Brief description of the cardiac anatomy in a tiger (*Panthera tigris*, Linnaeus, 1758): a case report

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ABSTRACT: This article describes the cardiac anatomy of an 18-years-old male tiger that died at a local zoo. In general, the cardiac anatomy of this animal corresponded with that described for domestic carnivores. The left atrium received four pulmonary veins. In the right ventricle the musculus papillaris magnus and m. papillaris subarterial had the same size. In the left ventricle there was a greater development of the musculus papillaris subauricularis. The trabeculae carnae had a conspicuous size in a large part of the ventricles. The left coronary artery predominated, being responsible for the irrigation of the majority of the cardiac region; it divided itself into the ramus interventricularis paraconalis and circumflexus, the latter giving off the ramus interventricularis subsinuosus.

Keywords: animal anatomy; heart anatomy; wild animals; Felidae; carnivores; coronary vessels

The anatomy of the genus *Panthera* and that of the tiger in particular is scarcely described in the scientific literature consulted. The cardiac anatomy of domestic carnivores is well documented (Evans, 1993; Barone, 1996), but we have not found any published paper about the cardiac anatomy of the tiger. According to Wallach (Wallach and Boever, 1983) the anatomy and physiology of the exotic feline cardiovascular system are identical to that of the domestic cat.

In a review article (Mazak, 1981) weights and measurements of hearts are cited of three females and one male, with lengths of head and body of 1 720, 1 650, and 1 980 mm, and weights of 145, 135, 97, and 170 kg, respectively, with heart weights being 770, 570, 970, 1 090 g.

The objective of this paper is to describe the cardiac anatomy of a tiger. In this case, the cardiac anatomy of the tiger corresponds in general terms to that described for domestic carnivores.

MATERIAL AND METHODS

An 18-years-old tiger obtained following its death at a local zoo was used. A necropsy and dissection using the classical technique were performed. The heart was studied outside the thorax and pericardium. Both ventricles were incised parallelly to the coronary and longitudinal grooves. Both auricles were incised at their free border. Photographs were taken using a Nikon digital camera. The Nomina Anatomica Veterinaria (International Committee on Veterinary Gross Anatomical Nomenclature, 2005) was used.

RESULTS

The weight of the heart isolated from the pericardium was 940.0 g. The distance measured from the beginning of the pulmonary trunk up to the apex

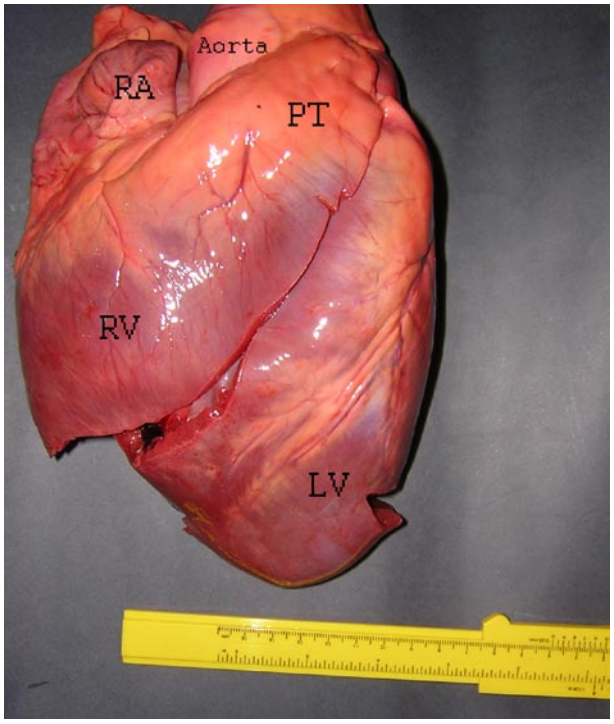

Figure 1. Auricular face of tiger's heart. RA = right auricle, RV = right ventricle, PT = pulmonary trunk, LV = left ventricle

was 15.0 cm. The length between the right and left ventricular borders was 13.0 cm. The cranio-caudal dimension at the base was 10.5 cm.

Seen from the auricular face, the auricles were poorly developed, and the left ventricle predominated on this face (Figure 1). On the atrial face the right ventricle predominated.

Inside the right atrium, caudally to the intervenous tubercle, the fossa ovalis had an elliptical form, with a cranio-caudal length of 2.5 cm and a dorso-ventral length of 1.5 cm. The musculi pectinati were not limited to the right auricle (Figure 2).

The cranial and caudal venae cavae had an inside diameter of 1.5 cm. Ventrally to the orifice of the caudal vena cava was the coronary sinus, where the majority of the venous blood from the heart empties into the atrium.

