BRIEF NOTE

**Microarchitecture of Air Capillaries and Blood Capillaries
in the Respiratory Area of the Hen's Lung Examined
by Scanning Electron Microscopy**

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The bronchus of the fowl gives off successively the primary, secondary, and tertiary branches (parabronchi). It finally terminates in air capillaries which communicate with one another. The parabronchi and their surrounding tissues considered to be the respiratory area where gas exchange actually takes place. Many investigators [1-4] have examined in detail the structure of the lung, particularly that of the respiratory area. Little observation, however, has been made on the microarchitecture of the air capillaries and blood capillaries which are involved directly in gas exchange. In the present study three-dimensional arrangements of these capillaries were observed in the resin cast preparations of the hen's lung.

Eight adult hens weighing about 1.6 kg were used. Just after decapitation, the thoracic cavity was opened to expose the surface of the lung. For the examination of the vascular architecture, methyl methacrylate was introduced through the pulmonary artery by the method of Murakami [5] immediately after the irrigation of blood vessels with physiological saline solution. For the examination of the bronchial architecture, the same resin was introduced

through the trachea into the lung. The resulting casts were cut out and corroded in 20% NaOH solution. They were examined by scanning electron microscopy in the conventional manner.

The parabronchi comprising the terminal portion of the respiratory tubes were led to a large number of dilated polygonal chambers named atria (Fig. 1). The atria were 100-200 μm in diameter and only separated one another by thin septa. Each atrium was further led to a few narrow columnar chambers called infundibula (Fig. 2). From the bottom or wall of each infundibulum, a number of air capillaries arose (Fig. 2). They ramified repeatedly, as they proceeded outward from the bronchial lumen. Thus, the respiratory area was formed by a network of highly anastomosing air capillaries (Figs. 3 and 5).

The air capillaries generally looked round, although they varied somewhat in shape in association with the passing of blood capillaries (Fig. 3). They were about 2 μm in width in their narrowest part and 4 μm in the widest part. The outer surface of the parabronchus appeared to be alveolar due to the outward extension of air capil-

laries (Fig. 4). This extension may have been induced artificially by the forcible injection of resin. The air capillaries of one parabronchus did not anastomose with those of any other one, because of the presence of the delimiting interparabronchial connective tissue.

On the other hand, the pulmonary artery entering the lung at the hilus is divided into three large rami, the cranial, the caudal and the caudolateral. Each ramus stretched out into the interbronchial septum, where it became an arteriole. Thereafter, it ramified in such manner as to cover the whole outer surface of the parabronchus (Fig. 6). Arterial capillaries from the arteriole passed the inner surface of the parabronchus, as they ramified repeatedly (Figs. 7 and 8). Thus, highly anastomosing blood capillaries formed a network in the respiratory area surrounding the lumen of the parabronchus (Figs. 9 and 10).

Venous capillaries from the vascular network of the respiratory area came out of the inner surface of the parabronchus through the wall of the atrium and then abruptly drained into veins (Figs. 11 and 12). These veins were collected into large veins, which ran just under the epithelium of the parabronchial lumen along its long axis. Then the veins pierced the wall of the para-

bronchus and drained into larger veins in the interparabronchial septum. Whether the above-mentioned extraprabronchial blood vessels are arterial or venous remains a controversial problem. They may be considered to be arterial, since they are reduced progressively in caliber, whereas the intraprabronchial blood vessels drained abruptly into larger vessels.

From these results, it could be concluded that the blood flow in the respiratory area was originated from the artery in the periphery of the parabronchus and proceeded to the veins lying at the basis of the atrium through the intermediate network of capillaries in the respiratory area.

References

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要 約

鶏肺の呼吸域における毛細気管と毛細血管の微細構築 (短報): 藤井俊策・田村達堂・岡本敏一 (広島大学生物生産学部) —— 鶏肺の呼吸域における毛細気管と毛細血管の立体的構築を, 合成樹脂鑄型標本によって走査電顕的に調べた. 旁気管支 (三次気管支) 周囲のいわゆる呼吸野は, 複雑に吻合する毛細気管網と毛細血管網のからみ合いによって構築されていた. 毛細気管網は旁気管支の側壁から進入する呼吸細管の末端に形成されていた. 毛細血管網は旁気管支の外側から進入する動脈性血管の分枝によって構築され, これは旁気管支粘膜下の静脈と連絡していた.

Explanation of Figures

All the photographs are scanning electron micrographs of resin casts of the respiratory area of the chicken lung. T, lumen of parabronchus; A, atrium; I, infundibulum; C, network of air capillaries; Aa, arterial vessels; Vv, venous vessels.

- Fig. 1. A parabronchus with numerous polygonal chambers (atria) projected from its wall. $\times 50$.
- Fig. 2. Transverse view of a parabronchus showing the pathway of respiratory tubes. The parabronchial lumen is led successively to the atrium, infundibulum and air capillaries. $\times 100$.
- Fig. 3. Network of air capillaries in the respiratory area. Note the varying sizes of densely intercommunicating air capillaries. $\times 100$.
- Fig. 4. Air capillaries on the outer surface of the parabronchus. Arrows show the pathway of arterial vessels. $\times 100$.
- Fig. 5. Cross section of a parabronchus enclosed deeply in a network of air capillaries. $\times 50$.
- Fig. 6. Outer surface of the parabronchus showing the supplying arterial vessels. The vessels arise from the interparabronchial septum (arrows). $\times 50$.
- Fig. 7. Outer surface of the parabronchus. Note a dense network of blood vessels. $\times 80$.
- Fig. 8. Magnification of a part of Fig. 7. $\times 120$.
- Fig. 9. Cross section of a parabronchus showing the distribution of capillary vessels in the respiratory area. An arrow shows a large vein across the wall of the parabronchus. $\times 40$.
- Fig. 10. High-power magnification of Fig. 9. $\times 120$.
- Fig. 11. Inner surface of the parabronchial lumen showing the running of venous vessels. Arrows show the site of atria. $\times 60$.
- Fig. 12. High-power magnification of Fig. 11. Blood capillaries from the respiratory area drain abruptly into veins on the wall of the atrium. $\times 300$.