POLIOMYELITIS OF NEWBORN CHICKS
(EPIDEMIC TREMOR OF CHICKENS, AVIAN ENCEPHALOMYELITIS)

II. ELECTRON MICROSCOPIC OBSERVATIONS OF DEGENERATED NERVE CELLS

Saburo Yamagiwa
Department of Veterinary Pathology, Obihiro Zootechnical University,
Obihiro, Hokkaido

Tadayuki Yamashita
Department of Veterinary Anatomy, Obihiro Zootechnical University,
Obihiro, Hokkaido

Chitoshi Itakura
Department of Veterinary Pathology, Faculty of Agriculture,
Gifu University, Kagamigahara, Gifu

(Received for Publication January 10, 1969)

In the previous part of this series of studies, the present authors proposed a new name of the disease “poliomyelitis of newborn chicks” from the light microscopic findings of the central nervous system in 105 chicks. This article deals with the electron microscopic observations of degenerated nerve cells. Such observations have not yet been reported as to poliomyelitis of newborn chicks (epidemic tremor of chickens, avian encephalomyelitis), which may be called “chick paralysis”.

MATERIALS AND METHODS

The materials used for the present observations were collected from one chick (poultry farm K, autopsy No. 850, White Cornish ♀ × New Hampshire ♂, 18 days old, killed on May 25, 1968). This chick belonged to the poultry farm K group mentioned in the authors’ previous report. The epidemiological aspects of this group were already reported. The weakness of the legs was observed as the main symptom of this case.

Tissue specimens were collected from the spinal cord at the cervical enlargement. The specimens were fixed in 2% glutaraldehyde (4°C) for 2 hours and then stored in phosphate buffer. After one week, the stored specimens were rinsed with phosphate buffer, postfixed in OsO₄ solution, and then embedded in Epon.

OBSERVATIONS

Of the electron microscopic findings obtained, those from six nerve cells (A~F) are given in Figs. 1~15. Therefore, the special description of these cells is abbreviated.

SUMMARY OF THE FINDINGS AND CONSIDERATIONS

The most noteworthy changes in the electron microscopic findings were observed in the rough-surfaced endoplasmic reticulum in the motor nerve cell of the ventral horn of the spinal cord. In the rough-surfaced endoplasmic reticulum, dilatation and vacuolisation first appeared, and then loss of the normal structure and transfiguration to small vacuoles. These changes were most marked in the central area of the cytoplasm. On this occasion, the peripheral area of the cytoplasm showed often the features of the normal structure. In addition to the abnormality of the rough-surfaced endoplasmic reticulum, significant changes were loss of the ribosomes and decrease of free ribosomes. In the nucleus, irregular distribution of chromatin matrix was noticed. As other changes, appearance of numerous lysosomes, increase and anomaly of mitochondria, destruction of the Golgi membrane, abnormal increase of microfibrils, and appearance of microtubules were pointed out.

It is of great interest to compare such electron microscopic findings with the light microscopic features. It is obvious that the area of the motor nerve cell where is located a structure named Nissl substance is the region where there is a rough-surfaced endoplasmic reticulum. On the other hand, the abnormality of rough-surfaced endoplasmic reticulum which is observed in the central area of the cytoplasm of the motor nerve cell, is nothing but the cellular change which is named chromatolysis or central tigrolysis in light microscopy.

The significance of the changes of the other organelles could not be clarified thoroughly. It may be thought, however, that the appearance of numerous lysosomes plays an active part in the disposal of degenerated products within the nerve cell.

ACKNOWLEDGMENTS

The authors wish to express their thanks to Dr. Masanori Tajima, of the Nippon Institute for Biological Science, for his technical assistance and kind advice.

