The Bronchial Arteries and Their Anastomoses in the Human Lung

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The lung has a dual blood supply comprised of the pulmonary and the bronchial arteries. There are several differences between the two vascular systems. The pulmonary artery, carrying deoxygenated, venous blood provides the lung with a much larger blood volume than the bronchial arteries, which carry oxygenated, arterial blood. Secondly, the pulmonary artery carries the blood at a relatively low blood pressure of approximately 25/8 mm. Hg, whereas the bronchial arteries convey the blood at the systemic blood pressure of approximately 120/80 mm. Hg. This is an important difference. The bronchial arteries, therefore, carry oxygenated blood at the systemic blood pressure into an organ which is perfused with deoxygenated blood at a low pressure.

The pressure difference to which the two types of blood vessels are subjected also accounts for the difference in their histologic structures. The walls of the pulmonary arteries are relatively thin and their larger and medium branches are of the elastic type. The bronchial arteries, on the other hand, are of the muscular type similar to those of the systemic arterial circulation and their walls are considerably thicker.

The stroke volume injected into the pulmonary artery equals that of the aorta, but the total blood volume delivered to the lungs with each systole is larger than that conveyed to the rest of the body because of the bronchial arteries which are branches of the aorta and thus carry part of its stroke volume to the lungs.

The origin of the bronchial arteries is stated to be directly from the aorta or from a trunk common to an aortic intercostal and a bronchial artery. The latter occurs on the right side in 88.7 per cent.1

Other sites of origin, such as the right internal mammary, or right subclavian are described, but these are uncommon.1

The total number of bronchial arteries are supposed to vary from two to four. The left bronchial arteries follow a more constant course, arising, usually from the anterior surface of the aorta or from the arch. Besides conveying oxygenated blood to the tissues of the lungs and pleura, they supply tracheobronchial lymph nodes, the middle third of the esophagus, pericardium, posterior mediastinal fascia and pulmonary nerve plexuses of the vagus and sympathetic.1

Miller and Tobin1,2 found that each subdivision of the bronchus usually has two branches of the bronchial artery coursing along its length. These arteries may proceed in a straight or tortuous course. According to Lapp,6 the bronchial artery branches communicate with one another by numerous anastomosing branches. In his opinion, the bronchial arteries continue along the bronchi as far as the alveolar duct where the branches divide to form a capillary network which then anastomoses with the capillary network of the alveoli. Tobin and Verloop,5,7 however, disagree with this and state that the bronchial arteries continue only as far as the respiratory bronchioles and at this site anastomose with the pulmonary arterial vessels by means of capillaries.

Verloop5 stated that branches of the bronchial arteries ramify as vasa vasorum in the adventitious tissue of the pulmonary arteries and veins. These branches, however, do not form direct connections with the lumen of the pulmonary arteries. The visceral pleura, in his opinion, is also supplied by the bronchial arteries. Some of the branches enter the pleura at the hilum, whereas others enter by way of the interlobular septa.

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The importance of the bronchial arteries in maintaining the nutrition of the lung parenchyma was already recognized by Virchow in 1849. He postulated that there must be extensive anastomoses between the bronchial and the pulmonary arteries since blocking of the pulmonary artery in the dog had no effect on the nutrition of the lung parenchyma.

Zuckerkandl in 1883 was able to demonstrate "deep" arterial anastomoses in the bronchial wall and "superficial" ones in the pleura.

Since then, many investigators have proved the existence of anastomoses between the bronchial and the pulmonary arteries by the use of various techniques. Thus, Ellis and co-workers, Ghoreyeb and Karsner and their associates employed physiologic studies on dogs. They occluded the bronchial artery or arteries at the hilum in some animals and found that in such cases there was gangrene of the bronchus for a distance of 1-2 cm. If, however, the bronchial artery of a bronchus to the apical lobe was occluded, there was no evidence of gangrene in the bronchus. They concluded that except in the hilar region, a functional anastomosis exists between the bronchial and the pulmonary vascular systems and that the pulmonary arterial blood nourished the pulmonary parenchyma and the bronchial wall distal to the hilum after the obliteration of the bronchial arterial circulation.

