HISTOPATHOLOGICAL STUDIES ON BONE
DYSPLASIA OF CHICKENS

II. HISTOPATHOLOGY OF THE PARATHYROID GLAND

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The present authors have previously reported the histopathological features of the bone tissue in bone dysplasia of chickens\(^1\). This paper describes the histopathological pictures of the parathyroid gland in the same cases as mentioned in the previous report.

MATERIALS AND METHODS

The parathyroid gland was collected from twenty of 25 chickens brought in from a poultry farm where broiler chickens were reared, and used for this investigation. Five of the 20 chickens had no significant lesions in the bone tissue. They were hybrids, White Cornish ♂×White Rock ♀, and killed for autopsy.

The parathyroid gland was fixed in 10% formalin solution after macroscopical examination. The fixed material was embedded in paraffin. Most tissue sections were stained with hematoxylin and eosin. Some sections were subjected to Gomori’s method of Bielschowsky’s silver impregnation for argyrophile fibers.

RESULTS

A. Description of Cases

1. Findings of 5 cases with no lesions in the bone tissue

Autopsy No. 883. Male. 36 days old.
Roundish nests composed of closely arranged parenchymal cells were present compactly in all regions. Some of them were tubular in shape. Vacant spaces were rarely formed between the nest and the interstitial connective tissue. No proliferation was observed in argyrophile fibers.

Autopsy No. 884. Female. 36 days old. Size of parathyroid gland: 3×3×2 mm for the left and 3×2×2 mm for the right gland.
Roundish nests composed of closely arranged parenchymal cells were present compactly in all regions. Some of them took the shape of short cord. On this occasion, small amounts of amorphous substance stained poorly with eosin was observed within vacant spaces formed in the peripheral areas of the parenchymal cell cord.

Autopsy No. 892. Female. 56 days old. Size of parathyroid gland: $4 \times 3 \times 3$ mm for the left gland.

The findings of this case were almost the same as those of autopsy case No. 884.

Autopsy No. 893. Male. 56 days old. Size of parathyroid gland: $4 \times 3 \times 3$ mm for the left gland.

A large number of nests composed of parenchymal cells were present. These parenchymal cells tended to be arranged in such manner as to form a cord. In the peripheral areas of the parenchymal cell cord there were small amounts of amorphous substance stained poorly with eosin. Karyopyknosis was observed in parenchymal cells rather frequently.

Autopsy No. 888. Male. 81 days old. Size of parathyroid gland: $4 \times 3 \times 3$ mm for the left gland.

There were a large number of nests composed of closely arranged parenchymal cells. In the peripheral region of the gland, occasionally parenchymal cells were arranged to form a cord.

2. Findings of 15 cases with lesions in the bone tissue

Autopsy No. 882. Female. 36 days old.

In every region, parenchymal cells exhibited such arrangement as to form winding cords. In the peripheral areas of parenchymal-cell cord, distinct vacant spaces were present, containing small amounts of amorphous substance stained poorly with eosin. Karyopyknosis was seen in parenchymal cells here and there.

Autopsy No. 889. Male. 56 days old. Size of parathyroid gland: $4 \times 3 \times 3$ mm for the right gland.

The findings of this case (Fig. 1) were almost the same as those of autopsy case No. 882.

Autopsy No. 891. Female. 56 days old. Size of parathyroid gland: $5 \times 4 \times 4$ mm for the right gland.

Parenchymal cells showed a close arrangement, forming nests in almost every region. In the peripheral region of the gland, they were arranged in such manner as to form a cord. In the peripheral areas of the parenchymal-cell cord, conspicuous vacant spaces appeared and contained small amounts of amorphous substance stained poorly with eosin. Karyopyknosis was observed in parenchymal cells here and there.

Autopsy No. 873. Male. 68 days old. Size of parathyroid gland: $7 \times 5 \times 4$ mm for the left gland.

Parenchymal cells exhibited such arrangement as to form a short cord in every region. Karyopyknosis was often observed in parenchymal cells. Histiocytic cells with a pale nucleus increased in number within vacant spaces which lay in the peripheral areas of the parenchymal-cell cord. Such histiocytic cells also increased in number among nests of parenchymal cells and in the interstitial connective tissue in which there were somewhat large blood vessels. Therefore, it seem that every region was rich in cellular element. Argyrophilic fibers formed a network in some regions where histiocytic cells increased in number. Both left and right parathyroid glands revealed the same changes (Figs. 3 and 4).

Autopsy No. 874. Female. 68 days old. Size of parathyroid gland $8 \times 6 \times 4$ mm for the left and $7 \times 6 \times 6$ mm for the right gland.

Parenchymal cells showed arrangement as to form a winding cord. Vacant spaces were clearly present in the peripheral areas of the parenchymal-cell cord. Karyopyknosis was rarely recognized in parenchymal cells. Both left and right parathyroid
glands gave the same findings.

Autopsy No. 875. Female. 68 days old. Size of parathyroid gland: $6 \times 5 \times 4$ mm for the left and $5 \times 5 \times 4$ mm for the right gland.

