Histopathology of Purulent Arthritis of Chickens

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Abstract. Of 101 broiler chickens showing leg weakness, thirty-six were affected with purulent arthritis. Lesions of the condition varied from mild to severe, with the hock joint involved most frequently. Purulent arthritis was associated with bursitis, tenosynovitis and pyogenic osteomyelitis. Lesions suggesting a bacterial infection occurred in the visceral organs of most of the cases. Hence, purulent arthritis was regarded as a part of bacterial septicemia. Pathogenetically, the relationship between purulent arthritis and pyogenic osteomyelitis was considered to be important. That disorder may probably constitute a significant proportion of the cases of leg weakness in chickens seen in Japan.

Recently, leg weakness in young chickens has become a serious problem in Japan. The term leg weakness is a symptomatic word describing a condition resulting from several causes. It is assumed that purulent arthritis may constitute a significant proportion of the cases of leg weakness. In the present study the arthritis was found in 36 (36%) of 101 chickens showing leg weakness. In turkeys bacterial arthritis with osteomyelitis has been detected in 85 (57%) of 149 birds affected with leg weakness [7].

On purulent arthritis of fowls etiological studies have been reported frequently, but morphological investigations are scarce [1, 6–8]. This paper describes the pathology of spontaneous purulent arthritis in chickens and its pathogenesis.

Materials and Methods

One hundred and one chicken cases diagnosed clinically or grossly as suffering from leg weakness were submitted to the Department of Veterinary Pathology at the authors’ University over a period from June, 1970 to October, 1973. In histopathological examination 36 of these were found to be affected with purulent arthritis. The 36 birds were used as materials for this study.

All the birds were of broiler type. They ranged from 28 to 178 days in age. All of them, except one which was 178 days of age, were under 100 days of age. About half of them were under 65 days of age. Of the 36 birds, 20 were male, 12 female, and 4 unknown; 5 were dead and 31 killed. Purulent arthritis appeared to have occurred most frequently during the growing period (40 to 60 days of age). The morbidity ranged from 3 to 18% in each affected chicken flock. It was about 5% in most flocks. In addition, Staphylococcus aureus was isolated from some visceral organs and joints of 4 birds which had been examined bacteriologically in this study.

After a complete postmortem examination, the following procedures were employed for histological examination: 10% formalin fixation, electric decalcification, celloidin (only for bone tissue) and paraffin embedding, and hematoxylin and eosin staining. The bone tissue sections examined had been cut from both entire legs of each bird in the following manner: longitudinal sections through joints (hip, knee, hock, metatarsophalangeal and interphalangeal), including the distal and proximal ends of each bone, and cross sections through the middle portion of the diaphysis of each bone.
contained the surrounding tissues, skeletal muscles, bursae, tendinous sheaths and tendons. The visceral organs examined were the spleen, liver, heart, lung and kidney.

Results

1. Gross pathology

The affected joints were swollen in varying degrees, some showing fluctuation on palpation. Within the articular cavity there was an increase of synovial fluid which was turbid and yellowish in color, pus-like or cheese-like. Occasionally, the lesions spread over the adjacent bursae or tendinous sheaths. When the hock joint was involved, the leg bone below it was frequently bent or twisted. Small abscesses were observed rarely on the cut surface of the metaphyseal bone marrow. There were commonly a slight swelling of the liver and kidney, congestion of the lung, and an increase in mucus in the trachea and larynx.

2. Histopathology

a. Joint (Figs. 2–8)

Lesions in the joint varied in degree (Fig. 1). The mild lesion consisted of swelling or rounding with hyperplasia and desquamation of the synovial cells. There were a slight infiltration of heterophils and small amounts of sero-fibrinous exudate on the inner surface. In the synovial membrane of fibrous type, small amounts of fibrin were present, frequently forming a thin layer, on the inner surface, associated with a proliferation of histiocytes and fibroblasts and an infiltration of some heterophils in the subsynovial layer.