Tobin, Lapp, Verloop and von Hayek all studied the problem of the bronchial and pulmonary arterial anastomoses by means of serial sections. Tobin suggested that the bronchial and pulmonary arteries normally anastomose by means of vessels larger than capillaries. He found two types of anastomoses, one type was relatively short (1-2 mm.) and narrow (50-100 micra), whereas the other type was long (10-40 mm.) and much wider (300-400 micra). The short type was located within the lobular subdivision of the lungs, whereas the longer anastomoses extended between a branch of the bronchial artery on the wall of a segmental bronchus to a more distally placed branch of the pulmonary artery. These vessels were found in the lungs of the newborn, the child and the adult up to 91 years of age, with different causes of death and with or without pulmonary pathology. The larger branches were not found on every bronchus, but one or two were found in each bronchopulmonary segment. The anastomotic vessels were usually coiled, which, in his opinion, created resistance and helped to reduce the pressure as the blood flowed from the bronchial to the pulmonary artery.

It is interesting to note that Tobin, in our perusal of the literature, was the only investigator to mention the existence of anastomoses by means of vessels larger than capillaries.

Verloop, who also studied the anastomoses by means of serial sections, found that they occurred only in the small air passages, which still had a few cartilaginous pieces in their walls. He described the anastomoses as being formed by branches of the bronchial arteries which proceeded distally along the bronchioles and ended in small ramifications of the pulmonary artery. Similar anastomoses occurred between small branches in the visceral pleura. The anastomoses which he described frequently ran with many convolutions to the outer side of the bronchial wall, or into the adventitial tissue of the lung vessel. He states that as a rule, the anastomosing vessels were rather short, varying from 10 to 100 micra in length. The vessel wall was usually from two to ten muscle fibers thick.

Von Hayek was the first to investigate the anastomoses between the pulmonary and bronchial arteries microscopically. He described the anastomoses in the bronchial walls and stated that they were formed by very muscular "Sperrarterien," implying that they were controlled by a type of sphincter mechanism. He also stated that these anastomoses gave off lateral arteriovenous anastomoses to the bronchial ve-
nous plexus. He described similar anastomoses in the visceral pleura.

These sphincter-like anastomoses were then further studied microscopically by Verloop and Lapp. Both studied them in great detail and found that in these anastomotic vessels, longitudinal muscle fibers lying next to the internal elastic membrane had developed to a special degree. On contraction, they were capable of obstructing the lumen of the vessel completely. When the vessel anastomosed with a branch of the pulmonary artery, it lost its longitudinal muscle fibers shortly before it entered the branch of the pulmonary artery.

Lapp stated that in his extensive serial investigations he had never encountered anastomoses between the bronchial and the pulmonary arteries outside of the secondary lobules, and that every intralobular bronchus had at least three to five “Sperrarterien” all of which eventually merged into the respective pulmonary artery.

A “Sperrarterie” according to him may be several mm. to 1 cm. and more in length and the anastomoses between the bronchial and pulmonary artery can be considered as being part of the normal human lung.

It is, therefore, evident that Lapp, too, believed anastomoses to exist only within the secondary lobule which implied that only bronchial and pulmonary arterial vessels of very small calibre took part in the anastomoses.

It is noteworthy that Miller insisted there were no anastomoses between the pulmonary and the bronchial arteries. The vasa vasorum of the pulmonary artery are derived from branches of the bronchial arteries and these, in the opinion of Miller, are often misinterpreted as anastomoses.

Recent structural studies by Verloop and Ellis and colleagues have shown that the size of the bronchial arteries of the human fetus is nearly the same as that of the adult. Since a great expansion occurs in the pulmonary vascular system after birth, they postulate that the bronchial arteries may be considered as a vestigial circulatory system, important in the fetus before birth, but of little significance under normal conditions after birth, except in the region of the hilum. They believe that when pathologic processes involve the lung, this vestigial blood supply may again be called upon to fulfill an important nutrient function.

