Aquatic Mammals 1989, **15.3,** 125–129

Normal and aberrant origin and course of the coronary arteries in small cetaceans

C. J. van Nie DVM

Vakgroep Anatomie & Biomechanica, Medische Faculteit, Vrije Universiteit, van der Boechorststraat 7, 1081 BT Amsterdam

Summary

The normal and aberrant origin and course of the coronary arteries in 27 small cetaceans is described. All hearts display a right preponderance of the coronary arteries. Five anomalies of the arteria coronaria sinistra and one of the ramus circumflexus a.c.s. were observed. None of them caused the death of the animal. The developing of full functional arteries from the anastomoses between the coronary arteries may be the saving factor.

Introduction

Anomalous origin and aberrant courses of the coronary arteries have been observed in man (El-Said *et al.*, 1973) as well as in domestic animals (v.Nie, 1968). The incidence in these mammals remains unknown. In cetaceans only one anomaly has previously been recorded, in a *Physeter* (Truex *et al.*, 1961), while in *Phoca vitulina*, 19 cases have been observed (v.Nie, 1985). Here too an exact incidence mark cannot be computed.

Since a study of the anomalous localization or absent origin and aberrant courses of the coronary arteries cannot be performed without a study of the normal topography of these structures. Both will be described in the following communication.

The literature concerning the cetaceans available to the present author is reviewed in Table 1.

The nomenclature of the morphological structures used will be derived from the Nomina Anatomica Veterinaria, third edition, 1983.

Material and techniques

The hearts belonged to 12 dolphins: 6 white-snouted dolphins (*Lagenorhynchus albirostris*, Gray, 1846); 1 white-side dolphin (*Lagenorhynchus acutus*, Gray, 1828); 3 true dolphins (*Delphinus delphis*, L., 1758); 2 bottle nosed dolphins (*Tursiops truncatus*, Montagu, 1821) and 15 harbour porpoises (*Phocoena phocoena*, L., 1758).

The hearts were rinsed in tapwater after the post-mortem examination of the animals and stored in 4% formaldehyde for at least one month. Since the clotted blood in the coronary arteries makes an X-ray examination not practicable, the dissection of the vessels was performed manually by means of fine polished surgical instruments under a spotlight.

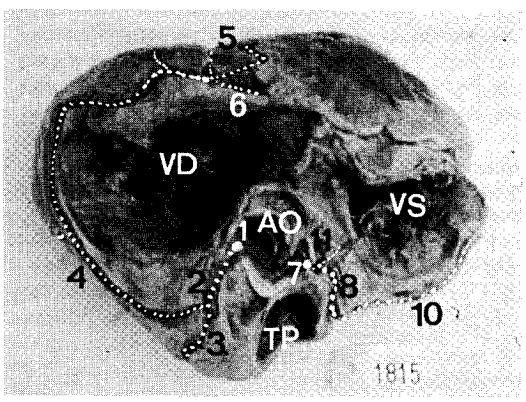

Figure 1. Basal view of the heart of a dolphin with an aplasia of the origin of the r.interv.paraconalis.

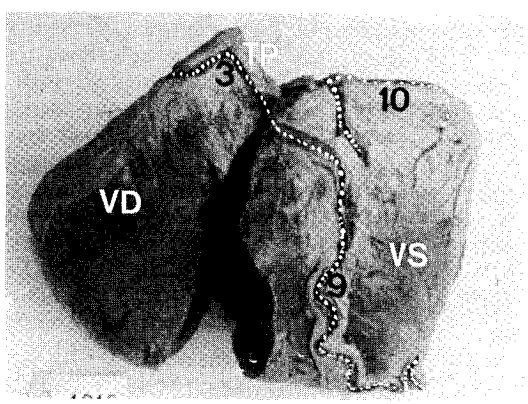

Figure 2. View of the left side of the heart of a dolphin with an aplasia of the origin of the r.interv.paraconalis.