As the lesions progressed, the articular cavity was dilated with various amounts of fibrino-purulent exudate. The hyperplasia and desquamation of the swollen synovial cells and the infiltration of heterophils in the synovial membrane were more conspicuous. In addition, the subsynovial layer was thickened due to marked congestion, infiltration of heterophils, and proliferation of histiocytes and fibroblasts.

In the severest lesions the fibrino-purulent exudate in the articular cavity became a detritus substance which often contained bacterial clumps and which was surrounded by a layer of foreign body giant cells. The articular capsule showed extensive thickening with a marked hyperplasia of swollen synovial cells, infiltration of heterophils, and proliferation of histiocytes and fibroblasts. Sometimes the synovial membrane was lost and a detritus was attached to the inner surface. Accordingly, it was difficult to differentiate the synovial membrane from the subsynovial layer. Such lesions extended to the surrounding tissues. Rarely, the fibrino-purulent exudate infiltrated into the articular cartilage, eroding the inner surface of the articular cavity.

The severity and distribution of articular lesions are set out in Fig. 1. The region most frequently involved was the hock joint (left, 86%; right, 81%), which was followed by the knee joint (left, 64%; right, 49%), the metatarsophalangeal joint (left, 29%; right, 24%), the hip joint (left, 21%; right, 14%), and the interphalangeal joint (left, 11%; right, 12%) in the order named. Both left and right joints at each site were involved at the same time in most of the birds, but either of them was affected in a few birds.

b. Bursa and tendinous sheath

(Figs. 5–7)

Lesions involving both bursa and tendinous sheath were essentially identical with those described in the joint. The severity of the lesions was approximately parallel to that of the coexisting articular alterations. The bursa and tendinous sheath in the proximity of the hock joint were most
PURULENT ARTHRITIS OF CHICKENS

Fig. 1. Distribution and severity of purulent arthritis in each joint of the leg

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<th>Joint</th>
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Remarks.

■: Mild, □: Moderate, and □: Severe in severity.
L: Left, R: Right.

frequently involved and followed by the bursa close to the knee joint. The bursae around the metatarsophalangeal and interphalangeal joints were also affected in a few cases, although their lesions were less intense. Frequently, there was an extensive fibroblastic proliferation with an infiltration of heterophils in the subcutaneous tissue of the hock joint. No significant changes were found in the tendon itself, although there was rarely an infiltration of a few heterophils.

c. Bone marrow (Figs. 9–12)

Purulent osteomyelitis was present in 34 of the 36 birds examined. It presented a diffuse increase in heterophils (mature) and heterophil metamyelocytes and abscess formation. In the former the parenchymatous tissue with congestion extended from the metaphysis toward the diaphysis and then from the bone marrow cavity into the canalicul system of the cortical bone. Heterophils were also packed within blood vessels in the epiphyseal cartilaginous plate and articular cartilage, infiltrating into the perivascular areas. Such increase in heterophils was so dominant in the metaphyseal and epiphyseal bone marrow that the bone trabeculae and developing cartilaginous columns involved showed pressure atrophy or became thin and fragile.

On the other hand, abscesses consisted only of focal aggregation of heterophils in the early stage and sometimes contained bacterial clumps later. Subsequently, the aggregation became a mass of detritus and then was surrounded by a layer of foreign body giant cells. Occasionally, a proliferation of osteoblasts was seen in its surrounding areas. Some bone trabeculae and cartilaginous columns within or adjacent to the abscesses were necrotic (sequestra). In a few cases abscesses spread through the articular cartilage to the articular cavity or the periosteum. A diffuse increase in heterophils and abscess formation coexisted in all the birds, except a few in which they occurred separately.

d. Bone (Figs. 13 and 14)

Six birds were affected with periostitis. In them, an active new formation of bone tissue was induced by periosteal osteogenesis in the inner layer of the periosteum. It was associated with abscess formation in 8 birds. Severe arthritis, bursitis or tenosynovitis occurred in the proximity of the
lesion.