REFERENCES

新生雛の脊髄灰白質炎（Epidemic tremor of chickens；Avian encephalomyelitis）について

II. 変性神経細胞の電子顕微鏡像

山楕三郎
帯広畜産大学家畜病理学教室
山下忠幸
帯広畜産大学家畜病理学教室
板倉智敏
帯広大学農学部家畜病理学教室
(昭和44年1月10日受付)

著者らは、本研究の第1報として、もと光学顕微鏡所見を記述し、脊髄の新病名を提案した。今回は、その場合に認められる変性神経細胞の電子顕微鏡像について報告する。この種の業績は、新生雛の脊髄灰白質炎（ヒヨコ麻痺と呼称する）に関する限り、まだ学界に報ぜられていな

研究に用いた材料は、第1報において記述した、K養鶏家群に属する18日齢の雛1例（K-850、白色キキョウギ×ニューハンプシャー♀、雄、1968年5月25日産）の、脊髄頸膨大部である。この部は、臨床的には程度の異常症状を呈していた。

電子顕微鏡用組織片は、採取後2% glutaraldehydeで2時間固定（4℃）後、貼解後、貼解後に保存した。そして1週間後、貼解後液で2回洗い、その後OsO₄で2回固定を行なった。包埋にはEponを用いた。

電子顕微鏡所見として、6個の神経細胞を図示した（Figs. 1~15）。

これらの電子顕微鏡所見の中で最も注目されたものとして、まず、脊髄脳角の運動性神経細胞における、粗面小胞体の崩壊、空胞化、ついで正常構造の消失、小胞体への変形などの事実が指摘された。これらの変化は、神経細胞原形質の中心部において顕著に認められた。この場合、その神経細胞の辺緣部では、同時に障害適応の残存が認められた。これら粗面小胞体の異常化と並んでものが空胞化する重要な変化は、ribosomeの脱落と、free ribosomeの減少であった。核の変化としては、染色質顆粒の不均一分布が注目された。その他の変化としては、lysosomeの多数出現、コア体の増殖数とその変態をはじめ、Golgi膜の破損、microfibrilの異常増加、microtubuleの出現などが指摘された。

以上述べた所見を、光学顕微鏡所見と対比して考えてみると興味深い。すなわち、運動性神経細胞において、ニッスル小体、虎炎などと呼ばれる部位は、明らかに粗面小胞体の特殊地域である。これに反して、小胞体の異常を示す地域、そしてそれは細胞中心部で遭遇するものであるが、これこそが光頭顕微鏡でchromatolysisと呼ばれ重変性に欠かならない、中心性虎炎融解（central tigrolysis）という記載も少なくない。その他の細胞内小器官の変化については、その意義づけを完璧なものとすることができない。しかし、多数のlysosomeが出現していることは、変性産物処理に対して、それらが積極的な役割を果たしているものと、充分考えられる。
EXPLANATION of PLATES

PLATE I

Fig. 1. "A" cell. A motor nerve cell of the ventral horn is seen occupying the center of the micrograph. Area (A) shows the localized disappearance of rough-surfaced endoplasmic reticulum and a marked decrease in free ribosomes. Area (B) shows abnormality of rough-surfaced endoplasmic reticulum. The nucleus is almost normal; chromatin matrix is scattered homogeneously in the karyoplasm. The nucleolus is large, containing small granules of high electron density arranged in threads. ×5,773.

Fig. 2. "A" cell. The micrograph shows a part of the cytoplasm of the same nerve cell as in Fig. 1, with the nucleus in the right upper portion. Rough-surfaced endoplasmic reticulum has a normal structure. There are many cross sections of nuclear pores (Np) in the left-hand portion of the micrograph. ×23,000.

PLATE II

Fig. 3. "A" cell. This is a micrograph of higher magnification of area (B) in Fig. 1. Dilatation of rough-surfaced endoplasmic reticulum and loss of some ribosomes are seen. A slight decrease in free ribosomes is also recognized. The ground substance is low in electron density. ×23,000.

Fig. 4. "B" cell. A motor nerve cell of the ventral horn occupies most of the micrograph. Numerous dilated structures of rough-surfaced endoplasmic reticulum are seen. ×9,200.

PLATE III

Fig. 5. "B" cell. This is a micrograph of higher magnification of the area surrounding the nucleus in Fig. 4. Rough-surfaced endoplasmic reticulum is dilated markedly. Some vacuoles are present. Many cross sections of nuclear pores are seen. ×23,000.

Fig. 6. "C" cell. This micrograph shows a part of the cytoplasm of a motor nerve cell of the ventral horn. Rough-surfaced endoplasmic reticulum is irregularly and slightly dilated. ×23,000.