**Methods**

Normal human lungs were used for this study. One lung, however, which was found to have injected more completely than others and which consequently proved most useful in this study, was from an 81-year-old man who had a mild case of emphysema. Death was not due to respiratory disease.

In removing the lung, great care was exercised not to tear the pleura or the pulmonary vessels. The left lung was preferably used because of greater constancy in the anatomy of the bronchial arteries. The whole left lung, with its branches severed and tied, was removed. Part of the left auricle was left attached to the pulmonary veins so as to provide as long a stem for the pulmonary veins as possible. The pulmonary artery was severed at its base. The aorta was severed at its base and its thoracic portion was removed in toto by carefully dissecting it away from the posterior wall of the thorax. Following the sectioning of the subclavian and carotid arteries, the intercostal arteries were cut after they were clearly identified. Throughout this procedure, the aorta was pressed in an anterior direction against the lung so as not to sever or damage the bronchial arteries.

After the lung and aorta had been removed, the lung was rinsed with isotonic saline solution by cannulating the pulmonary artery and allowing the solution to run in from a height of about 120 cm. The flow was interrupted occasionally to avoid overdistention of the lung. The rinsing was continued until the parenchyma assumed a greyish or greyish-pink color. As much as possible of the fluid was removed.

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by gently compressing the lung and forcing the fluid out through the pulmonary veins. A considerable quantity of fluid also oozed out through the pleura.

For the purpose of this study, the lungs were then injected with Vultex moulage,** a latex preparation, using a modified method of Lieb.**

Vultex moulage was found to be superior to Neoprene used in our earlier studies. Vultex moulage has the advantage of being miscible with water and thus can be diluted as conditions require. It appears to be also more stable and does not deteriorate when mounted on slides. Vultex moulage can be obtained in various colors, a feature which proved to be a great aid in this study.

The pulmonary artery was injected first with blue Vultex moulage using the same system as was used for the rinsing. The lung was frequently inspected for leaks, and the damaged vessels were then clamped and tied. A stubborn leak could sometimes be sealed by congealing the latex by application of concentrated hydrochloric acid.

The pressure with which the lung was injected was adjusted according to the ease of flow and the presence or absence of leaks. As a rule, the injection fluid was permitted to run from a height of 120 cm., but if conditions were favorable, extra pressure was applied by forcing air into the bottle. The cannula was not withdrawn from the vessel as long as there was evidence that Vultex moulage was still running in. The surface of the lung was inspected to see whether the capillaries became injected, for as long as this did not happen, further attempts were made to introduce more of the Vultex moulage.

To inject the bronchial arteries, the aorta was cut for its whole length along the posterior wall. The surface was then carefully inspected until the ostia of the bronchial arteries were found.

Small vinyl tubing with a diameter a little smaller than the bronchial artery was threaded into the bronchial artery for several centimeters. The length of the tubing was such that about 1-1½ cm. of the tubing was protruding from the ostium of the bronchial artery. The bronchial artery was then injected with brilliant green Vultex moulage using a 20 ml syringe and a 20 gauge needle. The latter was inserted into the vinyl tubing and then securely tied by placing a string over the bronchial artery near its origin from the aorta. During the injection, not too much pressure was applied so as not to cause a rupture in the bronchial arterial system.

To inject the pulmonary vein, black Vultex moulage was used. After the blood vessels had been adequately filled, the bronchial tree was injected with white Vultex moulage, using the same method as for the pulmonary vessels. To facilitate studies of the pulmonary vessels it is an advantage not to inject the alveoli too completely but to limit oneself to the arborizations of the bronchial tree.

After completion of the injections, the cannulae were tied and severed. The preparation was immersed in concentrated hydrochloric acid until all tissues were digested. This usually required from 48 to 72 hours. The model was then thoroughly washed in water following which it was ready for study.

Suitable pieces of the model were studied and dissected under a Leitz stereo microscope. The studies were facilitated by cutting a lobe into serial sections about 2-3 cm. thick. The pulmonary artery and the bronchus with its bronchial arteries and veins were found and studied with ease as the structures were easily identified because of the different colors. An anastomosis between the bronchial and pulmonary artery was identified by finding the green vessel coming from the bronchial artery and terminating in a blue vessel of the pulmonary artery. In some cases, the change in color was abrupt, whereas in others, there was a gradual mixing of the blue and green.

