

Proliferative Lung Disease in Broiler Breeder Hens

Oscar J. Fletcher, Michael Martin, and H. John Barnes

Poultry Health Management, Department of Population Health and Pathobiology, College of Veterinary Medicine
NC State University, Raleigh, NC 27606



Abstract

Examination of the lungs obtained from 41 broiler breeder hens not yet in peak production (26-29 weeks old) revealed histologic lesions of a proliferative disease. Characteristics of this condition are hypertrophy of smooth muscle in the walls of parabronchi with hyperplasia and metaplasia of epithelium (normally simple squamous) lining parabronchi, atria, and infundibulae. This proliferative process results in increased cellularity in the respiratory lobules and blocks the air passages from the parabronchi into the air capillary network.

The term avian proliferative pulmonary disease is suggested because exudative inflammation (fibrin, heterophils, and lymphocytes) is absent or minimal. Proliferative lesions were found in 79 of 81 hen lung sections examined. Thirty-three hens with locomotor disturbances were examined and 100% of removed and fixed lungs had proliferative lesions; 94% of *in-situ* fixed lungs had proliferative lesions. Eight normal (no clinical signs) hens were examined and 100% had proliferative lesions in both removed and *in-situ* fixed lungs.

Fixation of lungs *in-situ* provides better preservation of lung histology and improves interpretation of lung lesions. Proliferative lesions were less severe in lungs fixed *in-situ* compared with the removed and formalin-fixed paired sample. Dust and/or other foreign particulate material that was presumably inhaled was found in many (75% to 88%) hens. Proliferative lesions can occur in the absence of evidence of bacterial infection.

Introduction

The respiratory epithelium lining the parabronchi, atrial smooth muscles, atria, and infundibulae of the avian lung normally is simple squamous. This epithelium has tremendous capacity to respond by hypertrophy, hyperplasia, and metaplasia when injured and especially in response to injury from viable bacteria. The respiratory system of birds has fewer free macrophages in comparison to the mammalian lung and the responsiveness of a highly specialized respiratory epithelium that comprises over 70% of the blood-gas barrier is a vital part of the avian defense mechanisms (Nganpiep and Maina, 2002, Toth, 2000).

Lungs from broiler breeder hens were examined as part of our protocol for investigation of causes of impaired mobility occurring at 26-30 weeks. A high incidence of proliferative lesions characterized by hypertrophy and hyperplasia of respiratory epithelium and hypertrophy of smooth muscle in the walls of parabronchi was found. Most cases did not have an obvious association with lesions of exudative pneumonia or other evidence of bacterial or mycotic infection.

Proliferative lesions are illustrated and comparisons made between mobility-impaired and clinically normal hens using two lesion scoring methods. Differences between lungs removed and fixed and paired lungs fixed *in-situ* are illustrated.

Samples

Broiler breeder hens ranging in age from 26-29 weeks were obtained from two farms owned by the same company and managed by different growers. Twenty-two mobility-impaired (MI) and 8 clinically normal hens (CN) were from Farm 1. Eleven MI hens were from Farm 2. No differences were found in lesions between the two farms thus the data is pooled for this report.

One lung from each hen was removed at necropsy and immediately fixed in neutral buffered formalin (R). The opposite lung in each hen was left attached and fixed by immersion of this portion of the thoracic cavity in neutral buffered formalin (IS). After fixation, both removed and *in-situ* samples were processed for routine H&E staining.

Figures



Figure 1. MI-IS lung illustrating parabronchi with atria and infundibulae. PPL score = 1.

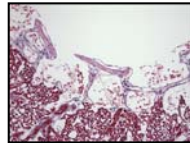


Figure 2. CN-IS lung illustrating parabronchus, atria, and infundibulae. PPL score = 1.

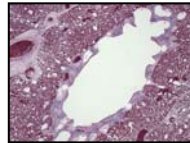


Figure 3. MI-IS lung with a PPL score of 2.

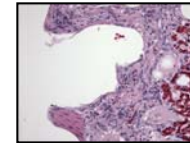


Figure 4. Higher magnification of figure 3, illustrating cuboidal metaplasia and smooth muscle hypertrophy.

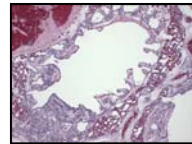


Figure 5. CN-IS lung with a PPL score = 3.

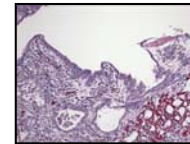


Figure 6. Higher magnification of figure 5 illustrates pigment deposition and hyperplasia of atrial epithelium.

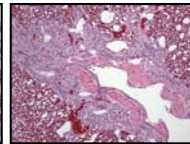


Figure 7. MI-R lung with a PPL score = 4.