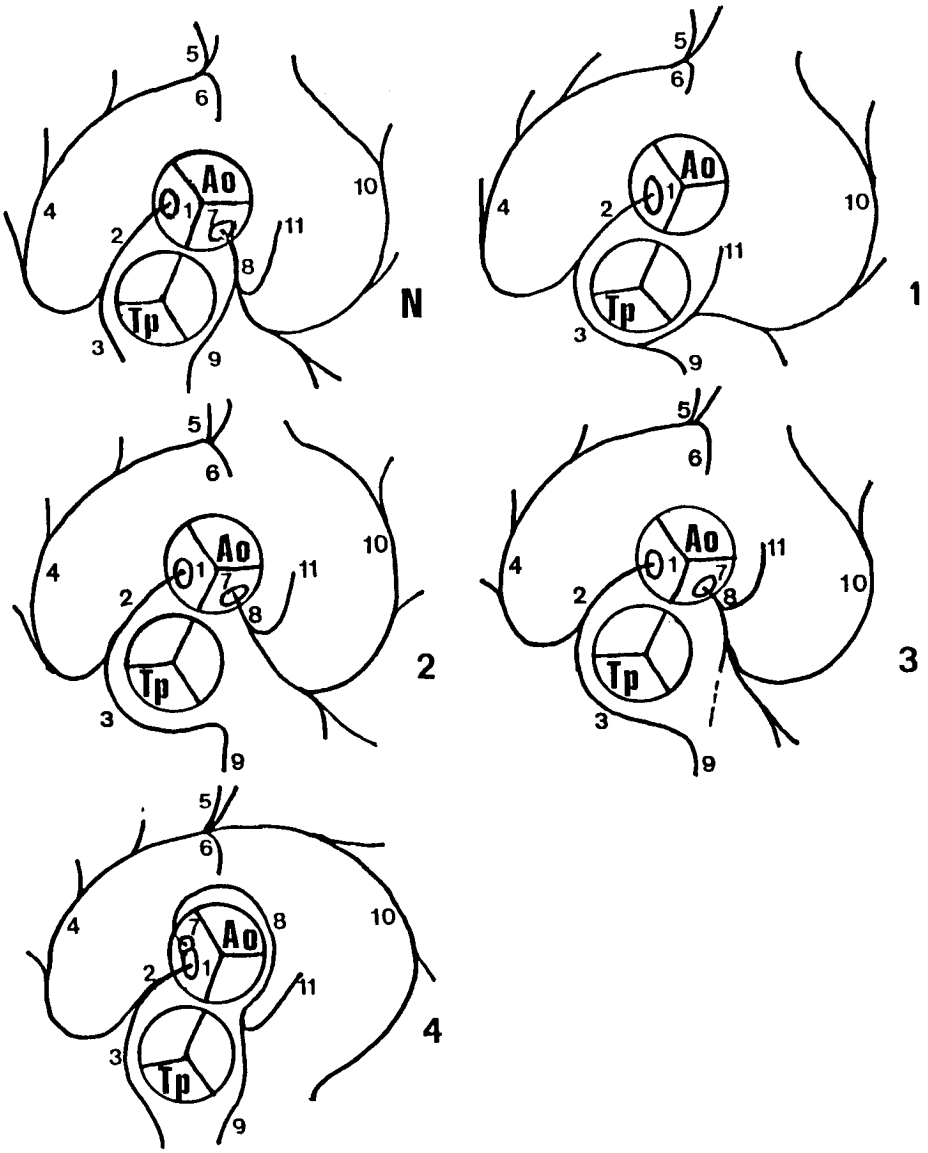

Figure 3. N. normal origin and course of the arteriae coronariae. 1. aplasia origin of the a.c.s. 2. aplasia origin of the ramus interventricularis paraconalis. 3. hypoplasia origin of the ramus interventricularis paraconalis. 4. aberrant origin a.c.s. and aplasia of the ramus circumflexus a.c.s.

Ao—Aorta
VD—ventriculus dexter
TP—truncus pulmonalis
VS—ventriculus sinister
1. origin arteria coronaria dextra
2. arteria coronaria dextra (a.c.d.)
3. ramus conalis
4. ramus circumflexus a.c.d.
5. ramus interventricularis subsinuosus
6. ramus septalis
7. origin arteria coronaria sinstra
8. arteria coronaria sinistra (a.c.s)
9. ramus interventricularis paraconalis
10. ramus circumflexus a.c.s.
11. ramus atrialis
____course of the arteria coronaria

n.b. according to Nomina Anatomica Veterinaria 1983

Table 1.