**Obtained from General Latex and Chemicals Ltd., Verdun, Quebec.
In some instances, one also found small bronchial artery branches proceeding to a branch of the pulmonary artery. These branches of the bronchial artery remained brilliant green throughout their course and when they were carefully dissected out one found that they broke up into capillaries and were attached to the pulmonary artery branch. The capillaries could be teased away which proved that they were not connected to the lumen of the pulmonary artery branch. These vessels were the branches of the bronchial artery which constituted the vasa vasorum of the pulmonary artery and they should not be confused with anastomotic vessels. Similar small vessels breaking up into capillaries could be seen to go to the bronchi and they obviously supplied oxygenated blood to the bronchial wall.

Slides were prepared according to the method of Duff and More. Well slides with the deepest depression were used. Measurements were made by the use of a calibrated grid located in the eyepiece of the microscope.

**Figure 1:** Drawing of human bronchial arteries to demonstrate the larger type of anastomoses between branches of bronchial and pulmonary arteries. AN. P.A.-B.A.-0.15 mm. Anastomosis between a branch of the pulmonary and bronchial artery measuring 0.15 mm. in diameter. This particular anastomosis shows a gradual mixing of the blue and green Vultex moulage. The branch of the pulmonary artery joined to the anastomosis has been cut so as to facilitate the demonstration of the anastomosis. AN. PA.-B.A.-3 mm. Anastomosis between a branch of the pulmonary and bronchial artery measuring 0.3 mm. in diameter. The blue and green colors in this anastomosis join abruptly. B.A.- A bronchial artery, proceeding along a straight course in this section. B.A.-0.3 mm. Bronchial artery measuring 0.3 mm. in diameter and proceeding along a spiralling course. B.A.-CAP-0.025 mm. A branch of the bronchial artery, a little larger than a capillary, proceeding directly to the wall of the bronchiole. B.R.-3.50 mm. Bronchiole with a diameter of 3.50 mm. P.A.-1.55 mm. Branch of the pulmonary artery with a diameter of 1.55 mm. P.V. Small pulmonary veins, in great numbers, proceeding along the surface of the bronchiole in an irregular fashion.
Drawings were made from the slides with the aid of a Leitz camera lucida.

Further details of the methods have been described in previous publications.13,14

Observations

When the bronchial arteries enter the lung at the hilum, they measure approximately 1.5 mm. in diameter. They immediately proceed to the main bronchus of the particular lung and from then on stay in close association with the bronchial tree throughout its subdivisions.

At the hilum and as it proceeds along the bronchus for the next cm. or two, the bronchial artery gives off many branches which supply the various structures in the vicinity of the hilum. Some supply the larger bronchi, whereas others proceed to the walls of the larger pulmonary artery branches as the vasa vasorum.

As the bronchial tree subdivides, each one of its branches receives at least one, but usually two, branches of the bronchial artery. These branches proceed along the surface of the bronchi in a rather unpredictable manner. In some instances, they are very coiled, whereas in other sections, they may proceed in a straight course or

![Figure 2: Drawing of human bronchial arteries to demonstrate the larger type of anastomoses between branches of the bronchial and pulmonary arteries. AN. P.A. B.A. 1 mm. Anastomosis between a pulmonary and a bronchial arterial vessel measuring 0.1 mm. in diameter. This anastomotic vessel was markedly coiled. AN. P.A. B.A. 2 mm. Anastomotic vessel with a diameter of 0.2 mm. This is an unusually long anastomotic vessel in which the blue and green colors of the Vultex moulage mixed gradually. B.A.-0.15 mm. Bronchial artery with a diameter of 0.15 mm. BR-2.40 mm. Bronchiole with a diameter of 2.40 mm. P.A.-1.60 mm. Branch of pulmonary artery with a diameter of 1.60 mm. P.A.- Branch of pulmonary artery. A piece was cut out to facilitate the demonstration of the anastomotic vessel. P.V.- Pulmonary veins lying on the surface of the bronchiole.](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21383/ on 06/27/2017)
THE BRONCHIAL ARTERIES

may spiral around the bronchi (Figs. 1 and 2).

