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PROFILES IN CARDIOLOGY

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The Botallo Mystery

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In several dictionaries the name of Botallo appears as eponym for three cardiovascular anatomical structures: the foramen ovale, the ductus arteriosus, and the ligamentum arteriosum, and in an anatomical atlas based on international nomenclature it is still linked to both the ductus arteriosus and its corresponding ligament.^{1–4} Some, however, claim that the Botallo eponym for the ductus arteriosus is erroneous, and that his original description in 1564 is only a note and remains just a short passage in his book *Opera Omnia*, a Leiden edition not printed until 1660. The structures he described were already known, and the word rediscovery is sometimes used in connection with Botallo.^{2, 5–8}

Leonardo Botallo

Botallo was an Italian surgeon working at the French royal court and was doctor to several prominent people (Fig. 1). As an army surgeon he opposed the current theory that shotwounds were poisonous, and he advocated a milder treatment than was customary although he was a strong believer in bloodletting. Both these issues are illustrated on a title page of the *Opera Omnia*. The poor prognosis of chest wounds at that time led Botallo to conclude that all wounds involving the lung were beyond cure.^{6, 8–10} In 1560 he published *De curandis vulneribus sclopettorum*, to be followed by several new editions. He published the first description of hay fever in *De catarrho commentarius* and commented on medical ethics and on the treatment of syphilis. He opposed the astrological influence on medical thought.^{2, 6, 8, 10}

Botallo was born in Asti, Italy, but there is disagreement about his birthdate, 1519 or 1530, with 1530 sometimes given as the year of his graduation.^{2, 3, 8, 10} According to other sources, Botallo graduated doctor of medicine at the Italian university of Pavia in 1543. He then studied under Fallopio, the successor of Vesalius at Padua. A year later he joined the French military forces as a surgeon. In his final years he was probably afflicted by malaria. The place and year of death are uncertain, 1587/88 or 1600, and his burial place is unknown.^{6–8, 10}

Cardiovascular Discoveries

Botallo repudiated the openings in the intraventricular septum described by Galen. Instead, he aimed to show that blood passed by means of a "duct" between the right and left atria, which he claimed himself to have discovered. He called it *vena arteriarum nutrix*, nourishing arteries and vital spirit. He claimed that

this passage varied in humans, but was always patent in calves, swine, and dogs. His account was first published as a short note in 1564, added to *De catarrho*, reprinted the year after, and once more in 1641. According to others, Botallo's duct corresponds to the foramen ovale, and had also been described in the second century by Galen in his *De Usu Partium*. Canalis was Botallo's name for the ductus arteriosus.^{2, 5-7, 9, 11}

Perhaps because of a too superficial interpretation of Botallo's text, his name became attached to certain anatomical structures of the heart already described before him. In his 1660 edition of the *Opera Omnia*, van Horne inserted Botallo's short version but also a long footnote and an illustration, probably his own, of the heart (Fig. 2). Van Horne also mentions Galen's description. There is no evidence that Botallo's original note was accompanied by any illustration. Furthermore, Botallo's interpretation of Galen's and Colombo's concept of the circulation is said to be incomplete.^{7, 11}

Even the great men of science William Harvey and later Albrecht von Haller are supposed to have prolonged the misconception by referring to Botallo. Although Galen knew of the existence of the foramen ovale and its normal closure, Botallo seems have been the first to describe a persistent foramen ovale after birth, but without understanding its function in the fetal state. A persistent ductus arteriosus after birth was described much later in 1757 by the German Reinmann.^{8, 11, 12} In 1786, the Swedish surgeon Hagströmer described a patent foramen ovale in a deceased 40-year-old woman; the report is to be found in the proceedings of the Swedish Royal Academy of Science (Fig. 3). At this time, a number of case reports of patent foramen ovale in the adult were known, and Hagströmer refers to Bartholin, von Haller, Vieussens, and Morgagni, among others, but not to Botallo or earlier sources. Hagströmer presents correct knowledge of the physiology of the fetal circulation including the function of both the foramen ovale and ductus arteriosus. He strongly refutes a contemporary idea that divers with a patent foramen ovale ought to perform better due to longer survival without air; on the contrary, a patent foramen ovale can predispose to decompression sickness and other forms of paradoxical embolism or arterial desaturation.^{13, 14}

The ductus arteriosus is derived from the sixth left bronchial arch. It usually closes functionally within hours after birth and permanently during the following weeks. This muscular constriction of the ductus is stimulated by a high level of blood oxygenation. In the African and South American lungfish, however, a ductus similar to the ductus arteriosus of mammals acts in a cyclic fashion depending on the animals phase of immersion or air breathing. The lungfish is able to breathe by way of lungs or, to a lesser extent, gills.^{5, 15}

In 1564, another Italian physician, Julio Cesare Aranzio, pupil of Vesalius at Padua and subsequently professor of anatomy at Bologna, described both the fetal foramen ovale and the ductus arteriosus, but modestly claimed only to elaborate in detail on Galen's earlier descriptions. Both these anatomical structures were supposed to nourish the heart and lungs with venous and arterial blood, respectively.^{2, 7, 16} According to other sources, Aranzio was the true discoverer of the ductus arteriosus; he also mentions the postnatal closure of the ductus arteriosus and foramen ovale. Another discovery in connection with Aranzio and the heart is the *corpora Arantii* or nodules of the semilunar aortic valve.^{1-3, 6, 16} In 1561, both Fallopio and Vesalius also mentioned the ductus arteriosus and the foramen ovale.^{2, 11, 12}

