ON THE OCCURRENCE OF PULMONARY ARTERIES ARISING FROM THE THORACIC AORTA

ROLLO E. McCOTTER

From the Anatomical Laboratory, University of Michigan.

WITH ONE FIGURE

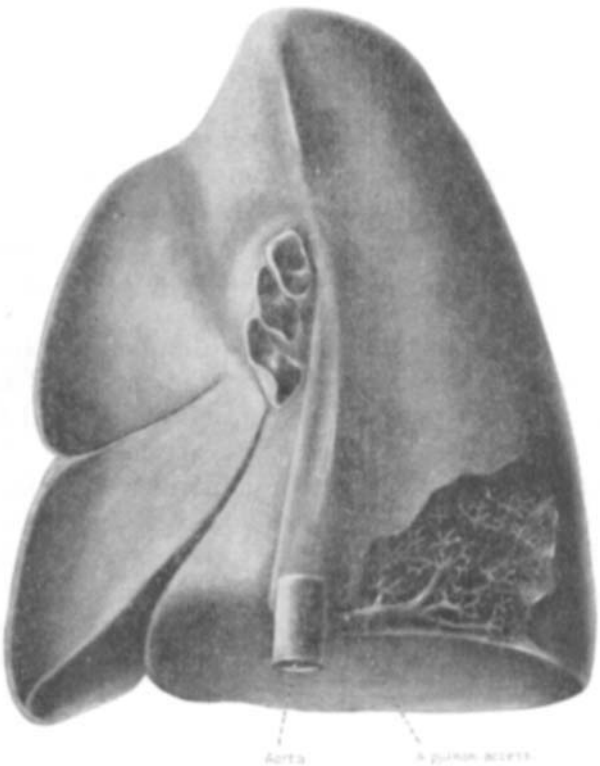
In the light of the recent advances that have been made in our knowledge concerning the early stages in the development of the vascular system, vascular anomalies take on a new interest. It is with this in mind that the writer reports the following apparently rare case of an accessory pulmonary artery arising from the lower part of the thoracic aorta.

The present case was observed in the anatomical laboratory of the University of Michigan. It occurred in a well nourished male white subject of medium height and build, aged 65 years. The cause of death was recorded as "heart disease." Upon dissection of the body the following conditions were found. From the front of the thoracic aorta, on a level with the tenth thoracic vertebra, 7 cm. above the cœliac axis, there was given off an artery, 7 mm. in diameter, which passed upward and to the right between the folds of the ligamentum latum pulmonis to the lower inner margin of the right lung. Here it entered the substance of the lung and broke up into branches which ramified among the lobules of the lower lobe, as is shown in the accompanying figure. There was no vein accompanying the artery. The lung itself otherwise appeared normal. From the aorta there were given off the usual number of intercostal arteries. Aside from the presence of the accessory pulmonary artery the pleura and structures in the mediastinum appeared entirely normal.

On reviewing the literature we have found nine cases recorded of accessory pulmonary arteries, in seven of which the accessory arteries arose from the thoracic aorta, one was given off from the

abdominal aorta, and one from an intercostal artery. In four of them as in the present case, the lung was otherwise normal. In the remaining five cases the arteries supplied accessory lobes.

The first case was reported by Huber (1777), who found in a two-year-old female child a large trunk arising from the thoracic aorta on a level with the seventh thoracic vertebra, which went



to the lower lobe of the right lung, where it entered the lung substance along its lower margin. In its course it gave off branches to the œsophagus and bronchial glands. Maugars ('02) described a case occurring in a seven-year-old child in which the abdominal aorta gave off an artery 5 mm. in diameter, which passed upward through the œsophageal opening in the diaphragm. After giv-

ing off branches to that muscle it divided into two trunks, one going to the lower lobe of each lung. Meckel ('20) described a case occurring in a nine-months-old child, where an artery, 9 mm. in diameter, was given off from the thoracic aorta about 1 cm. above its passage through the diaphragm. It passed upward and to the left to reach the lower border of the left lung, and divided into a medial and a lateral branch. The former was distributed to the lower portion of the lower lobe of the left lung. The lateral branch could not be followed. The vein that accompanied this artery terminated in the left pulmonary vein. Hyrtl ('39) recorded the occurrence in a new-born child of a pulmonary artery given off from the thoracic aorta supplying the left lower lobe, the left pulmonary artery proper supplied only the left upper lobe.