Capillary-sized branches are given off at frequent intervals which may proceed to the wall of the bronchus (Fig. 1—B.A-CAP.) or to the nearby pulmonary arterial vessel to form its vasa vasorum. The latter are easily identified as they form a fine capillary network on the wall of the artery which can be easily separated from it. Since it does not communicate with the lumen of the artery, the color of the bronchial arterial capillary remains green and does not become mixed with the blue of the pulmonary artery.

Now and then one can even identify capillary sized vessels (Fig. 1 B.A.-CAP-0.025 mm.) and (Fig. 3 B.A-CAP. 0.05 mm.) of the bronchial artery which proceed to nearby lung parenchyma and become attached to the alveoli. So far, we have not been able to trace their final termination because the Vultex moulage in these instances failed to impregnate the ultimate capillary networks.

When the ramifications of the bronchial arteries were closely studied under the stereoscopic dissection microscope, numerous anastomoses between the pulmonary arterial and bronchial arterial systems were found.

The diameter of the anastomotic vessels ranged from 0.05 mm. to 0.5 mm. in size, and their length from 0.1 mm. to 10 mm. (Figs. 1, 2 and 4—AN. P.A-B.A.).

Figure 3: Drawing of a human bronchial artery and one of its small branches proceeding directly to alveoli of the pulmonary parenchyma. B.A.-0.25 mm. Bronchial artery with a diameter of 0.25 mm. B.A-CAP. 0.05 mm. Bronchial artery branch, measuring 0.05 mm. in diameter proceeding to alveoli of the lung parenchyma. BR.-1.85 mm. Bronchiole measuring 1.85 mm. in diameter. P.V.-Pulmonary veins lying on the surface of the bronchiole. P.V.-CAP Small pulmonary venule returning blood from the area supplied by the bronchial artery branch.
Since a specific and distinctive colored Vultex moulage was used for each system, the anastomoses were easily identified. Frequently, the bright green Vultex moulage of the bronchial arterial vessels would gradually mix with the cerulean type of blue of the pulmonary arterial vessels (Fig. 2 AN. P.A.-B.A.-2 mm.). In other instances, the blue and green stopped abruptly within one and the same vessel (Fig. 1 AN. P.A.-B.A.-3 mm.). Teasing and pulling at this juncture would not separate the two colors.

In order to ascertain where most of the anastomoses occurred, a lobe was dissected under the microscope from the hilum to the periphery.

In the vicinity of the hilum, no anastomoses were found. The first anastomosis seen was approximately 11 cm. along the meandering course of the pulmonary artery. This anastomosis measured 0.25 mm. in diameter and was 10 mm. long, that is, it anastomosed a pulmonary and bronchial artery 10 mm. apart.

Proceeding to the periphery, the anastomoses became more plentiful. In the regions where the pulmonary artery branches were of the size of 0.2-0.3 mm., the anastomoses were very numerous. Many anastomoses, often too numerous to count, were found in areas where the bronchial artery branched out to form a capillary network, as in the subpleural region. These capillaries then anastomosed with capillaries from the pulmonary arterial network. The same could be observed with vessels supplying secondary lobules. These anastomoses were usually very small, 0.05 mm. and less in diameter and they were also quite short.

Anastomoses which were formed with the first or second branches of pulmonary arterial vessels measuring from 1.0 to 2.0 mm. in diameter were usually quite large and long (Figs. 1 and 2 AN. P.A.-B.A.). They were not numerous. As a rule, the anastomotic vessel was fairly straight, but occasionally, they proceeded in a rather coiled fashion (Fig. 2—AN. P.A.-B.A.-0.1 mm.).

A short anastomotic vessel was, at times, extremely coiled throughout its whole length.

