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Short Note

Remnant of the Intra-Abdominal Vitelline Artery in the Antarctic Minke Whale (*Balaenoptera bonaerensis*) and in the Sei Whale (*Balaenoptera borealis*)

William Pérez,[1*] Javier S. Tellechea,[1, 2] and Martin Lima[1]

[1]*Área de Anatomía, Facultad de Veterinaria, Universidad de la República, Lasplaces 1620, 11600 Montevideo, Uruguay*
**E-mail: vetanat@gmail.com*
[2]*Laboratorio de Fisiología de la Reproducción y Ecología de Peces, Departamento de Biología Animal, Instituto de Biología, Facultad de Ciencias, Universidad de la Republica, Igua 4225, 11400 Montevideo, Uruguay*

In comparison to Artiodactyla, little is known about embryonic and fetal extra-embryonic membranes in whales as it is difficult to obtain specimens suitable for morphological studies. The placentas of the Antarctic minke whale (*Balaenoptera bonaerensis*) and of the sei whale (*Balaenoptera borealis*) were described as diffuse and epitheliochorial (Sasaki et al., 2013, 2014; Kitayama et al., 2015). Mossman (1937, 1987) noted the resemblance in definitive yolk sac placentation between whales, artiodactyls, and perissodactyls.

In the prenatal life of mammals, after body folding has occurred, the midgut (mesenteron) is connected to the extra-embryonic yolk sac (*Saccus vitellinus*) by the vitelline (omphalomesenteric) duct (Noden & De Lahunta, 1985). Together with the vitelline duct, blood is conveyed to the wall of the sac by the paired vitelline arteries (*Arteria vitellinae*); and after circulating through a wide-meshed capillary plexus, it is returned by the vitelline veins to the embryo (Noden & De Lahunta, 1985). The extra-embryonic vitelline vessels normally involute at the same time as the yolk sac. The vitelline duct normally regresses completely during the first third of pregnancy. Together with the regression of this duct and the yolk sac, the entire left vitelline artery and the extra-embryonic part of the right vitelline artery regress while in contrast the intra-embryonic part of the right vitelline artery persists as the cranial mesenteric artery (Noden & De Lahunta, 1985; De Bosschere et al., 1999).

The incomplete disappearance of intra-embryonic vitelline structures were found at necropsy in humans, domestic cattle (Koch et al., 1978), and horses (Freeman et al., 1979; Mogg et al., 1992; De Bosschere et al., 1999). These vascular remnants, when persisting postnatally as a strong cord-like band, may cause volvulus and possible compromise of the blood, leading to strangulation of the involved intestinal loop(s) (Manning & McLaughlin, 1947; Kleinhaus et al., 1974; Koch et al., 1978; Freeman et al., 1979; Weaver, 1987; Hooper, 1989; De Bosschere et al., 1999).

To our knowledge, no data exist about vitelline vascular remnants in these species of Cetacea. We used the opportunity of whale necropsies to describe the presence of a vitelline artery in two Antarctic or southern minke whales and one newborn sei whale. These three whales were found on the coast of Uruguay between 2013 and 2016. The whales were weighed with the scale of a truck crane and were dissected at the Anatomy Laboratory of the Veterinary Faculty of Montevideo, Uruguay. All three were females. The first minke whale was found on 26 October 2014 on the beach of Montevideo (34° 52' S, 56° 13' W); she weighed 2,400 kg and had a total body length (TBL) of 6.7 m. The second minke whale was found on 18 October 2015 on the coast of Laguna de Rocha, Uruguay (34° 37' 23" S, 54° 17' 22" W), and had a weight of 1,430 kg and a TBL of 4.5 m. Based on Christensen & Rorvik (1980, 1981), these two minke whales were sexually immature. The sei whale was found on 3 June 2016 on the coast of Punta Espinillo, Montevideo (34° 49' 44" S, 56° 25' 25" W), and weighed 380 kg with a TBL of 3.1 m; she was a neonate.

The skeletons of these animals are deposited in the Museum of Anatomy of Veterinary Faculty of Montevideo with the museum catalogue numbers MAFV 123, 124, and 125, respectively. In the three dissections, gastrointestinal tracts were removed, and the mesenteries of the intestines were observed to identify vascular remnants. Terms are used in agreement with the *Nomina Anatomica Veterinaria* (Waibl et al., 2012). In each whale, a small and