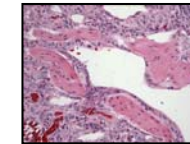


Figure 8. Higher magnification of figure 7 illustrates smooth muscle hypertrophy and epithelial metaplasia and hyperplasia.

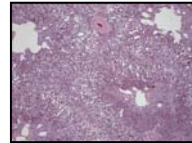


Figure 9. MI-R lung with a PPL score = 4.

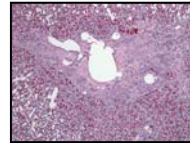


Figure 10. Higher magnification of figure 9 illustrates blockage of atria and infundibulae. Macrophages are in capillary bed.

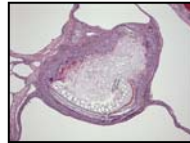


Figure 11. MI-IS lung has plant material associated with a granulomatous response in the wall of a parabronchus.

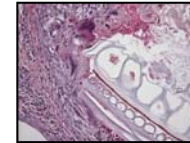


Figure 12. Higher magnification of figure 11 illustrates plant material and surrounding granulomatous response.

Lesion Scoring

Lesion Pattern and Extent (LPE)

The absence (score = 1) or presence (score = 2) of the following 6 lesions was determined.

Proliferative lesions; Fluid – Edema or Fibrin; Heterophils; Dust and/or Pigment; Necrosis; Agents – Bacteria or Fungi

Extent was evaluated and a score assigned based on 1 = no lesions; 2 = up to 25%; 3 = 25-50%; and 4 = >50% of the section having lesions

Lesion Pattern and Extent Score = (Sum of the 6 Lesion Scores X Extent)/6 thus giving a range of 1 to 8.

Parabronchial Proliferative Lesion Score (PPL)

A subjective value of 1 to 4 was assigned to each of 25 parabronchi examined – 8 to 9 per 1/3 of each section - using a 10X objective. The mean of the 25 observations is the PPL score for the sample.

1 = Normal – no lesions; 2 = Mild with at least one lesion (metaplasia, hyperplasia, or smooth muscle hypertrophy) and confined to atria and infundibulae; 3 = Moderate with two or more lesions present and extending into respiratory lobe; 4 = Severe with closure of parabronchial lumen, significant distortion of lobular architecture, and epithelial hyperplasia with prominent smooth muscle hypertrophy.

Results and Conclusions

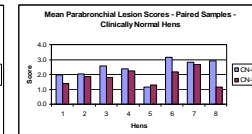
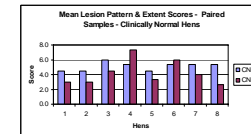
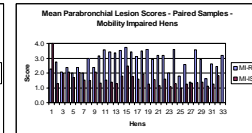
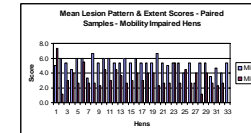


Table 1. Comparison of Mean Lesion Pattern and Extent (LPE) Scores

	Mobility Impaired (MI) Mean	No. MI Hens	Clinically Normal (CN) Mean	No. CN Hens
Removed	5.2	33	5.1	8
<i>In-situ</i>	3.4	32	4.2	8

Table 2. Comparison of Mean Parabronchial Lesion (PPL) Scores

	Mobility Impaired (MI) Mean	No. MI Hens	Clinically Normal (CN) Mean	No. CN Hens
Removed	2.8	33	2.4	8
<i>In-situ</i>	1.6	32	1.8	8

• Lesion pattern & extent scores and parabronchial scores are lower in *in-situ* fixed as compared to removed and fixed lungs. Artifacts are introduced when lungs are removed and *in-situ* fixation improves ability to recognize lesions.

• Proliferative lesions were in 94% of *in-situ* fixed compared with 100% in removed lungs. These proliferative lesions were similar in clinically-normal hens and mobility-impaired hens thus were not related to clinical condition and likely are related to environmental conditions in the houses.

• Dust and/or pigment was found in 75 to 88% of hens depending on group with the highest frequency found in clinically normal hens and at the same frequency in both removed and *in-situ* lungs from this group. Relatively large fragments of plant material were in walls of some parabronchi and were not group or method of fixation dependent.

• Proliferative lesions were found with much greater frequency than fluid, heterophils, necrosis, or agents (bacteria or fungi) and thus can occur in the absence of these lesions.

Selected References

Nganpiep, L. N. and Maina, J. N.: Composite Cellular Defence Stratagem in the Avian Respiratory System: Functional Morphology of the Free (Surface) Macrophages and Specialized Pulmonary Epithelia. J. Anat. 200: 499-516. 2002.

Toth, T. E.: Nonspecific Cellular Defense of the Avian Respiratory System: A Review. Dev. & Comp. Immunol. 24: 121-139.2000.