Bone dysplasia was evidenced in the cortical bone of 10 birds. It presented a focal abnormal development of periosteal bone tissue and a delay in maturity of the bone tissue. It occurred most frequently in the posterior part of the tibia, followed by the posterior part of the femur, the anterior part of the tibia, and the anterior and posterior parts of the metatarsus in the order named.

e. Skeletal muscle

Twenty-two birds were affected with mild or moderate interstitial myositis, which consisted of heterophil infiltration, histiocytic proliferation, and sometimes hyaline degeneration of muscle fibers. The lesion was rather severe in the muscle adjacent to that of arthritis, bursitis or tenosynovitis. In addition, lesions consisting only of swelling and fragmentation of muscle fibers were scattered in 3 birds.

d. Visceral organs

The following lesions due to a bacterial infection were observed in all the birds, but three.

Spleen: Reticular cells proliferated around sheathed arteries, accompanied occasionally with fibrinous exudation and rarely with bacterial clumps. In addition, large mononuclear cells and heterophils increased in number and reticuloendothelial cells were sometimes activated in the red pulp in most cases.

Liver: Mild or moderate fatty degeneration was noticed in hepatic cells of many birds. Frequently, heterophils migrated into the sinusoids, in which endothelial cells were activated slightly. Foci of coagulative or fibrinoid necrosis were scattered in the hepatic parenchyma in 6 birds. Heterophils, as well as heterophil metamyelocytes, increased in number in the interlobular connective tissue.

Heart: Focal and rarely diffuse fibrinous epicarditis was observed in 9 individuals. Focal aggregations of heterophils, including heterophil metamyelocytes, were scattered in the myocardium of some cases. Bacterial valvulitis was seen in 2 birds.

Lung: Heterophils often migrated into blood capillaries in the walls of the air capillaries, in which reticuloendothelial cells were swollen. Abscesses surrounded by a layer of foreign body giant cells were rarely found in the interlobular or intra-lobular connective tissue of 4 cases.

In a few cases heterophils increased within the blood vessels of all the organs.

Discussion

In this study purulent arthritis, commonly associated with bursitis and tenosynovitis, was observed. It was usually complicated with pyogenic osteomyelitis. Pathogenetically, there is a well-known close relationship between purulent arthritis and pyogenic osteomyelitis in man. It is suggested that purulent ostomyelitis in the long tubular bone, especially in its metaphyseal region, may spread through the canalicular system of the cortical bone to cause periostitis with abscess formation and pyogenic arthritis in the adjacent areas [3]. This proposed manner of spread may be applicable to the cases in this study. It should be emphasized that lesions occurred in the visceral organs almost constantly alongside the joint lesions. This suggests that the arthritis may be a part of bacterial septicemia. Nairn [7] regarded bacterial osteomyelitis and synovitis in turkeys as a single disease entity. He and his co-worker [8] reported the same findings in meat-type chickens.

There appears to be an age disposition in the incidence of this condition. All the birds, except one (178 days of age),
examined in this study were under 100 days of age. Nairn [7] observed that bacterial osteomyelitis and synovitis did not develop in turkeys more than 23 weeks of age. Furthermore, he and his co-worker [8] pointed out that the clinical incidence of the condition might reach 50% in a meat-type chicken flock, with a mortality up to 5% in birds 4 to 8 weeks of age. It is known that pyogenic osteomyelitis has very often occurred in human beings ranging from 5 to 15 years of age; that is, during the period of most active skeletal growth [3].

Bacteriological examination was not routinely performed in the present investigation, although staphylococci were isolated from a few of the birds. The histological findings obtained, however, indicated that the conditions was due to a bacterial infection. Several workers have shown that the most common etiological agent of purulent arthritis and osteomyelitis in man [3], chickens and turkeys [7, 8] is staphylococcus. Hinshaw and McNeil [1] and Miner et al. [5] reproduced experimentally such synovitis in turkeys as almost identical to that described in the present study by injecting intravenously with staphylococci. They also referred to an induced septicaemia.

