

Angiographic aspect of the distal forelimb in donkeys (*Equus asinus*) used for animal traction

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Resumo

Aspectos angiográficos da região distal do membro torácico de asininos (*Equus asinus*) usados para tração animal. A espécie asinina foi originada há milhões de anos atrás, a partir do mesmo ramo do equino doméstico. O asinino tem sido submetido a grandes adaptações, resultando em características distintas observadas em populações de asininos em todo o mundo. Na região Nordeste do Brasil, estes animais apresentam um papel essencial na economia das famílias locais. Devido ao grande número de alterações locomotoras e a carência de acesso a cuidados profissionais, foi realizado um estudo radiográfico da região distal dos membros torácicos de asininos, a fim de se obter informações para melhoria da prática clínica e cirúrgica nesta espécie e compreender a menor suscetibilidade dos mesmos a lesões locomotoras, quando comparados ao equino doméstico. O exame angiográfico demonstrou os principais vasos arteriais comprometidos com o suprimento sanguíneo da porção distal dos membros torácicos nesses animais, possibilitando evidenciar o padrão vascular das artérias mediana e digital palmar comum, que originam um grande número de ramos colaterais, especialmente para a falange distal. A região distal dos membros torácicos em asininos demonstrou numerosas anastomoses vasculares, promovendo um suprimento sanguíneo adicional profundamente ao perióstio e endóstio, provavelmente como uma resposta adaptativa a atividades físicas executadas por estes animais.

Unitermos: diagnóstico por imagem, equídeos, locomotor, radiografia

Abstract

The asinine species was originated thousands of years ago from the same branch of domestic equine. Asinines have been undergoing a great adaptation resulting in different characteristics observed in their populations around the world. In the northeastern region of Brazil, they play an essential role in the economy of local families. Due to a large number of locomotor disorders and a lack of professional care for these animals, a radiographic study of the distal forelimb region of the asinine was carried out in order to gather information for the improvement of clinical and surgical practices in this species, and to explain their low susceptibility to locomotor disorders compared to that of the domestic equine. The angiographic examination revealed the main arterial vessels committed to the blood supply of the forelimbs in these animals, providing evidence of the vascular pattern of the median and palmar common digital arteries, which originated a great number of collateral branches, mainly to the distal phalanx. The distal forelimbs in donkeys have shown great vascular anastomosis, promoting additional blood supply to the deep endosteum and periosteum regions, probably as a response to the physical activity developed by these animals.

Key words: equideous, image diagnosis, locomotor, radiography

Introduction

The origin of horses has been described to be either in the Orient or in North America (Rumuszkán and Junqueira, 1980; Bennet and Hoffman, 1999), so therefore in the USA, a horse's skeleton found in 1967 in a rock of the Eocene era was considered to be the antecedent of the current horse on the continent.

The domestic donkey (*E. asinus vulgaris*) was originated from the same filogenetic branch of horses. Paleontological data reported its appearance from the Tertiary era in the Paleocene period in the Adriatic Sea (Torres and Jardim, 1983). *E. asinus atlanticus* was described in the Quaternary era in the Argelini region (Rumuszkán and Junqueira, 1980).

The donkey is the animal elected to perform a wide range of work in the Brazilian northern region because of its great physical resistance when compared to common horses (Torres and Jardim, 1983). Anatomical studies of the distal regions of the forelimbs of donkeys have been conducted for comparison to those of the horses. So far, clinical observations have not identified less severe symptoms for foot affections in donkeys than for horses (Alves et al., 2003; 2005; 2008). Aiming to contribute to clinical medicine and surgical procedures, we described the angiography of the distal region of donkey forelimbs in comparison to that of the common horse.

Material and Method

We investigated 15 forelimbs of donkeys of both sexes and of different ages with an average weight of 150kg. Samples were taken from animals that had died from diseases in the Large Animal Veterinary Hospital of the State University of Maranhão (UEMA), Brazil.

Following the death of an animal, the median artery was cannulated and perfused with 0.9% saline solution at 40°C. After the cleansing of the artery system, non-ionic iodide contrast, *Henetix 350* (iobitridol), was injected. The limbs were radiographed following the protocol described by Alves et al. (2003), on a portable x-ray device, *MinXrays HF 100*, 40 -100KVp and 20mAs potency.

Results

The main irrigation of the donkey's forelimb was provided by the median artery. An anastomosis between the median artery and the radial artery formed the deep palmar arch (Figure 1) at the level of the carpal articulation.

From the deep palmar arch, the lateral and medial metacarpal arteries were formed lying on the palmar sulcus, therefore emitting branches to the dorsal surface of the third metacarpal bone (Figure 2).

The median artery extended along the palmar surface of the third metacarpal bone in lateral-medial orientation. The median artery formed the common digital palmar artery in the medial portion of the metacarpal bone.