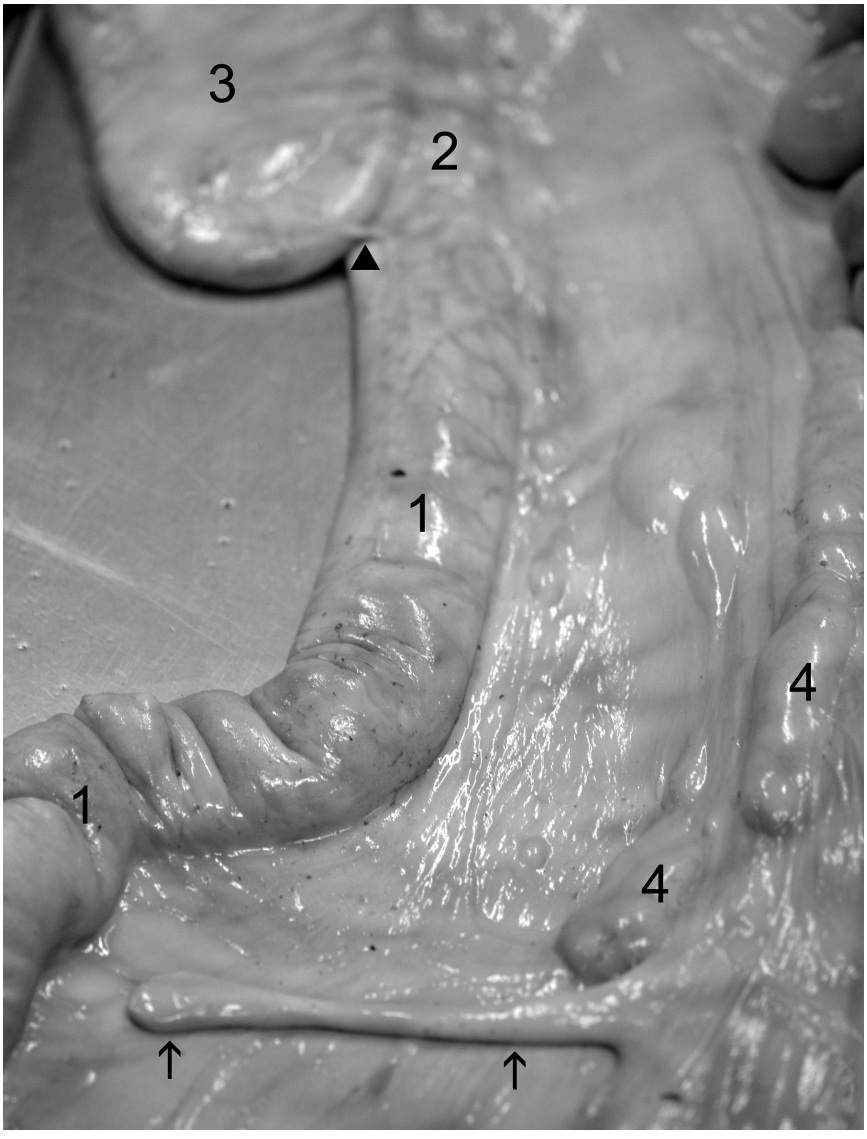

Figure 1. Left view of the first female minke whale's (*Balaenoptera bonaerensis*) (total body length [TBL], 6.7 m) intestine at the transition between small and large parts: (1) jejunum, (2) ileum, (3) caecum, and (4) jejunal lymph nodes with arcade of jejunal artery between labelled lymph nodes. Arrows = remnant of vitelline artery as free-hanging cord; black arrowhead = ileocecal fold.

thin cord (14.9 cm long in the first minke whale, 13.7 cm long in the second minke whale, and 8.7 cm long in the sei whale [12.4 ± 3.2 SD]) was found on the left surface of the mesentery (mesoileum) near the ileum (Figure 1). Based on our topographical observations, this cord represents the embryonic remnant of the terminal part of the left vitelline artery and its mesenteric wrapping. No other developmental anomalies or remnants were detected during the *postmortem* examination.

The vitelline vessels usually disappear before birth. Nevertheless, in some species, remains of these vessels can be found as short cords or small peritoneal folds. In the horse, these arteries have been described in the mesoileum and the caecum (Schauder, 1917; Heller, 1932). The anomalous persistence of these vessels as intra-abdominal cords can have consequences of clinical importance in the horse (Mogg et al., 1992; De Bosschere et al., 1999). These arteries were

described in the manatee (Kostanecki, 1923). In the dog, remnants of these vessels have been described in the mesoileum and mesoduodenum (Heller, 1932; Rivera et al., 1985). We found similar remains in the adult rabbit in places similar to those studied in the dog (Pérez et al., 2005). These remnants were identified as the vitelline vein in the mesoduodenum and as the vitelline artery in the mesoileum.

In summary, this is the first description of a remnant of the vitelline artery in immature minke and sei whales. This was an incidental morphological finding at *postmortem* examination, unrelated to cause of death and without functional significance.

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