The Formation of Erosions of the Gizzard Lining in the Young Chick

ALBERT I. LANSING, DAVID MILLER, AND HARRY W. TITUS
Poultry Nutrition Laboratory, Bureau of Animal Industry, National Agricultural Research Center, Beltsville, Maryland
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Gizzard erosion in young chicks has been described by Dam (1934, 1935), Almquist and Stokstad (1935), and Bird and co-workers (1936). Dam (1935), observed it in young chicks fed a diet deficient in vitamin K which caused hemorrhages under the skin and in the various tissues of the body. Several workers, including Almquist (1938) and Bird and co-workers (1938), have suggested that the condition is the result of one or more nutritional deficiencies. The former ascribed curative action to bile acids and the latter reported a beneficial effect as a result of feeding chondroitin sulphuric acid.

While making routine examinations of the alimentary tracts of dressed chickens, workers in the Poultry Nutrition Laboratory at the Agricultural Research Center, Beltsville, Maryland, observed several gizzards with eroded linings. To obtain information on the incidence of gizzard erosion, the gizzards of all chickens that died or were killed for experimental purposes at the Poultry Nutrition Laboratory during a period of several months were examined. The incidence at different ages from hatching to nearly two years was found to be much higher than had been anticipated and was very high in chicks one to two days old.

A review of the literature on gizzard erosions revealed that no study of their formation had been reported. Accordingly, a study of the formation of gizzard erosions was undertaken. This paper reports the results of this study and the conclusions drawn from it and from gross observations made on approximately 7,000 chicks from a few hours to a few weeks old.

MATERIALS AND METHODS

In the study of the formation of gizzard erosions, 600 unfed chicks from one to two days old were used. These chicks were from eggs laid by Rhode Island Red pullets which were being fed a supposedly adequate diet. Previous experience with this diet had shown that it was capable of supporting egg production at a rate of 200 or more eggs per bird per year and that when the fertile eggs were incubated about 92 percent hatched.

The gizzards of all the chicks were examined for macroscopic evidence of abnormality. Approximately 12 normal gizzards and 30 showing evidence of abnormality were prepared for microscopic purposes at the Poultry Nutrition Laboratory during a period of several months were examined. The incidence at different ages from hatching to nearly two years was found to be much higher than had been anticipated and was very high in chicks one to two days old.

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The gizzards of all the chicks were examined for macroscopic evidence of abnormality. Approximately 12 normal gizzards and 30 showing evidence of abnormality were prepared for microscopic study. These gizzards were promptly fixed in Bouin's solution after their removal, dehydrated in alcohol, cleared in xylol, and imbedded in paraffin in the usual manner. Sections were cut at 10 micra and stained with Mayer's hemalum. Several sections were counterstained with eosin, but all sections, of which photomicrographs are given in this paper, were stained only with the hemalum.

All the other chicks, which were observed

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The abnormal condition of the gizzards might be compared.

GROSS OBSERVATIONS

Of the 600 chicks fully 75 percent had gizzards which were not normal. Three types of abnormality were observed. The first was characterized by the presence in the gizzard lining of reddish-brown areas of various shapes and sizes. In the second type there were areas where the discolored lining was separated from the glandular erosion. Approximately 45 percent of all the abnormal gizzards were of this type. Several cases of gizzard erosion of different degrees of severity are shown in Figure 1. Usually the characteristic lesions of gizzard erosion were found in the region of the junction of the proventriculus and gizzard and in the two distal areas where the musculature is thinnest.

Three important observations from the standpoint of the mode of formation of gizzard erosion were made. First, there...
was a very low incidence of the second and third types of abnormal gizzards—particularly of the third type—in the chicks which were observed during the first 24 hours after hatching. Second, the incidence of the third type increased during the next 24 hours and, third, in the older chicks the further development of the condition was influenced by the diet they received.

MICROSCOPIC OBSERVATIONS

Normal gizzards. The fixed and stained linings of normal gizzards of chicks (one to two days old) were found to be relatively translucent and thin and to have rough, irregular attrition surfaces. There was an appreciable quantity of cellular débris, in various stages of decomposition, scattered throughout the lining. The cells from which this débris originated appeared to have come from the epithelial lining of the gland tips. In general the long, simple tubular glands were uniform in size, shape, and distribution, but those under a trough of a corrugation in the lining were considerably shortened (see Fig. 2). The glands were lined with "low cuboidal epithelium" (Calhoun, 1933), but the epithelial cells at the bases of the crypts were more strictly cuboidal than those at the tips. The latter were long and tapered and contained considerably more cytoplasm than the former. For a more complete description of the microscopic anatomy of the normal gizzard the reader is referred to the papers of Cazin (1886) and Calhoun (1933).