Sometimes, numerous anastomoses were found involving one particular pulmonary artery branch (Fig. 4). In this instance, the pulmonary artery vessel measured 1.15 mm. in diameter. Practically each one of its branches for a distance of 16.57 mm. had one or more anastomoses with the bronchial artery. The diameter of the anastomoses ranged from 0.1 mm. to 0.4 mm.

In addition to the bronchial artery or arteries, the bronchi have a rich network of pulmonary veins on their surface (Figs. 1, 2 and 3—P.V.). They are present in great abundance, literally covering the surface of the bronchi and appear to follow an irregular course.

Some believe them to be bronchial veins, but it is difficult to conceive that bronchial veins would be present in such numbers and for this reason, they are just called pulmonary veins. The pulmonary artery follows a fairly direct course lying alongside the bronchus. Not only does the pulmonary artery maintain a close anatomic relationship to the bronchus, but it also appears that there is a close relationship in size between the two structures.

**DISCUSSION**

That the bronchial arteries play an important part in the circulation of the lung has long been surmised, but their full significance and purpose is still not known.

It is known that they form the vasa vasorum for the pulmonary artery and its branches, supply the walls of the bronchial tree and at least part of the esophagus and probably send small branches to some of the hilar lymph nodes and the vagus nerve. However, it is quite probable that the bronchial arteries have other and more important functions. The numerous anastomoses described earlier do, no doubt, play an important physiologic function. The fact that they are found in the lungs of the young and the old, in normal and diseased
lungs would indicate that they are a normal part of the circulatory pattern of the lung.

With the exception of Tobin, anastomoses between the pulmonary and bronchial arteries were thought to exist only between vessels slightly larger than capillaries. The fact that there are also many anastomoses between vessels of considerably larger dimensions is of great interest.

The concept by Lapp, Verloop and von Hayek that the anastomotic vessel constitutes a sphincter-like mechanism and is able to control the blood flow in the vessel has certain appeal. The considerable difference in the pressures between the pulmonary and the bronchial arteries would allow the blood, under normal circumstances, to flow only in the direction from the bronchial to the pulmonary artery. This apparently occurs whenever the pressure in the pulmonary arterial vessels falls below a certain minimum. In health, such a fall could occur during inspiration or whenever, for some reason or other, the circulation is reduced to some parts of the lung as it has been described to occur.

There are many pathologic states where the blood pressure in certain parts of the lung could fall considerably. This must occur in a pulmonary artery distal to an occlusion by an embolus or by thrombosis. Thrombosis, temporary or permanent, may occur in pulmonary arteries adjacent to an

![Diagram of anastomoses between branches of the pulmonary and bronchial arteries.

Figure 4: Drawing to illustrate anastomoses between branches of the pulmonary and bronchial arteries. AN. P.A-B.A. Anastomoses between branches of pulmonary and bronchial arteries. The figures denote the diameter of the vessels in mm. The change of color of the blue and green Vultex moulage is abrupt in all instances. BR. Bronchiole which is a branch of the bronchiole measuring 1.60 mm. in diameter. P.A. 1.15 mm. Branch of pulmonary artery measuring 1.15 mm. in diameter.
abscess, bronchiectatic cavity, inflammatory focus as in tuberculosis, and in pneumonias. In such instances, the pulmonary parenchyma peripheral to such an occlusion could be supplied by a collateral circulation established by means of the anastomoses between the bronchial and pulmonary arterial circulations. Fall in vascular pressure may also occur in certain parts of the lung in such diseased states as pulmonary fibrosis and in emphysema. In lungs where the capillaries have become compressed by fibrous tissue and the resistance in the lesser circulation has considerably increased, it is logical to assume that the blood pressure in the peripheral pulmonary arterial circulation is lower than normal and thus may favor an increased flow of blood through the anastomoses from the bronchial to the pulmonary arteries. It is most likely by such means that almost solidly fibrosed lung tissue can be kept alive without unduly straining the heart to raise the blood pressure in the lung. A lung compressed by pleural effusion or pneumothorax can be kept viable, similarly.

One can also postulate that the anastomoses may contribute unfavorably to the sudden development of pulmonary edema in left heart failure.