Year	Author	Species	R/L prep.	Anast.	Anomalies
1901	Marschner	Phocoena 4x	R/L	+	
		Balaenoptera 3x	R/L	+	
1938	Walmsley	Balaenoptera 1x	R	+	
1959	Race *et al.*	Physeter 2x	R	+	
1961	Truex *et al.*	Balaenoptera 3x	R	+	
		Eschrichtius 2x	L	+	
		Physeter 5x	?	+	aplasia orig. a.c.s. 1x
1968	Sommer *et al.*	Tursiops 4x	R	+	
1975	Rowlatt *et al.*	Phocoena 36x	R	−	
1977	Cave	Tursiops 1x	R	−	
1978	Halina *et al.*	Phocoena 16x	R	+	
1988	this paper	Phocoena 15x	R	+	aplasia orig. a.c.s. 2x err. orig. a.c.s. 1x
		Lagenorhinchus 7x	R	+	aplasia orig. a.c.s. 1x aplasia orig. r. interv. parac. 1x
		Delphinus 3x	R	+	hypoplasia r. interv. parac. 1x
		Tursiops 2x	R	+	

For legends, symbols and abbreviations see table 2

Results

The results are listed in Table 2 and are displayed in the diagrams and the photographs.

The results may be summarized as follows: The ramus interventricularis subsinuosus is drained by the arteria coronaria dextra (abridged a.c.d.), so a right preponderance of the coronary arteries is acceptable. The following aberrant courses and origins of the arteria coronaria sinistra (abridged a.c.s.) were observed:

a. Thrice, an aplasia of the origin of the a.c.s. (once in a dolphin and twice in harbour porpoises).
b. Once an aplasia of the origin of the ramus interventricularis paraconalis (in a dolphin).
c. Once a hypoplasia of the ramus interventricularis paraconalis (in a dolphin).
d. Once an aberrant origin of the a.c.s. and aplasia of the left ramus circumflexus a.c.s. (in a harbour porpoises).

Discussion

The described cases of aberrant and anomalous origin and courses of the coronary arteries in aquatic mammals were obviously compatible with life. The observed anastomoses secured by the development in full functional arteries a correct circulation. The right preponderance of the a.c.d. plays an important role too, while the greatest and most important part of the mentioned circulation is provided by this artery.

Up till now an aplasia of the origin and a hypoplasia of the a.c.d. and its branches has not been observed in aquatic mammals. Such cases are incompatible with life hypothetically; they may be observed in dead baby animals.

The observed cases display the same variants as described in seals (v.Nie, 1985); however in these animals a left preponderance of the a.c.s. is present in 5% of the cases. The scant anastomses in the seal heart make this heart more vulnerable than that of the cetaceans, in cases where anomalous or aberrant coronary arteries are found.

The pathology of the mentioned anomalies is still in discussion in terrestrial animals (v.Nie, 1968), while in man anomalous coronary arteries are taken up in surgical programmes (El-Said *et al.*, 1973).

Recently Moscovici (1985) states, that the right preponderance as well as the left one of the heart circulation is based upon macroscopical observations only. His special technique for visualizing the minor intra-muscular coronary arteries leads to the conclusion, that in man a left preponderance is always present. It is the present author's opinion, that Moscovici's technique will be valuable in a further study of the topography of the coronary arteries in small cetaceans.

Conclusion

A right preponderance of the coronary arteries was observed in 27 examined cetacean hearts.

Table 2.

Nr	Species	Heart weight	R/L prep	Anast.	Anomaly
1	P. pho	60	R	+	
2	T. tru	80	R	+	
3	P. pho	85	R	+	
4	T. tru	90	R	+	
5	P. pho	100	R	+	aberrant orig. a.c.s.
6	P. pho	125	R	+	hypopl. r. circum. a.c.s. 4
7	P. pho	150	R	+	
8	P. pho	150	R	+	
9	P. pho	170	R	+	
10	P. pho	180	R	+	
11	P. pho	235	R	+	
12	P. pho	250	R	+	aplas. orig. a.c.s. 1
13	P. pho	250	R	+	aplas. orig. a.c.s. 1
14	P. pho	285	R	+	
15	P. pho	320	R	+	
16	P. pho	320	R	+	
17	P. pho	380	R	+	
18	D. del	550	R	+	
19	D. del	550	R	+	hypopl. r. interv. par. 3
20	L. alb	675	R	+	
21	D. del	750	R	+	
22.	L. acu	1300	R	+	
23.	L. alb	1350	R	+	
24	L. alb	1800	R	+	
25	L. alb	2525	R	+	aplas. orig. r. inter. par. 2
26	L. alb	2800	R	+	aplas. orig. a.c.s. 1
27	L. alb	2800	R	+	