The right atrioventricular valve had three well-developed cusps (cuspis angularis, parietalis and septalis) (Figure 2).

In the right ventricle the trabeculae carnae were well developed in both parietal and septal walls (Figure 2), mainly in the parietal face near the inflow route of the ventricle. The width of the right ventricle wall was 0.5 cm at the level of the conus arteriosus and in the area where the trabeculae carnae were more developed the maximum width was 1.0 cm. The supraventricular crest was poorly developed (Figure 2). The papillary muscles were not developed very much either, and were distributed into two principal muscles of similar size (musculus papillaris magnus and subarterial) and into other minor ones (musculi papillaris parvi) (Figure 2).

The valve of the pulmonary trunk (valva trunci pulmonalis) had three semilunar valvulae (sinistra, dextra and intermedia), on the arterial side they were concave and their nodules and lunae were easily visible. The pulmonary trunk, of lesser size and width than the aorta, divided itself into two pulmonary arteries 6 cm from its point of origin. The pulmonary arteries had an internal diameter of 2 cm.

The left auricle had very few musculi pectinati, less than a half of those in the right auricle. Four pulmonary veins were seen entering the right atrium.

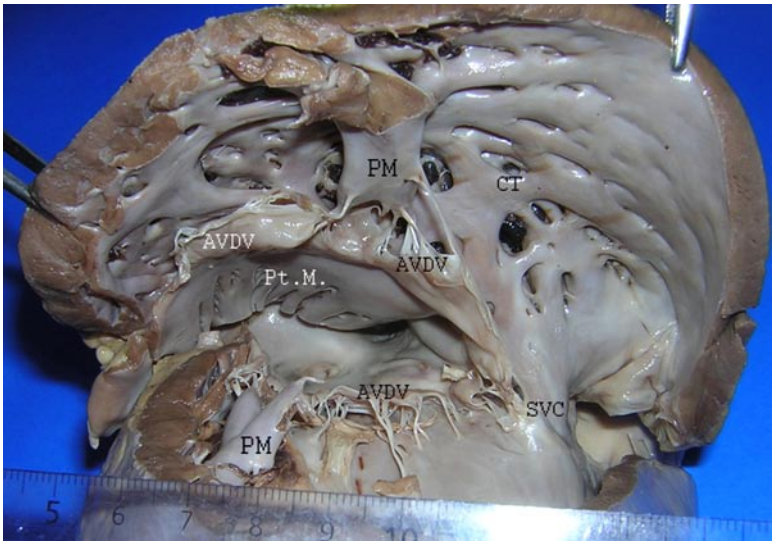

Figure 2. Interior view of the right ventricle. PM = papillari muscles, AVDV = right atrioventricular valve, SVC = supraventricular crest, CT = trabeculae carnae, Pt. M. = musculi pectinati

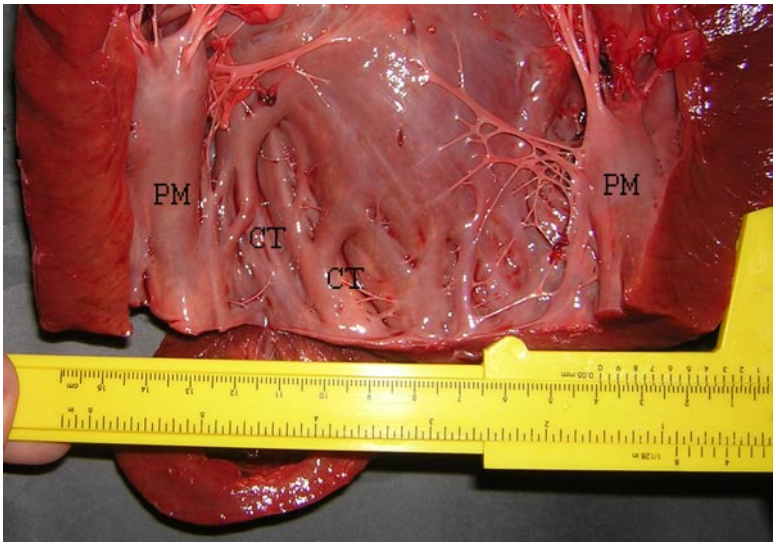

Figure 3. Interior view of the left ventricle. PM = papillari muscles, CT = trabeculae carnae

The wall of the left ventricle had a width of 2.5 cm. The left atrioventricular valve was bicuspid (septal and parietal cusps). The largest papillary muscle of the left ventricle, musculus papillaris subauricularis, measured 4.0 cm in length, and the musculus papillaris subatrialis measured 3.0 cm (Figure 3). There was a great development of the trabeculae carnae near the musculus papillaris subauricularis, and a fine network of muscular strands close to the musculus papillaris subatrialis that came from the septal wall (Figure 3).

