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Case report

RARE VARIATION OF THIRD DORSAL METATARSAL ARTERY OF THE HORSE

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Summary

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The purpose of this case report is to describe and document a rare anatomical variation of the cranial and caudal tibial arteries seen in a mare. During routine dissection, a deviation of the great metatarsal artery (third dorsal metatarsal artery) of the right limb of a horse was detected. The artery was smaller than usual and localised between the third and the fourth metatarsal bone, while the main blood supply of the digit was received by the medial plantar artery. Deviation of the artery of the left limb and of the veins of both limbs was not detected. This variation of the main arterial vessel topography is important not only for anatomy but also for the evaluation of the normal pulse, inflammatory processes of the digit and the hoof, occlusion of the artery itself, as well as in performing conduction anaesthesia and surgery in the metatarsal area of the horse.

Key words: horse, medial plantar artery, third dorsal metatarsal artery, variation

The arterial and venous blood supply of the pelvic limb of the horse is described in details by a number of authors (Waibl *et al.*, 1996; Wissdorf *et al*., 2002a,b; Schaller, 2007; Budras *et al.*, 2009; Ashdown & Done, 2011; Vodenicharov, 2014). Principally, the popliteal artery is divided into a much stronger cranial tibial and weaker caudal tibial artery. *A. tibialis cranialis*, the main arterial vessel of the crural region, continues as a. *dorsalis pedis* at the hock and as *a. metatarsea dorsalis III* in the metatarsus. The third metatarsal dorsal artery perforates the distal space between the third and the fourth metatarsal bones as *ramus perforans distalis III* and bifurcates into lateral and medial arteries to supply pelvic limb digit. *A. tibialis caudalis* is located between the medial flexor of the digit and the popliteal muscle, ramifying into two branches – *a. malleolaris caudalis lateralis* and *ramus anastomoticus cum arteria saphena*. The last anastomoses with the saphenous artery, descends on the tendon of the deep flexor and gives rise to the medial and lateral plantar arteries. These arteries form the deep plantar arch in the proximal

metatarsus, continue distally between the tendons of the deep and superficial flexor muscle as weak *aa. digitales plantares communes II and III* and join the described perforating branch or the corresponding digital artery distally of the metatarsus before the metatarsophalangeal joint (Waibl *et al.*, 1996; Schaller, 2007; Vodenicharov, 2014).

Variations of arteries in the horse have been researched in recent years by many authors (Barros & Cortés, 2012; Khairuddin *et al*., 2015; Gómez *et al*., 2017). Variations of the right coronary artery (Gómez *et al*., 2017), the internal carotid artery (Khairuddin *et al*., 2015), the internal maxillary or upper alveolar artery (Barros & Cortés, 2012) were reported.

Deviations of the arteries in the horse, however rare they are, are important not only for variational anatomy but also for veterinary orthopaedics (Carter & Hogan, 1996), anaesthesiology (Bassage & Ross, 2003), surgery (Richardson, 1990) and radiology (Khairuddin *et al*., 2015). Pulse examination on the pelvic limb is essential to determine the general condition of the horse and its status in orthopaedic traumatology (Wissdorf *et al*., 2002a,b) and vascular surgery.

Case description

During routine dissection of the cadaver of a 2-month-old mare, a deviation of tibial arteries was found. Purple-coloured gypsum has been introduced in the common carotid artery before the gross anatomy dissection to highlight the arterial blood vessels. The pelvic limbs of the horse were dissected, the position, the direction and the branching of both arterial and venous vessels were compared and the variation was photographed.

A poorly developed *a. tibialis cranialis,* which continues as *a. dorsalis pedis*, accompanied by a corresponding vein (Fig. 1), and a strongly developed *a. tibialis caudalis*, that gives rise to its strong branches, were observed (Fig. 2). The caudal branch of the saphenous artery receives *r. anastomoticus cum a. saphena*, which is more developed than that on the left limb and the most commonly described in the literature (Fig. 2). This caudal branch bifurcates into a smaller *a. plantaris lateralis* and bigger *a. plantaris medialis*, which continues under the deep plantar arch as *a. digitalis plantaris communis II* between the tendons of the superficial and the deep flexor muscle at the metatarsus (Fig. 3).