It will be seen that these four cases are essentially similar to our case. They differ only in that they were found in very young subjects. In one of them the artery supplied the right lung as in our case; in two of them it supplied the left lung, and in the remaining case it arose much lower down, below the diaphragm, and supplied both lungs.

In the following five cases the lungs were abnormal; Rektorzik ('61) described a case, observed in the body of a well-nourished girl who had died of peritonitis, of an accessory lobe 4 cm. long, $2\frac{1}{4}$ cm. wide, and $1\frac{3}{4}$ cm. thick. The lobe was situated between the left lung and the diaphragm. At the level of the tenth vertebra an artery 2 cm. long and having a diameter about the same as the left renal entered at the inner surface of the accessory lobe, where it divided into a number of branches. A single vein accompanied the artery and terminated in the hemiazygos. Rokitansky ('61) found in the left pleural sac of a three-months-old child between the normal left lung and the diaphragm, an accessory lobe, conical in shape and containing no branches. Two arteries, which arose close to one another from the thoracic aorta on a level with the tenth intercostal space, entered the inferior surface of the accessory lobe. A single vein accompanied the artery and terminated in the vena azygos. Ruge ('78) described a case in a new-born child where an accessory lobe, situated between the left

lung and the diaphragm, received its blood supply by a small artery arising from the seventh intercostal. Humphrey ('85), during a postmortem examination on a year-old child, observed an accessory lobe between the base of the left lung and the diaphragm. A small pedicle which contained a small artery arising from the aorta and a vein which entered the hemiazygos connected the accessory lobe with the mediastinum. The most recent case was described by Simpson ('07), who found in a full-term fœtus, situated below the right lung, an accessory lobe connected to the mediastinal space by a pedicle which contained an artery, the size of the internal carotid, which sprang from the aorta on a level with the tenth thoracic vertebra. In these cases of accessory pulmonary arteries connecting the systemic circulation with abnormal lungs one occurred on the right side and four on the left. Like the first four cases of normal lungs, they occurred in very young individuals.

Accessory pulmonary arteries have been described in certain vertebrates (amphibia and reptiles). Mudge ('98) described a case occurring in a frog where the caudal tip of the right lung was supplied by an artery arising from the cœliac artery. The caudal tip of the left lung was supplied by two arteries arising from the superior mesenteric artery. These arteries were accompanied by veins that terminated in the portal vein. A similar case has since then been described by Warren ('00). In the necturus there was reported by Williams ('09) an artery arising from the seventh intercostal artery, which reached the caudal tip of the left lung and passed to the cephalic extremity along the inner surface, giving off many branches to the lung substance in its course. According to Hyrtl ('37) and later confirmed by Calori ('42), accessory pulmonary arteries occur normally in ophidia. He observed a series of arteries arising from the aorta which passed laterally to the posterior vesicular portion of the much elongated lung.

For an explanation of vascular anomalies of this character we must undoubtedly look to the developmental factors involved. It is now generally believed, owing to the researches of Thoma and more recently of Evans, that the blood vascular system begins

as a capillary plexus (area vasculosa) which spreads in all directions. Subsequently channels develop through the capillary net which enlarge and become arteries and veins, according to whether the channel develops on the arterial or venous side of the extending plexus. Many of the capillary connections between the main channels finally disappear.

According to Flint and Evans, who worked on pig embryos, a plexus is formed which extends caudad from the developing pulmonary arches and envelopes the lung anlage in a rich capillary net. It is supposed that the pulmonary arteries are normally formed as channels in this plexus. In cases, however, like those we have been considering, where the pulmonary artery arises from the thoracic aorta, we must conceive of a plexus extending laterally from the primitive aorta and joining the pulmonary capillary plexus mentioned above, resembling the capillary net that extends laterally from the developing aorta to the limb buds as described by Evans. It is probable that we have to do with one of two conditions; firstly, it may be that a lateral primary capillary connection between the lung anlage and aorta is always present, and that this usually atrophies with the disappearance of the vascular connection between the lung and aorta. Occasionally a permanent channel is developed through it, and then we have the rare condition present which we have just reported. Secondly, it is possible that only occasionally a capillary plexus is laid down between the aorta and lung anlage, resulting in the production of a permanent channel constituting an accessory pulmonary artery. The frequent occurrence of small arteries extending laterally from the aorta between the folds of the ligamentum latum pulmonis to the lung, as described by Turner, and which I have frequently confirmed in this laboratory, support the former view. But we cannot expect a complete explanation of these anomalies until the detailed development of the pulmonary arteries has been worked out.

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