# Quadricuspid Aortic Valve and Single Coronary Artery in a Greater White-Toothed Shrew, Crocidura russula

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## Quadricuspid Aortic Valve and Single Coronary Artery in a Greater White-Toothed Shrew, *Crocidura russula*

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ABSTRACT: An adult greater white-toothed shrew (*Crocidura russula*) had both a quadricuspid aortic valve and a single coronary artery arising from the aorta. The shrew was caught on 10 May 1994 in the environs of Málaga, southern Spain. Both congenital anomalies may be potential causes of cardiac dysfunction, but apparently produced no significant cardiac complication in the shrew. This is the first report of a quadricuspid aortic valve in a wild-living mammal.

*Key words:* *Crocidura russula*, Insectivora, Soricidae, heart, quadricuspid aortic valve, coronary artery anomalies.

In shrews (Insectivora, Soricidae), the normal aortic valve is tricuspid; it has three aortic sinuses, right, left, and dorsal, each supporting one cusp (leaflet). Two coronary arteries, the right and left, arise from the right and left aortic sinuses, respectively, and become intramyocardial shortly after their origin from the aorta (Durán et al., 1991).

Here I describe a greater white-toothed shrew (*Crocidura russula*) with a quadricuspid aortic valve; this condition is characterized by four aortic sinuses and four cusps. In addition, the shrew had a single coronary arterial trunk arising from the aorta.

The affected shrew was accidentally caught with a rat snap-trap on 10 May 1994 in the environs of Málaga, southern Spain (36°44′N, 4°32′W). It was a male, with a body weight of 9.2 g and a body lenght of 79 mm. The estimated age of the animal was at least 14 mo, based on dental wear and condition of the fur coat (López-Fuster, 1983). Greater white-toothed shrews seldom live more than 2 yr (Genoud and Hutterer, 1990); thus, this animal was relatively old.

The shrew was included in an ongoing study of the cardiac semilunar valves and coronary arteries of wild-living mammals. Therefore, the postmortem examination of the animal was confined to the heart.

The heart was evaluated histologically. Histologic sections of the hearts from nine greater white-toothed shrews with normal aortic valves and coronary arteries were used for comparative purposes. All specimens were deposited in the Department of Animal Biology of the University of Málaga, Málaga, Spain.

Each heart was fixed in 10% neutral formalin buffered with magnesium carbonate, and embedded in paraffin. Transverse sections serially cut at 10 μm thickness for light microscopy were stained with hematoxylin-eosin or Masson-Goldner's trichrome stains (Martoja and Martoja-Pierson, 1970).

The anomalous aortic valve (Fig. 1A) had two dorsal cusps, right and left, and two ventral cusps, right and left, all of them of similar size. Each cusp was supported by its own aortic sinus so that, overall, four aortic sinuses, two dorsal and two ventral, were present. The commissures between the two dorsal cusps and between the two ventral cusps were slightly fused. All of the cusps were somewhat thickened, compared with normal (tricuspid) aortic valves (Fig. 1B).

A single coronary arterial trunk arose from the left ventral aortic sinus (Fig. 1A). This single coronary trunk became intramyocardial very soon after its origin from the aorta, and divided into the right coronary artery, left coronary artery, and septal artery. The right and left coronary arteries partially irrigated the right and left

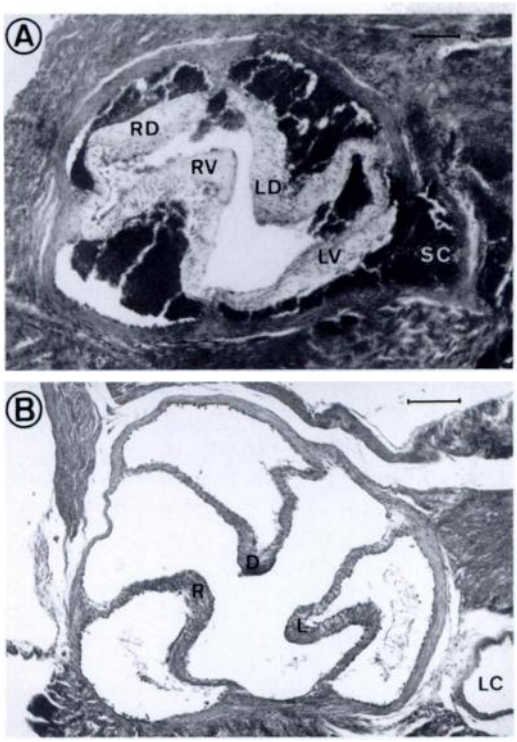


FIGURE 1. Transverse section of the quadricuspid aortic valve (A) of a greater white-toothed shrew as compared with a normal (tricuspid) aortic valve (B) from an adult of the same species. The cusps of the anomalous valve (A) are thickened. D = dorsal cusp; L = left cusp; LC = normal left coronary artery; LD = left dorsal cusp; LV = left ventral cusp; R = right cusp; RD = right dorsal cusp; RV = right ventral cusp; SC = single coronary artery trunk arising from the left ventral aortic sinus. A: hematoxylin-eosin; B: Masson-Goldner's trichrome. Bar = 100 μm.

ventricles, respectively. The septal artery was larger and branched more than usual. Indeed, in shrews, the septal artery usually arises from the left coronary artery and does not extend further than the proximal two thirds of the interventricular septum. The distal portion of the septum is supplied by penetrating vessels originating from the right and left coronary arteries (Durán et al., 1991). But in this shrew, the septal artery supplied the whole interventricular septum as well as the distal third of the wall of each ventricle.

No other congenital cardiac malformations were detected in the affected shrew. Myocardial lesions were not observed. The pulmonary valve was normal.

Occurrence of a congenital quadricuspid aortic valve has been repeatedly reported in humans, as reviewed by James et al. (1991); the estimated prevalence of the defect ranges between 0.008% in 25,666 necropsies (Simonds, 1923) and 0.043% in 13,805 echocardiographies (Feldman et al., 1990). The only report of this cardiac anomaly in non-human mammals is that of Fernández et al. (1994), who described a developing aortic valve with four valve cushions in a laboratory Syrian hamster (*Mesocricetus auratus*) embryo. On the other hand, the anomalous origin of the coronary arteries from a single ostium in the aorta has been mentioned in both humans (Roberts, 1987) and non-human mammals (Sans-Coma et al., 1989), but not in shrews. In humans, quadricuspid aortic valve and single coronary ostium in the aorta usually occur independently (Kim et al., 1988). Concurrence of both anomalies in an individual seems to be a random event; to my knowledge, only one case has been reported (Kim et al., 1988).

In greater white-toothed shrews, the mean basal heart rate is 444 beats/min, and heart rate can exceed 800 beats/min under extreme conditions (Nagel, 1991). Under these circumstances, the dynamics of the aortic valve become quite demanding, and an undisturbed blood supply to the heart is needed. It is well known that a tricuspid design is best suited for normal aortic valve performance and that the presence of two coronary arteries, right and left, ensures an adequate cardiac vascularization. In humans, quadricuspid aortic valves do not necessarily cause symptomatic hemodynamic complications. However, valvular insufficiency (Sievers et al., 1982), aortic stenosis (Feldman et al., 1990), and infective endocarditis (Matsukawa et al., 1988) have been reported in association with such anomalous valves. On the other hand, the anomalous origin of the coronary arteries from a single os-

tium in the aorta has been adduced as a possible cause of myocardial ischemia during or just after severe exertion (Roberts, 1987). However, none of the congenital cardiac anomalies found in the present shrew had apparently produced cardiac complications that might have reduced the life expectancy of the animal.

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