PLATE IV

Fig. 7. "C" cell. This shows another portion of the same cell as in Fig. 6. Rough-surfaced endoplasmic reticulum has undergone dilatation and transfiguration to vacuolisation. Loss of ribosomes and decrease in free fibrosomes are seen. ×23,000.

Fig. 8. "D" cell. This is the whole aspect of a motor nerve cell of the ventral horn. The nucleus has migrated distinctly to the peripheral area of the cell. Chromatin matrix is arranged irregularly. Granular chromatin clings to the nuclear membrane. (In the normal nucleus, chromatin matrix is arranged almost homogeneously in the karyoplasm, as shown in Fig. 1.) In the cytoplasm, flattened rough-surfaced endoplasmic reticulum and free ribosomes are seen. Below the nucleus, marked vacuolisation of rough-surfaced endoplasmic reticulum is observed. ×6,900.

PLATE V

Fig. 9. "D" cell. This is a micrograph of higher magnification of the lower part of the cytoplasm and the nucleus in Fig. 8. Vacuole-like dilatation of rough-surfaced endoplasmic reticulum, loss of ribosomes, and decrease of free ribosomes are seen. The cytoplasmic ground substance is low in electron density. The Golgi apparatus (G) in this area shows marked destruction of the membrane and a decrease in vesicles. ×23,000.

Fig. 10. "D" cell. This is a higher-power magnification of the upper right cytoplasmic ground substance of the nucleus (N) in Fig. 8. Flattened, rough-surfaced endoplasmic reticulum (Rer) and numerous free ribosomes (R) are seen. A few mitochondria are also observed.
Ribosomes show the morphology of polysome and an obviously rosette-like arrangement. The Golgi apparatus (G) has developed well. Lysosome granules have been formed in a part of the Golgi membrane. Multivesicular bodies (Mv) and microfibrils (Mf) are in an area contiguous to the Golgi apparatus. ×23,000.

PLATE VI

Fig. 11. "E" cell. This micrograph presents a part of the cytoplasm of a motor nerve cell of the ventral horn. In the peripheral region (P), there is a small area where flattened, rough-surfaced endoplasmic reticulum is seen. In the central region (C), rough-surfaced endoplasmic reticulum has disappeared, and numerous small vacuoles, degenerated mitochondria, and a few microtubules have appeared. A Golgi apparatus (G) is seen between regions P and C. ×6,900.

Fig. 12. "E" cell. This micrograph is a higher-power magnification of the central region (C) of the same cytoplasm as that in Fig. 11. Rough-surfaced endoplasmic reticulum has disappeared completely. A marked decrease in polysomes is seen. There are many mitochondria, most of which show formation of vacuoles, appearance of myelin-like structure, decrease and eventual disappearance of cristae, thinning of mitochondrial matrix, and swelling and projection of the limiting membrane. Moreover, abnormally increased microfibrils (Mf) and microtubules (Mt) are noticed. Lysosomes in this cell are relatively few. The cytoplasmic ground substance has become low in electron density. ×23,000.

PLATE VII

Fig. 13. "E" cell. This micrograph is a higher-power magnification of the peripheral region (P) of the same cytoplasm as that in Fig. 11. There are no particular changes in the cellular structure. A Golgi apparatus is developed between regions P and C. ×23,000.

Fig. 14. "F" cell. This micrograph shows a part of a motor nerve cell of the ventral horn. The feature presented resembles the changes of E cell (Figs. 11~13). Namely, rough-surfaced endoplasmic reticulum remains in the peripheral region of the cytoplasm, but has disappeared from the central region. Different from the E cell, the F cell contains many lysosomes. ×6,900.

PLATE VIII

Fig. 15. "F" cell. This micrograph is a higher-power magnification of the boundary region between the peripheral and the central regions of the same cytoplasm as that in Fig. 14. Lysosomes (Ly) of various shapes are seen. They have an inner structure with myelin and vacuoles. Fairly numerous dense bodies (D) are present. The dense body is a kind of lysosome, contains granules of abnormally high electron density, and has one layer of limiting membrane. ×25,000.