D. del: Delphinus delphis L. 1758
L. acu: Lagenorhinchus acutus Gray 1825
L. alb: Lagenorhynchus albirostris Gray 1828
P. pho: Phocoena phocoena L. 1758
T. tru: Tursiops truncatus Montagu 1821
R/L prep: R or L preponderance, ramus interventricularis subsinuosis is drained by a.c.d. (R) or a.c.s. (L)
1, 2, 3 and 4 refer to the diagrams 1, 2, 3 and 4
anast.: anastomoses; a.c.d.: arteria coronaria dextra; a.c.s.: arteria coronaria sinistra; aplas.: aplasia; hypopl.: hypoplasia; orig.: origin; r.interv.par.: ramus interventricularis paraconalis

Anomalous course of these arteries—6 cases—was restricted to the origin and course of the a. coronaria sinistra and her main branches.

None of these anomalies caused the death of the animal.

Acknowledgements

The author is grateful to Dr C. Smeenk, Rijksmuseum van Natuurlijke Historie in Leiden and to Prof Dr. P. Zwart, Vakgroep Pathologie, afd. Ziektekunde Bijzondere Dieren, Veterinarire Faculteit in Utrecht for providing the hearts; Mr S. H. Speelman and Mr D. de Jong, Vakgroep Anatomie & Embryologie, Vrije Universiteit in Amsterdam for the photographs.

References

Cave, A. J. E. (1977). The Coronary Vasculature of the Bottlenosed Dolphin (Tursiops truncatus). In: Functional Anatomy of Marine Mammals, vol. 3, ed. R. J. Harrison, Acad. Press, London, New York & San Francisco, 119–215.

El-Said, G. M., Dawson, J. T. jr., Sandiford, F. M., Mullins, C. E., Hallman, G. L., Cooly, D. A. & McNamara, D. G. (1973). Coronary artery anomalies. *Eur. J. Cardiol.* **1,** 63–70.

Halina, W. G. & Gaskin, D. E. (1978). Functional anatomy of the coronary system of the harbour porpoise, Phocoena phocoena, (L). *Can. J. Zool.* **56,** 1643–1653.

Marschner, L. (1901). Beiträge zur Anatomie und Physiologie des Herzens und der grossen Gefässstämme der Wasser-säugetiere. Inaugural Dissertation, Breslau.

Nie, C. J. van (1968). Anomalous Origin of the Coronary Arteries in Animals. *Path. Vet.* **6,** 313–326.

Nie, C. J. van (1985). The topography of the coronary arteries in the Common Seal (Phoca vitulina vitulina) *Aquatic Mammals* **11,** 66–68.

Race, G. J., Edwards, W. L. J., Halden, E. R., Wilson, H. E. & Luibel, F. J. (1959). A Large Whale Heart. *Circulation XIX,* 928–932.

Rowlatt, U. & Gaskin. D. E. (1975). Functional Anatomy of the Heart of the Harbour Porpoise, Phocoena phocoena. *J. Morphol.* **146,** 479–494.

Sommer, L. S., McFarland, W. L., Gallino, R. E., Nagel, E. L. & Morgane, P. J. (1968). Hemodynamic and coronary angiographic studies in the bottlenose dolphin (Tursiops truncatus). *Am. J. Physiol.* **215,** 1498–1505.

Truex, R. C., Nolan, F. G., Truex, R. C. jr., Schneider, H. P. & Perlmutter, H. I. (1961). Anatomy and Pathology of the Whale heart with Special Reference to the Coronary Circulation. *The Anatomical Rec.* **141,** 325–354.

Walmsley, R. (1938). Some observations on the vascular system of the fetal female finback. *Contrib. Embryol.* **27,** 107–178.