Parenchymal cells exhibited a winding cord-forming arrangement conspicuously in almost every region. Karyopyknosis was seen in parenchymal cells here and there. Small amounts of amorphous substance stained poorly with eosin were contained in the peripheral areas of nests consisting of closely arranged parenchymal cells. Both left and right parathyroid glands presented the same findings.

Autopsy No. 886. Male. 81 days old. Size of parathyroid gland: $4 \times 4 \times 3$ mm for the right gland.

In the peripheral region of the gland, parenchymal cells exhibited a winding cord-forming arrangement. In the peripheral areas of such cords, vacant spaces were clearly present. Karyopyknosis was rarely recognized in parenchymal cells. A network of argyrophilic fibers was formed in the interstitial connective tissue, but was not dense.

Autopsy No. 887. Male. 81 days old. Size of parathyroid gland: $5 \times 4 \times 4$ mm for the right gland.

In every region, parenchymal cells exhibited a winding cord-forming arrangement. In the peripheral areas of such cords, vacant spaces were formed and contained large amounts of amorphous substance stained poorly with eosin. Karyopyknosis was rarely observed in parenchymal cells.

Autopsy No. 877. Male. 95 days old.

A winding cord-forming arrangement of parenchymal cells was not so clear. Vacant spaces were not conspicuous either in the peripheral areas of masses of parenchymal cells. Karyopyknosis was seen in parenchymal cells here and there. Both left and right parathyroid glands presented the same findings.

Autopsy No. 879. Female. 95 days old. Size of parathyroid gland: $8 \times 7 \times 5$ mm for the left gland.

In the peripheral region of the gland, parenchymal cells exhibited conspicuously a winding cord-forming arrangement. In the peripheral areas of the cell cord, vacant spaces were also clearly formed, containing a little amorphous substance stained poorly with eosin. Karyopyknosis was distinct in parenchymal cells in some regions (Fig. 2). Both left and right parathyroid glands gave the same findings.

Autopsy No. 880. Female. 95 days old.

In every region, parenchymal cells exhibited conspicuously a winding cord-forming arrangement. In the peripheral areas of the cell cord, vacant spaces were clearly formed. Karyopyknosis was rarely observed in parenchymal cells. A network of argyrophilic fibers was not so dense in the interstitial connective tissue. Both left and right parathyroid glands showed the same findings.

Autopsy No. 860. Female. 120 days old. Size of parathyroid gland: $5 \times 4 \times 4$ mm for the left gland.

In every region, parenchymal cells exhibited conspicuously a winding cord-forming arrangement. In the peripheral areas of the cell cord, vacant spaces were clearly formed, containing a little amorphous substance stained poorly with eosin. Karyopyknosis was rarely recognized in parenchymal cells. No proliferation of argyrophilic fibers was observed in the interstitial connective tissue. Both left and right parathyroid glands gave the same findings.

Autopsy No. 861. Female. 120 days old. Size of parathyroid gland: $6 \times 6 \times 5$ mm for the left and $6 \times 5 \times 5$ mm for the right gland.
Table 1. Relationship between Age of Bird and Severity of Histological Changes in Bone and Parathyroid Gland

<table>
<thead>
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<th>Degree of histological changes</th>
<th>Bone</th>
<th>36</th>
<th>56</th>
<th>68</th>
<th>81</th>
<th>95</th>
<th>120</th>
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<td>No change</td>
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<td>1</td>
<td></td>
<td>1</td>
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<td>3</td>
<td>1</td>
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</tbody>
</table>

* No. of birds.

In the peripheral region of the left gland, parenchymal cells exhibited a winding cord-forming arrangement. The cellular configuration tended to be as close to the central part as possible. In every region of the right gland, parenchymal cells exhibited a winding cord-forming arrangement conspicuously. In the peripheral areas of the cell cord, vacant spaces were formed clearly.

Autopsy No. 862. Female. 120 days old.

In every region of the gland, parenchymal cells exhibited a winding cord-forming arrangement conspicuously. In the peripheral areas of the cell cord, vacant spaces were formed clearly. Karyopyknosis was rarely recognized in parenchymal cells. Both left and right parathyroid glands presented the same findings.

Autopsy No. 863. Female. 120 days old. Size of parathyroid gland: 7×6×4 mm for the left and 7×7×6 mm for the right gland.

Both left and right parathyroid glands gave almost the same findings as those of autopsy case No. 862. There was a coarse network of argyrophile fibers in the interstitial connective tissue.

B. Summary of the Findings

Macroscopically, the parathyroid gland showed enlargement in almost all the 15 cases affected with bone dysplasia.

As common histological changes of the parathyroid gland, the following three ones were revealed: (1) Masses of parenchymal cells surrounded by slender interstitial connective tissue lost the close or tubular nest-like arrangement. They were generally lengthened, and exhibited a winding cord-forming arrangement. (2) Vacant spaces were present in the peripheral areas of the parenchymal cell cord. (3) These vacant spaces contained small amounts of amorphous substance stained poorly with eosin. The same findings as mentioned above were obtained from one case which had no lesions in the bone tissue. Such amorphous substance as mentioned above was present also in an area where parenchymal cells exhibited a close or tubular nest-like arrangement.