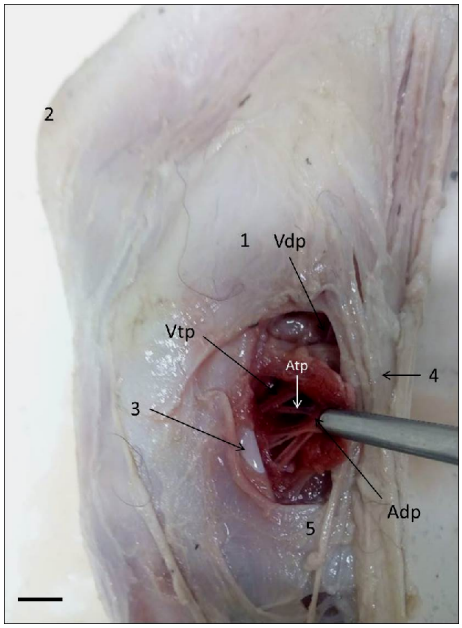

Fig. 1. Right tarsal region of the horse, dorsolateral view. 1 – lateral malleolus; 2 – galea calcanei; 3 – lateral digital extensor muscle; 4 – long digital extensor muscle; 5 – metatarsal extensor retinaculum; Vdp – dorsal pedal vein; Vtp – perforating tarsal vein; Adp – dorsal pedal artery; Atp – perforating tarsal artery. Bar = 1 cm.

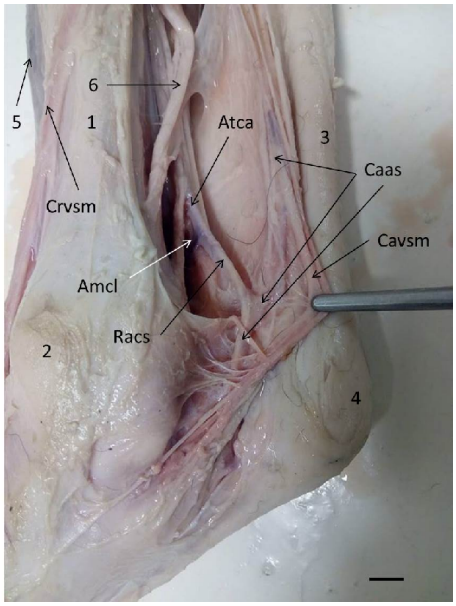

Fig. 2. Right distal crural region of the horse, medial view. 1 – planum cutaneum tibiae; 2 – medial malleolus; 3 – heel cord; 4 – galea calcanei; 5 – cranial tibial muscle; 6 – medial digital flexor muscle; Crvsm – cranial branch of medial saphenous vein; Cavsm – caudal branch of medial saphenous vein; Atca – caudal tibial artery; Amcl – lateral caudal malleolar artery; Racs – ramus anastomoticus cum a. saphena; Caas – caudal branch of saphenous artery. Bar = 1 cm.

In the same area, a very weak *a. metatarsea dorsalis III*, accompanied by the like-named nerve, located between third and fourth metatarsal bones and the absence of *r. perforans distalis III* were also observed (Fig. 3). The vascular groove on the cannon bone was not visualised. Above the metatarsophalangeal joint, the superficial branch of *a. plantaris medialis* was divided into a lateral and medial digital artery (Fig. 3). On the left limb, the development of arterial blood vessels in the crural region, the hock, the metatarsus, and the digit, as well as the venous blood vessels (Fig. 1, 2, 3) of both pelvic limbs fully corresponded to those described by most authors.

The established arterial vessel branching – a strongly developed caudal branch of the saphenous artery, continuing as a stronger superficial branch of *a. plantaris medialis* and blood-supplying the digits, is the most commonly described in literature for ruminants (Schaller, 2007; Ashdown & Done, 2010) and carnivores (Schaller, 2007; Evans & de Lahunta, 2013), but its occurrence as main artery in horse's metatarsal region was observed by us.

