial double membrane in this study differed from the other reports.[1,2,8,9,11]

The functional significance is unknown, but it is interest that these structures appeared much more after the estradiol than after progesterone treatment in this study. In this point of view, it can be suggested that the formation of these structures may affect the hormone control. Several investigators has been reported that these structures were presented in the certain pathological changes[7,10,11], and suggested that it may be a morphological changes of mitochondria in certain functional changes.

As these structures were composed of protein substances[3,5], it can be suggested that the appearance of crystalloid structures has a certain active function in ciliogenesis process of ciliated cells rather than simply degenerative changes by pathological process.

Further studies are necessary in order to determine their significances and special functions of these structures in the ciliogenesis of ciliated cells on the oviductal epithelium.

Conclusion

Mitochondrial crystalloid structure could be observed in the ciliated cells on the normal and hormone treated rat oviductal epithelium. The crystalloid structure could be distinguished into two types: type I that was formed obliquely and type II that parallel to the long axis of the mitochondria. Crystalloid structures were rectangular in shape and measured 0.1-0.2 μm in width and 0.5-1.2μm in length. A crystalloid lattice was formed the appearance of regular alternating dense and light band with a repeat of approximately 8 nm, and bounded with mitochondrial double membrane. These structures has generally a tendency to be found at estrous and metestrous during normal cycle, and found much more after estradiol than after progesterone treatment.

Legends for Figures

Fig. 1. Type I (single arrow) and Type II (double arrow) mitochondrial crystalloid structure are seen at estrous stage, ×80,000.

Fig. 2. Type I mitochondrial crystalloid structure. Mitochondria (M) is scattered in the cytoplasm of ciliated cell Estrous stage. ×40,000.

Fig. 3. Type I (single arrow) and Type II (double arrow) mitochondrial crystalloid structures are seen at metestrous stage. M: mitochondria, N: nucleus, ×16,000.

Fig. 4. Type II mitochondrial crystalloid structures are seen. Metestrous stage. ×50,000.

Fig. 5. Type II mitochondrial crystalloid structure (double arrow) is seen after estradiol treatment. M: mitochondria, N: nucleus. ×24,000.

Fig. 6. Type I mitochondrial crystalloid structure is seen after estradiol treatment. ×20,000.

Fig. 7. Type I mitochondrial crystalloid structure is seen after estradiol treatment. N: nucleus. ×60,000.

Fig. 8. Type I mitochondrial crystalloid structure (arrow) is seen after progesterone treatment. N: nucleus. ×5,500.

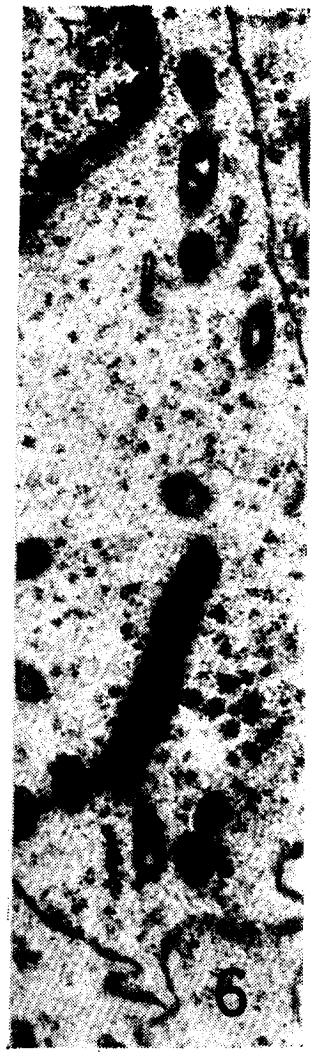
Fig. 9. Type II mitochondrial crystalloid strdcture (arrow) is eeen after progesterone treatment. ×15,000.

Fig. 10. Type II mitochondrial crystalloid structure (arrow) is seen after progesterone treatment. ×10,000.

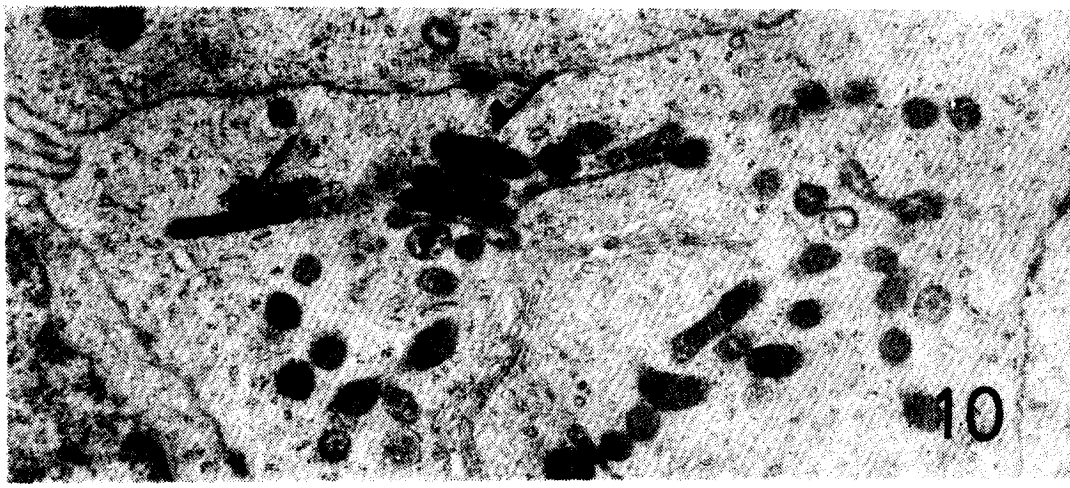

2


3
4


N




N



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Rat 卵管上皮細胞에 있어서 Crystal樣구조의 미세구조

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抄　　錄

正常 및 홀몬처리한 rat卵管上皮細胞 特히 纖毛細胞에서 mitochondrial crystalloid구조를 관찰하여 2가지 型으로 구분하였다. 第1型은 mitochondria장축에 대해 경사의 형태로, 第Ⅱ型은 평행의 형태로 출현하였다. 이들 구조는 길이 0.5～1.2μm, 폭 0.1～0.2μm이며 10nm 간격의 전자밀도가 높은선과 밝은선의 교차를 이루고 있었다. 또한 이들 구조는 正常 性週期에서는 주로 發情期 및 發情後期에, 홀몬처리시는 progesterone처리 시보다 estradiol 처리시에 多數出現하는 경향이었다. 이들 구조의 出現意義에 대해서 論하였다.