The relationship between the age of a bird and the severity of histological changes in the bone tissue and parathyroid gland of the bird is presented in Table 1.

DISCUSSION AND SUMMARY

Postmortem examination of 18 chickens revealed the enlargement of the parathyroid gland, which was also confirmed by actual measurement. No enlargement of the gland was observed in 2 chickens (56 and 81 days old, respectively), in which histological changes in the bone and the parathyroid gland were judged to be low in degree of
severity.

It may not always be right to express the severity of such histological changes vaguely by the term of “low or high in degree”, without taking the progressing degree of histological alterations into consideration. For instance, autopsy case No. 873 presented apparently different histological changes of the parathyroid gland from those of any other case that were high in degree. In other words, it showed continuous histological alternations.

At any rate, it seems to be unquestionable that cases with the histological change of high degree of both bone and parathyroid gland may be found more frequently among older chickens (Table I). In one chicken (56 days old) with no lesions in the bone tissue, histological changes were present in the parathyroid gland, although they were of low degree. How is such result interpreted? This result seems to be of no great significance when the relationship between the histological structure and the function of the bone and parathyroid gland is considered. Namely, it is considered that the three histological changes found out by the present authors represent an increase in the function of the parathyroid gland. Therefore, it does not always follow that such changes as these are induced only in chickens affected with bone dysplasia in which the function of the parathyroid gland is necessarily required to increase. Needless to say, there is an indivisible relationship between the development of bone tissue and the increase in the function of the parathyroid gland.

CONCLUSION

Studies were made on histological changes in the parathyroid glands of chickens affected with bone dysplasia, or abnormal development of the diaphyseal and epiphyseal osteogenious tissue, which had previously been reported by the present authors. Consequently, the histological features revealed by the parathyroid gland were regarded as manifestation of an increase in the function of this gland.

REFERENCE

鶏骨の Dysplasia について

II. 上皮小体の病理組織像

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著者らは、先に、本研究の第1報として、骨組織の病理像（全身性骨体（骨幹）性ならびに骨端性骨組織の異常増殖）を報告したが、今回は、前報と同一の症例における上皮小体について、その組織像を検討した。

研究に用いられた材料は、第1報に該当し、骨変化を示した17例のうち、上皮小体を採取し得た15例と、骨変化を欠いていたため第1報から除かれた8例のうちの5例、合わせて20例の上皮小体より成る。

剖検時、骨変化を示した15例では、大部分のものにおいて、上皮小体の腫大が認められた。

上皮小体の組織像としては、次に示す三変化が共通的なものであった。①細帯状間質結合組織に取り囲まれ、密實性ないし管腔状に配列した、類円形の実質細胞帯は、細長くなり、実質細胞は短曲しながら索状配列を示す。②索状に配列した実質細胞の周囲に、空隙部が形成される。③この空隙部内に、エオジン染色の繊状物質が認められる。

これらの変化は、骨変化を欠いていた5例のうち、1例においても認められた。

以上、上皮小体が呈した組織像は、明らかに機能増強を示しているものと判断された。
EXPLANATION OF PLATES

PLATE I

Fig. 1. In all fields of microscope, parenchymal cells exhibit a winding cord-forming arrangement. Between parenchymal-cell cords and slender interstitial connective tissue there are formed vacant spaces containing small amounts of amorphous substance stained poorly with eosin. This substance often looks like a protoplasmic process in the superficial areas of parenchymal-cell cords (see Figs. 2 and 3). Autopsy No. 889. Male. 56 days old. Hematoxylin and eosin staining. ×370.

Fig. 2. This microphotograph is a high-power magnification of a picture. The findings of its low-power magnification were almost the same as that shown in Fig. 1. Note changes in a parenchymal-cell cord running across the central portion of this microphotograph. Namely, the cytoplasm of parenchymal cells has been stained with eosin homogeneously and a little deeply. The nucleus is atrophic and pyknotic. Vacant spaces formed in the peripheral areas of the parenchymal-cell cord often contain small amounts of amorphous substance (arrows) stained poorly with eosin. Autopsy No. 879. Female. 95 days old. Hematoxylin and eosin staining. ×780.

PLATE II

Fig. 3. A large number of vacant spaces are seen in the peripheral areas of cords formed by parenchymal cells. They are not always distinct (see Fig. 1), since they are occupied by histiocytic cells which have increased in number mainly in the interstitial connective tissue. Autopsy No. 873. Male. 68 days old. Hematoxylin and eosin staining. ×370.

Fig. 4. This microphotograph shows a region almost the same as presented in Fig. 3. Vacant spaces lie in the peripheral areas of masses of parenchymal cell, but have decreased in number. On the contrary, a marked proliferation of argyrophil fibers is seen mainly in the interstitial connective tissue. Autopsy No. 873. Male. 68 days old. Impregnation method. ×183.