Abnormal gizzards. In sections cut perpendicular to the attrition surface of the
Blood cells escaping from the glands: Section of the gizzard of a chick (about one day old), cut perpendicularly to lining and stained with Mayer's hemalum. A stream of blood cells from a gland tip is shown. Photomicrograph, 675x.

lining of abnormal gizzards, many erythrocytes and a few polymorphonuclear blood cells were found in the secreted lining and in the glands of the affected areas (see Fig. 3). In sections cut through slightly hemorrhagic areas the blood cells were dispersed in the secretion of the glands. In severely affected areas the glands apparently had ceased to function and there was little or no secretion in the crypts or above the glands. In such cases the blood cells occurred in clumps. In the hemorrhagic area erythrocytes were observed within and outside the gland tips and between the epithelial cells of the tips, thus indicating their passage through the epithelium of the glands. Blood cells were found throughout the tunica propria and occasionally in the crypts of the glands (see Fig. 4). Erythrocytes were also found in the submucosa in the vicinity of the capillaries and in many cases it appeared that they must have passed through the walls of the capillaries.

The tips of the glands in hemorrhagic areas were generally swollen and the normal arrangement of the glands was distorted. The glands were curved, twisted, and slightly shortened. The epithelial lining of the glands showed indications of degeneration. The epithelial cells were loosely arranged (Fig. 5) and resembled those found during the early development of the glands in the embryos. In sections cut from affected gizzards of week-old chicks,

Fig. 4. Blood cells escaping from the glands: Section of the gizzard of a chick (about one day old), cut perpendicularly to lining and stained with Mayer's hemalum. A stream of blood cells from a gland tip is shown. Photomicrograph, 675x.

Fig. 5. Showing lack of differentiation in the glandular layer. Section of the gizzard of chick (about one day old), cut perpendicularly to lining and stained with Mayer's hemalum. Infiltration of blood cells into the lining, presence of blood cells in mucosa, and lack of differentiation in the glandular layer. Photomicrograph, 150x.

Unpublished observations of the senior author.
the anaplasia was more pronounced (see Fig. 6); however, the epithelial cells nearer the bases of the crypts (see Fig. 7) retained their regularity of arrangement but had very little cytoplasm and in general appeared to have shrunk. There was very little connective tissue in the glands.

No microorganisms were observed in any of the preparations.

**DISCUSSION**

The presence, in every abnormal gizzard examined, of blood cells in the secreted lining or of blood clots between the lining and the glandular layer is evidence that hemorrhage, either slight or pronounced, is an immediate cause of gizzard erosion. Other evidence is supplied by Jungherr's (1935) report on the diseases of brooder chicks in which reference is made to "old bloody spots" and "dry bloody ulcers" which were found in the gizzard lining. Crandall and co-workers (1939) apparently observed a connection between gizzard erosions and hemorrhage, because they stated that "it is conceivable that vitamin K may decrease the extent of gizzard erosion merely by preventing hemorrhage."

According to the writers' findings it may be assumed that gizzard erosions are formed in the following ways:

At one or more places there is a seepage of blood into the secretion from which the lining is formed, and the lining is thus weakened in these areas and loses some of
its cohesion. If the passage of blood into the secretion stops at this stage, the subsequent secretion yields a normal layer of lining under the affected area. In the areas where the lining has been materially weakened the muscular activity of the gizzard leads to the formation of cracks and eventually these areas slough and leave pits or eroded places. If further seepage of blood does not occur, the lining is gradually built up and eventually becomes normal in appearance. However, two weeks or more may be required because new lining is formed at a relatively slow rate.1

At times the initial seepage of blood may be followed by pronounced hemorrhages and the formation of blood clots between the weakened lining and the glandular layer. The affected lining now lacks the backing or support of the glandular layer and relatively large fissures and holes are promptly formed in the lining. Apparently, when there are pronounced hemorrhages, the secreting activity of the glands is markedly reduced or even stopped. In any case new lining is not formed and large eroded areas appear. If, however, a suitable diet is fed, the hemorrhages may stop entirely and after four weeks or more lining of normal appearance may be formed. It is obvious that in some cases the effectiveness of a diet in curing gizzard erosions cannot be determined until after the diet has been fed for several weeks.

**SUMMARY AND CONCLUSIONS**

Gross examinations were made of 600 gizzards. Microscopic preparations of 12 normal and 30 abnormal gizzards of chicks one to two days old were studied. Subsequent observations were made on approximately 7,000 chicks from a few hours to a few weeks old.

The microscopic examination of the abnormal gizzards revealed:

1. **Infiltration of blood cells from the submucosal capillaries into the glandular layer and subsequent mixing of the blood cells with the secretion which eventually "solidifies" and becomes the gizzard lining.**

2. A large number of cases in which there were pronounced hemorrhages from the glandular layer and accumulations of blood between the lining and the glandular layer.

3. Anaplasia of the epithelial cells of the glands.

4. Reduction in quantity of cytoplasm in the epithelial cells near the bases of the crypts.

It is concluded that hemorrhages from the glandular layer, but originating from the capillaries in the submucosa, are the immediate cause of gizzard erosions.

**LITERATURE CITED**