A disease showing leg weakness with some mortality has frequently occurred in young chickens in Japan for the past few years [4]. Staphylococcus aureus has usually been isolated from such birds, but no complete morphological examination has been made on the birds. The materials used for this study included some birds involved in such outbreaks.

It is unknown why the hock joint was most commonly affected in the present cases. Hinshaw and McNeil [1] reported that the same joint was most frequently involved in experimental staphylococcal arthritis of turkeys. A predisposing factor may be the fact that the hock joint bears the greater part of the body weight in fowls. The deformity of the leg below the hock joint is considered to be a secondary condition resulting from the arthritis in the region.

Bone dysplasia, as reported by Itakura and Yamagishi [2], was fairly frequently associated in the present cases. It does not seem to be concerned directly with the arthritis and osteomyelitis. It may be important, however, as one of the causes of leg weakness, or as a predisposing factor of this condition.

References


**Explanation of Figures**

All the photomicrographs were taken from sections stained with hematoxylin and eosin.

Fig. 2. Knee joint capsule. There is fibrinous exudate on the inner surface of the areolar type of synovial membrane (leftward). Young chicken. ×460.

Fig. 3. Villus of hock joint capsule. There is fibrinous exudation in the fibrous type of synovial membrane (leftward) and proliferation of fibroblasts and histiocytes with a low degree of heterophil infiltration in the subsynovial layer. Young chicken. ×460.

Fig. 4. Hock joint capsule. There is fibrinous exudate with a few heterophils on the inner surface of the synovial membrane which shows marked hyperplasia of synovial cells. 70 days of age. ×282.

Fig. 5. Bursa around metatarsus. Bursal synovial cells are swollen. The bursa itself is filled with fibrinous exudate containing some heterophils. 50 days of age. ×282.

Fig. 6. Tendinous sheath around metatarsus. Heterophils are exuded within the tendinous sheath (arrows), the wall of which shows marked thickening due to heterophil infiltration and fibroblastic proliferation. Almost normal tendons are seen on both upper and lower sides of the photomicrograph. 100 days of age. ×282.

Fig. 7. Bursa around knee joint. The dilated bursa is filled with a mass of detritus containing bacterial clumps, some of which are surrounded by foreign body giant cells. The bursal wall is markedly thickened due to hyperplasia of synovial cells. Proliferation of fibroblasts and histiocytes, and infiltration of heterophils in the subsynovial layer. 44 days of age. ×56.

Fig. 8. Knee joint. Purulent exudate is present within the articular cavity. It erodes articular cartilage by infiltration on both left and right sides of the photomicrograph. 46 days of age. ×115.

Fig. 9. Femoral bone marrow. A diffuse increase is seen in heterophils and heterophil myelocytes in the parenchyma, which shows congestion. Bone trabeculae are slender and fragile. Young chicken. ×115.

Fig. 10. High-power magnification of Fig. 9. There is a marked increase in heterophil metamyelocytes. ×730.

Fig. 11. Femoral bone marrow. An abscess is formed and partly surrounded by foreign body giant cells and fibroblasts (upper part). There are fragmental and slender bone trabeculae within the lesion. 71 days of age. ×141.

Fig. 12. Femoral bone marrow. A large abscess is formed. In it developing trabeculae are necrotic (sequestra). 44 days of age. ×65.

Fig. 13. Periostium of metaphysis of metatarsus. An abscess is formed in the inner layer of the periostium showing marked osteoblastic proliferation with new formation of bone tissue (periostitis). 50 days of age. ×141.

Fig. 14. Middle portion of diaphysis of tibia. New formation of bone tissue resulting from periosteal osteogenesis is in progress on the outer surface (periostitis). Some heterophils are scattered in this lesion. 178 days of age. ×184.