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Case report

A case of Y-shaped left coronary artery (*Vesperugo pipistrellus* embryo)*

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Summary. A case of Y-shaped left coronary artery from the aorta in a *Vesperugo pipistrellus* embryo is presented and its embryological origin discussed.

Key words: Vascular system – Heart – Anomalous coronary arteries-Chiroptera.

Introduction

The anomalous origin of the coronary arteries in humans is a particularly interesting problem owing to their inherent surgical importance. The problem of the embryological basis of their development which has considerable theoretical implications, is still unsolved.

Theories such as that of the malposition of the aortopulmonary septum (Abrikossof 1911), or that of the persistence of accessory coronary buds (Hackensellner 1956), have neither been posively proven nor definitively discarded (Goerttler 1963; Sarrouy et al. 1966; Van Mierop 1979).

Recently, we found a case of left coronary artery arising with two roots from the aorta in an embryo of *Vesperugo pipistrellus*. Even though we observed this fact in a non-human mammal it makes a very important contribution, in our orpinion, towards settling the controversy about the anomalous origin of the coronary arteries. Indeed, this finding agrees with our findings in humans (Conte and Grieco 1981; Conte 1982; Conte and Pellegrini 1984).

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This *V.p.* embryo is 6.7 mm in length (2.5 mm o.f.) and is n° 38 in the 48 serially sectioned embryos of *V.p.* in the collection of the Institute of Human Anatomy, Faculty of Medicine,

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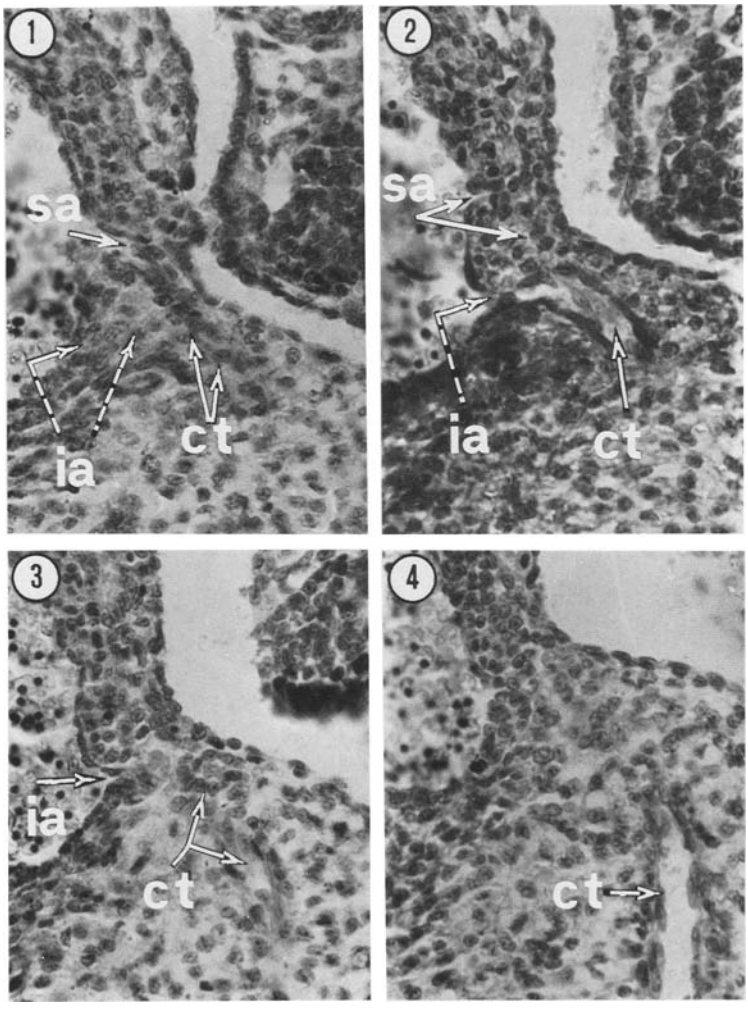