In view of these findings, therefore, it would appear that the bronchial arterial circulation constitutes an important and integral part of the pulmonary circulation. The bronchial circulation is of particular significance in emergency situations, such as described above, and is as important to the lungs as the parachute is to the pilot. The suggestion by Verloop and Ellis and associates\(^5\) that the bronchial arterial circulation is a vestigial structure does not appear to be valid.

Although Tobin\(^4\) identified anastomoses of a caliber larger than capillaries, he did not attach much importance to them and stated that there were only very few of them. The fact that the larger anastomoses were missed by the other investigators is probably due to the technique employed. They all, including Tobin,\(^4\) used serial microscopic sections for their studies. There would appear to be little doubt that the use of corrosion models as used in this study, is a reliable method for the study of the anastomoses between bronchial and pulmonary arteries.

**Summary**

Corrosion models of human lungs were made for the purpose of studying the anastomoses between the bronchial and pulmonary arteries.

The diameter of the anastomotic vessels ranged from 0.05 mm. to 0.5 mm. in size, and their length from 0.1 mm. to 10 mm. They were found on bronchi measuring in diameter from 1.60 mm. to 3.50 mm. Anastomoses were not confined to secondary lobules, but were found throughout the lung parenchyma except for a small area surrounding the hilum. In the regions where the pulmonary artery branches measured 0.2 mm. to 0.3 mm. in diameter, the anastomoses were very numerous.

The physiologic importance of the bronchial arteries and their anastomoses with the pulmonary arteries has been discussed.

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**Resumen**

Con el propósito de estudiar las anastomosis entre las arterias bronquiales y las pulmonares, se hicieron modelos de pulmones humanos por el procedimiento de la corrosión. El diámetro de las anastomosis vasculares varió de 0.05 mm. hasta 0.5 mm. y su longitud de 0.1 mm. hasta 10 mm. Se encontraron en bronquios con diámetros de 1.60 mm. hasta 3.5 mm. Las anastomosis no estaban limitados a los lóbulos secundarios sino que se encontraron en todo el parénquima pulmonar, con excepción de una área pequeña rodeando el hilio. En las regiones donde las son muy numerosas.

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Le importancia fisiológica de las arterias bronquiales y sus anastomosis con las pulmonares son el motivo de esta disertación.

ZUSAMMENFASSUNG

Korrosionsmodelle menschlicher Lungen wurden hergestellt, um den Versuch zu unternehmen, die Anastomosen zwischen den Bronchial- und Pulmonalarterien zu studieren.

Der Durchmesser der Gefäßanastomosen schwankte zwischen 0,05 bis 0,5 mm in der Breite und 0,1 bis 10 mm in der Länge. Sie wurden an Bronchien gefunden, die im Durchmesser 1,60 bis 3,50 mm maßen. Anastomosen waren nicht auf sekundäre Lohuli beschränkt, sondern, wurden im gesamten Lungenparenchym gefunden außer in eine kleinen Gebiet um den Hilus. In den Gebieten, in denen der Durchmesser der Äste der Pulmonalarterien 0,2 bis 0,3 mm betrug, fanden sich Anastomosen sehr zahlreich.

Die physiologische Wichtigkeit der Bronchialarterien und ihrer Anastomosen mit den Pulmonalarterien wurde erörtert.

REFERENCES


CAPLAN’S SYNDROME

Clinical observation over the last few years suggested that some widening of the definition of the pulmonary radiographic side of the rheumatoid pneumoconiosis syndrome was needed. Clinical and radiologic investigations in a group of coal-miners showed there was an increased prevalence of rheumatoid arthritis in both in miners with small nodular discrete radiographic opacities, normally defined as nodular simple pneumoconiosis, and in miners with a mixture of nodular and irregular opacities, normally included in the category of progressive massive fibrosis.

Independent immunologic studies showed that miners with these radiographic appearances or the classic chest radiographic changes of the rheumatoid pneumoconiosis syndrome, who had no history, signs or symptoms of rheumatoid arthritis, had a high proportion of positive rheumatoid factor tests.