The variation is of utmost importance in orthopaedics for laminitis and abscess of the horse's hoof, where strong pulsations of the most developed artery in the metatarsal region is examined proximodorsolaterally between the third and fourth metatarsal bones (Waibl *et al.*, 1996; Wissdorf *et al*., 2002b, Patan, 2009). In the established variation, the detection and measurement of the pulse in the same area would be possible proximoplantomedially between the tendons of the superficial and the deep flexor muscle.

During aorto-iliac thrombosis in horses, the pulse measured on the femoral artery and on the lateral and medial plantar artery is decreased (Crawford, 1982) and in our case, the degree of the pulse reduction would be even greater.

This difference in branching of the arterial vessels is also related in performing a 4-point and 6-point conduction anaesthesia (HPA – high plantar nerve block) of the pelvic limb in a horse (Carter & Hogan, 1996; Bassage & Ross, 2003; Patan, 2009). In normally developed vessels, there is a risk of an anaesthetic solution falling into *a. metatarsea dorsalis III* and *v. digitalis dorsalis communis II* (Carter & Hogan, 1996; Bassage & Ross, 2003; Patan, 2009), while in the variation

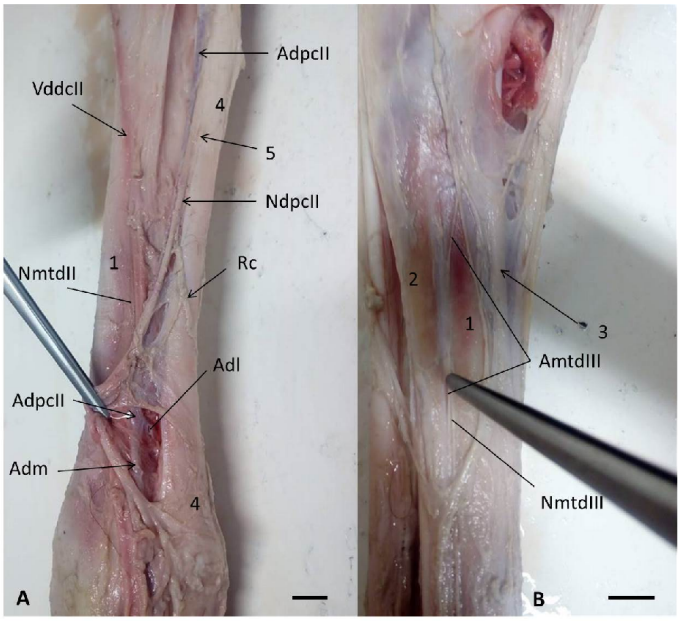

Fig. 3. Medial (A) and lateral (B) subdivision of the right metatarsal region of the horse. 1 – third metatarsal bone; 2 – fourth metatarsal bone; 3 – lateral digital extensor muscle; 4 – superficial digital flexor muscle; 5 – deep digital flexor muscle; AmtdIII – week third dorsal metatarsal artery; NmtdIII – third dorsal metatarsal nerve; AdpcII – strong second common digital plantar artery; NdpcII – second common digital plantar nerve; Rc – common branch between plantar nerves; VddcII – second common digital dorsal vein; NmtdII – second dorsal metatarsal nerve; Adm – medial digital artery; Adl – lateral digital artery. Bar = 1 cm (A) and 1.5 cm (B).

described by us, the risk is associated with the strong *a. digitalis plantaris communis II* in conduction anaesthesia of the medial plantar nerve.

It is also important for the surgical removal of the distal part of the fourth metatarsal bone (the globule). In a normally developed *ramus perforans distalis III* which gives the two finger arteries, there is a risk of affecting the vessel during the surgery (Richardson, 1990; Patan, 2009) while with the described variation, this branch is missing and there is no danger of it being affected.

In conclusion, the variation found by us gives the opportunity to recommend to veterinary surgeons to carry out a more thorough and complete discovery of the arterial vessel topography for pulse examination in the metatarsal area and the subsequent use of imaging methods for blood vessel visualisation.

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