Figs. 1–4. *Vesperugo pipistrellus* embryonic heart, coronal sections, ventral view (× 350). The figures show the left coronary artery truncus (*ct*) arising from the aorta with two anlagen, one superior (*sa*) and the other inferior (*ia*)

University of Pisa (see Conte and Arrigoni 1966). It was fixed in Zenker's fluid, stained with Carmalum, embedded in paraffin wax and sectioned, in a transverse direction, at a thickness of 10 µm. The heart, sectioned in a coronal direction, is the equivalent age of that of the human embryo C_9, 14 mm long, stage 18, age ca. 44 days (Conte and Pellegrini 1984). We observed that the left coronary artery truncus (ct) of this embryo originated from the aorta with two anlagen, one cranial (s a) and the other caudal (i a) (Figs. 1–4). The left coronary artery subsequently becomes Y-shaped; the right coronary artery is normal.

Embryological considerations

Every theory on the anomalies in the origin of the coronary arteries must always be related to their ontogenesis. The oldest theory (Abrikossof 1911)

is based on the studies by Martin (1894) concerning the development of the coronary arteries in rabbit embryos. This theory attributes anomalous origin of the coronary arteries to the dystopia of one or both the coronary buds or to the abnormal division of the truncus arteriosus by a deviated aortopulmonary septum. Feller (1931), Stein (1953), Tedeschi and Helpern (1954), George et al. (1959) have agreed with this hypothesis.

Hackensellner's theory (1956) is based on his own findings concerning coronary arteries originating from the pulmonary artery: he observed this phenomenon in 17% of human embryos and in 0.48% of the autopsies of the adults examined. Consequently, Hackensellner thought that in embryo numerous coronary buds develop from the aorta and pulmonary artery and then, normally, most coronary buds disappear and only two – the right and left ones – complete their development from the aorta. This author supposed, therefore, that anomalous coronary arteries develop if, instead of two, several aortic buds complete their growth simultaneously. However, this hypothesis of the multiple origin of the coronary arteries from the great arteries has been rejected by Goertler (1963) and Van Mierop (1969).

For our part, we recently observed (Conte and Grieco 1981; Conte 1982; Conte and Pellegrini 1984) that in fact the truncus of the coronary arteries in human embryos (stage 15) develop as multiple endothelial buds from the aorta and pulmonary artery and that then only two buds (namely, one on the right and one on the left side of the aorta) hollow out, increase in length and join up with the right-posterior and left-anterior subepicardial vascular networks (s.v.n.), respectively; all the other buds disappear. The two aortic buds form the truncus of the right and left coronary arteries, while the s.v.n. form their subepicardial branches.

Our findings therefore supported Hackensellner's hypothesis concerning the persistence of one of the additional buds, normally destined to involute, in the formation of the anomalies in the origin of the coronary arteries. But up to now it was impossible to find any embryological support for this hypothesis; indeed, the y-shaped coronary arteries observed by Stein (1953) – one root coming from the aorta and the other (the fistulous tract) from the pulmonary artery – were used to support the theories of Abrikossof (Stein 1953; Tedeschi and Helpern 1954) and of Hackensellner (Schulze and Rodin 1961; Roberts 1962; Sarrouy et al. 1966).

The case examined here is the first incontrovertible embryological demonstration that the anomalies in the origin of the coronary arteries (fistulas between the coronary arteries and the pulmonary truncus; accessory or ectopic coronary arteries, Goor and Lillehei 1975) really develop as Hackensellner supposed they did and, in our opinion, it is also the definitive demonstration that Abrikossof's theory is untenable. Indeed, whatever hypothetical anomalous development of the aortopulmonary septum is examined, this malpositioned septum is never able to cut the anlage of the truncus of one coronary artery in two in such a way as to create two superimposed roots, one above the other coming from the same artery that is, in our case, the aorta. In actual fact, the aortopulmonary septum can never be placed transversely to the arteriosus truncus.

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