Much later, in 1875, the Viennese pathologist Karl Rokitansky described in detail congenital heart disorders derived from defects in the atrial and ventricular septa.¹⁷ In 1938, Robert Gross, working in Boston, performed the first successful surgical closure of a persistent ductus arteriosus. This operation was soon to be taken up by Scandinavian surgeons, and pioneer work on the arteriographic depiction of the ductus

arteriosus followed in Sweden.¹² This, of course, was many centuries after the discovery of this anatomical structure sometimes still named after Botallo, who actually described the foramen ovale.

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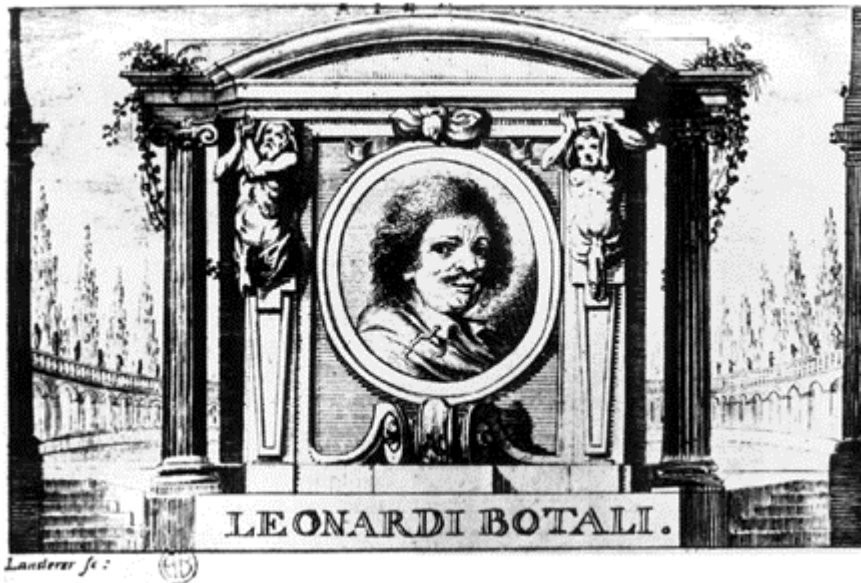


Fig. 1 The dates of Botallo's birth and death are given variously as 1519 or 1530, and 1587, 1588, or 1600, respectively. This photograph was published in *Botallo Leonardo: Astese, medico regio* by Prof. Dott. Leonardo Carerj (Asti, Italy: Casa Editrice Arethusa, 1954). The legend shown below the photograph indicates that Botallo's name was erroneously spelled Botali rather than Botallo in the figure. The author and publisher wish to thank Dr. Louis Acierno of the University of Central Florida and Dr. Frabboni of Bologna for their help in locating the photograph.

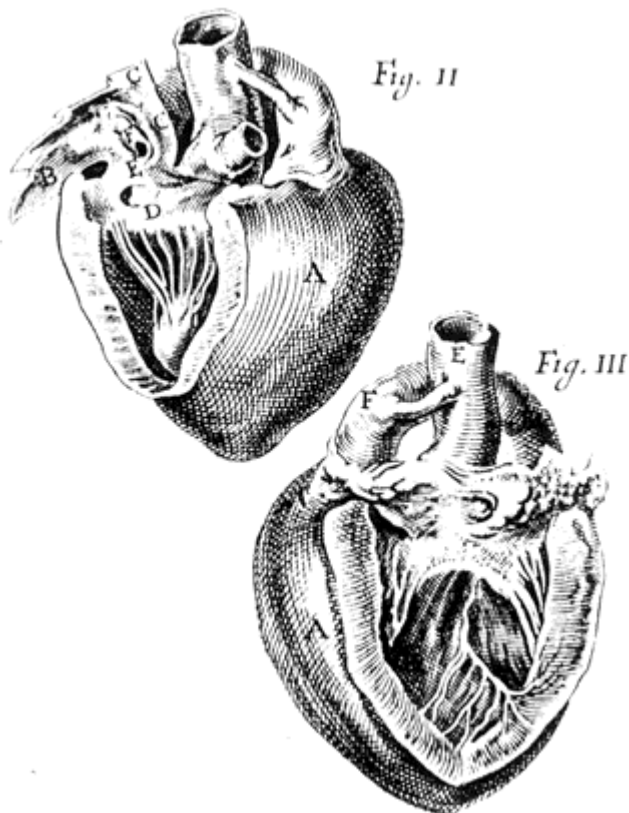


Fig. 2 Illustration probably inserted by van Horne relating to Botallo's description of cardiac anatomy. *Opera Omnia* 1660, from Uppsala University Library, the Waller collection.



Fig. 3 Title page to the 1786 proceedings of the Swedish Royal Academy of Science, containing Hagströmer's description of a persistent foramen ovale in an adult.