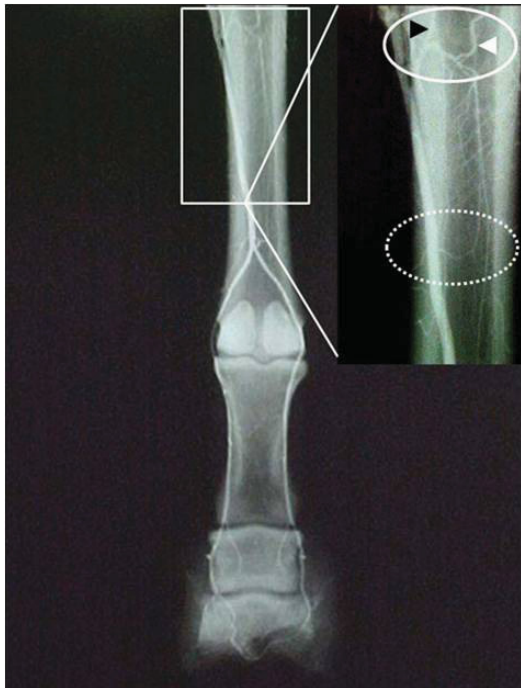


FIGURE 1: Angiography from dorsal-palmar view of the distal region of the right forelimb of a donkey demonstrating the deep palmar arch (full circle), formed by the median artery (black arrowhead) and radial artery (white arrowhead), and superficial palmar arch (segmented circle).

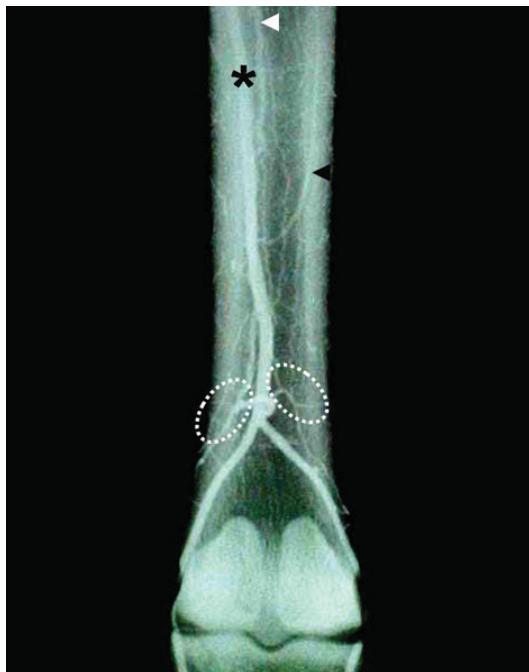


FIGURE 2: Angiography from dorsal-palmar view of the distal region of the right forelimb of a donkey demonstrating the palmar metacarpal arteries (white and black arrows) and common palmar digital artery (*) that emits dorsal branches to the third metacarpal bone (segmented circle).

The common digital palmar artery emitted the lateral and medial palmar arteries on the surface of the interosseum tendon bifurcation in the distal portion of the metacarpal bone (Figure 3a, 3b).



FIGURE 3: Angiography from dorsal-palmar (A) and lateral-medial (B) views of the distal right forelimb of a donkey demonstrating the common palmar digital artery (*) that forms the lateral and medial palmar digital arteries (white arrows).

Immediately after the metacarpal-phalangeal articulation, the palmar digital artery emitted branches to the proximal phalanx forming, an arch surrounding its dorsal surface (Figure 4a, 4b).

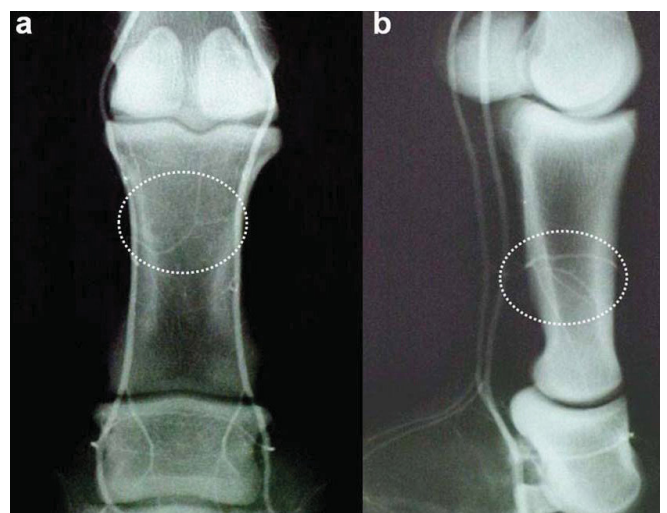


FIGURE 4: Angiography from dorsal-palmar (A) and lateral-medial (B) views of the distal right forelimb of a donkey demonstrating the dorsal branches to the proximal phalanx (circles) that originates from the lateral and medial palmar digital arteries.