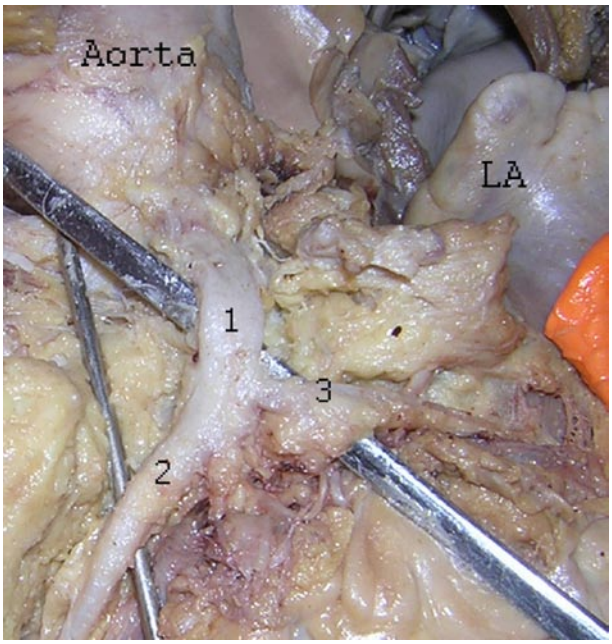

Figure 4. More important arteries of the heart. 1 = left coronary artery, 2 = ramus interventricularis paraconalis, 3 = ramus circumflexus, LA = left auricle

The aorta was the most conspicuous element at the base of the heart. It measured 6.0 cm in its internal diameter and the width of its wall was 6.0 mm.

The valve of the aorta (valva aortae) was composed of three semilunar valves (right, left and septal).

The cardiac arterial irrigation came from two coronary arteries, left and right, which emerged from their respective orifices of the left and right sinus aortae. The left coronary artery had a length of 2.5 cm from its origin up to its division into the ramus interventricularis paraconalis and circumflexus (Figure 4). The ramus circumflexus gave off the ramus interventricularis subsinuosus.

The vena cordis magna was single, and covered the arterial ramus interventricularis paraconalis, which was situated deep in the groove (sulcus interventricularis paraconalis), and both were covered by subendocardic fat. The vena cordis magna was dilated at the place where it emptied into the coronary sinus, ventrally to the orifice of the caudal vena cava. The vena cordis media ascended along the ramus interventricularis subsinuosus and united with the vena cordis magna before its termination.

DISCUSSION

In general terms, the cardiac anatomy of this animal corresponded with the description made for domestic carnivores (Evans, 1993; Barone, 1996), but it is not identical to it as it was stated (Wallach and Boever, 1983). The heart does not have a globose form as it does in the dog, and it is more similar to the heart of the domestic cat.

The body weight of this animal could not be established, but that of the heart could, and it corresponded to what was described (Mazak, 1981).

The poor development of the auricles and of their musculi pectinati was the most conspicuous difference from domestic carnivores. There were also differences in the conformation of the papillary muscles and in the trabeculae carnae.

In the right ventricle of the cat the m. papillaris subarteriosus predominates (Barone, 1996), and in the dog the m. papillaris magnus is the most developed (Evans, 1993; Barone, 1996). In the case of the tiger both these muscles had the same size.

In the left ventricle of the cat the m. papillaris subatrialis is stronger than the m. papillaris subauricularis (Barone, 1996); the opposite was found in the tiger, where there was a greater development of the m. papillaris subauricularis. In the dog the situation is similar to that of the tiger (Evans, 1993).

With respect to the muscular strands found near the m. papillaris subatrialis, it is probable that these contain fascicles of subendocardic network, considering the findings of similar strands seen in the left ventricle of other species (Truex and Warshaw, 1942).

In contrast, the trabeculae carnae were well developed in a large part of the ventricles. In the tiger four pulmonary veins emptied into the left atrium, where in domestic carnivores a variable number does so.

The cardiac arterial and venous irrigation corresponded with that described for domestic carnivores (Evans, 1993; Barone, 1996). In this case the left coronary artery predominated, and was responsible for the irrigation of the majority of the cardiac region. Similarly like in the dog, cat and domestic ruminants, it divided into the ramus interventricularis paraconalis and circumflexus, the latter giving off the ramus interventricularis subsinuosus.

As only one animal was studied, it is not possible to draw more conclusions about the cardiac anatomy of this species. With a larger number of animals it will be necessary to carry out topographic studies, and more detailed studies of the cardiac anatomy, and also establish differences from domestic carnivores.

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Received: 2006–07–03
Accepted: 2007–01–04

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