The palmar digital arteries, after the interphalangeic articulation, formed the branch to the digital torus, the dorsal branches to the medial phalanx, and the dorsal branch to the distal phalanx. Distally to the interphalangeic articulation, the palmar digital arteries formed the terminal arch, connecting to the artery of the opposite antimere and emitting branches to the solear margin of the distal phalange (Figure 5a, 5b).

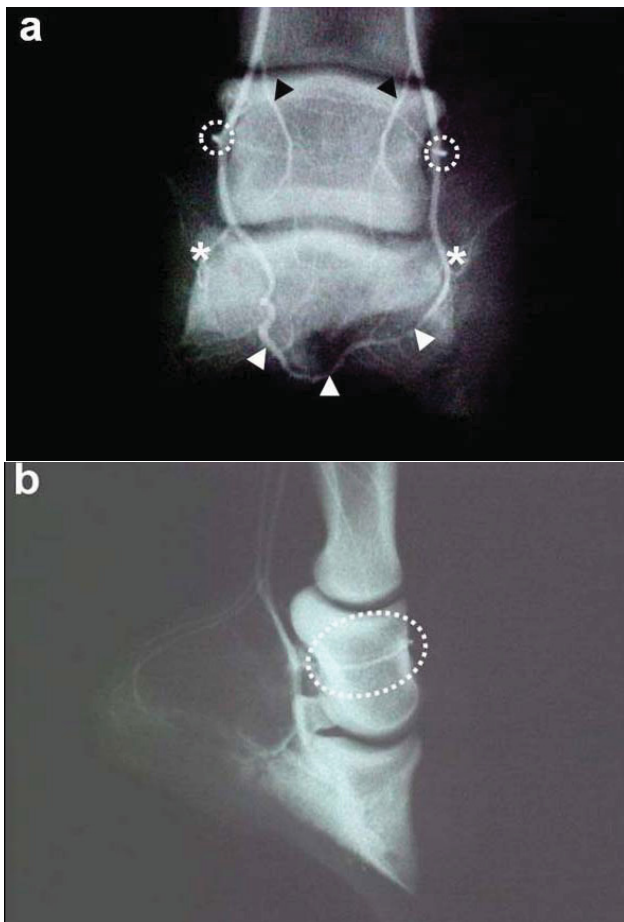


FIGURE 5: Angiography from dorsal-palmar (A) and lateral-medial (B) views of the distal right forelimb of a donkey demonstrating the origin of the dorsal branches to the medial phalanx (black arrow) from the lateral and medial palmar digital arteries, to the digital torus (segmented circle), to the distal phalanx (*), and to the terminal arch of the distal phalanx.

Discussion

The donkey's medium artery in the forelimb lay along the carpal articulation forming the deep palmar arch in association with the distal branch of the radial

artery. A similar description has been made for horses (Nickel et al., 1986; Collins et al., 2004).

The lateral and medial metacarpal palmar arteries were formed from the deep palmar arch, lying on the palmar sulcus and emitting branches to the dorsal portion of the metacarpal, in accordance with the descriptions of Cornelissen et al. (2002), Soffler and Hermanson (2006), Boesen et al. (2007) and Cohen et al. (2008) for the forelimbs of horses.

At the level of the carpal articulation, donkeys and horses (Hoffmann et al., 1999; Busoni and Denoix, 2001; Collins et al., 2004; Murray et al., 2006) differ due to the presence of a large number of collateral branches in donkeys. These collateral vessels are responsible for the supply to the periosteum and endosteum. We believe that the increase of the vascularization can be associated with the maintenance of the blood supply to distal portions.

After the proximal portion of the third metacarpal bone, in the donkey and in the horses (Scott et al., 1976; Dyce et al., 1997; Hoffmann et al., 1999; Crowson et al., 2004; Keys et al., 2006), the lateral and medial digital palmars are formed. Bordalai and Nigam (1977) and Nickel et al. (1986) report that the digital palmar arteries comprise proximal, medial and distal branches. However, we observed in donkeys the formation of dorsal and palmar branches.

Digital palmar arteries form the terminal arch which sends branches to the solear distal phalanx in donkeys and horses (Ackerman et al., 1975; Hoffmann et al., 1999; Rosenstein et al., 2000), but a large number of anastomoses are seen in donkeys.

We believe that although it is somewhat similar, the artery supply in the forelimbs of donkeys presents a greater number of anastomoses between its vessels than in horses. This arrangement is formed by the median artery, common palmar digital artery and branches directed to deeper layers of the endosteum and periosteum. We believe that the donkey's vascular arrangement in the forelimbs is more efficient than in horses and could be a biological adaptation to its type of work.

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