RESEARCH ARTICLE

ANGIOGRAPHY OF THE FORE DIGITS IN EGYPTIAN WATER BUFFALO (BOSBUBALIS)

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Abstract

The present work was carried out on the thoracic limbs of twelve apparently healthy buffaloes of different sex and age. The dorsal and palmar metacarpal as well as the cranial superficial antibrachial arteries were traced just distal to the carpal joint and catheterized with 16-gauge angiocatheter needle. Arteriography was carried out by 15 ml contrast medium injected through the catheter in each vessel. Radiographs were obtained in dorso-palmar, palmo-dorsal, medial and lateral views. The results of the present study were performed on four angiographic images of the buffalo metacarpal and digital arteries. Fine details of blood vessel patterns were recorded and the arterial anastomoses were clarified demonstrated and labeled. The purpose of the present study was to provide a detailed view of normal pattern of the arterial blood supply of the foot and digits of buffalo which would serve as an initial reference in order to be able to asses a diseased condition of digits and claw in this species, and finally providing a diagnostic basis by the aid of angiograph in such economically important animal, concerning meat and milk production.

INTRODUCTION

The buffalo is considered a very important meat and fat rich milk producing animal in Egypt. The aggregate share of buffalo milk is about 81% of total milk production in Egypt (Soliman and Sadek, 2004).

Digital affections in cattle occur frequently and comprise the majority of limb disorders, in which the vascular involvement is often under assessed. Several conditions, including acute laminitis are known to perpetuate significant alterations in the vascular dynamic of the digit. The early signs of vascular involvement may be purely subjective and often go unnoticed by the veterinarian (Manohar et al., 1973).

Angiography offers simple and precise mean of diagnosing and assessing vascular involvement, as the evaluation of size, number, distribution, wall integrity, and luminal diameter of vessels. It is used for the diagnosis of pathological conditions such as traumatic ischemia, thrombosis, congenital malformation, bone pathology and other conditions. Knowledge of normal angiographic appearance of a structure serves the basis for comparison. This technique has been used for normal digit in cattle (Manohart et al., 1973; Prenticet and Wyn-Jones, 1973; Gogoiet al.,1982; Singhet al., 1994), goat (Burns and Cornell, 1981; Dehghaniet al., 2007), horse (Ackerman et al., 1975; Scott et al., 1978; Rosenstein et al., 2000; Brunner, et al., 2008), donkey (Alveset al., 2009) and camel (Ramadan, 1994; Al-AniFalah, 2004; Dehghaniet al., 2011).
The present study aimed to provide a detailed view of normal pattern of blood circulation of the fore digits of the Egyptian water buffalo to be used for comparison with diseased digits and claws in this species.

MATERIALS AND METHODS:

The present work was carried out on the thoracic limbs of twelve apparently healthy buffaloes (of different sex and their age, 2-7 years old). The specimens were collected immediately after slaughtering by disarticulating the carpometacarpal joint. The specimens were transferred to the laboratory in ice cold water bags.

The dorsal, palmar metacarpal and cranial superficial antibrachial arteries were dissected free just distal to the carpal joint and subsequently catheterized with 16-gauge angiocatheter needle. These were flushed with heparinised saline solution (500 IU/ liter). The dorso-lateral metacarpal vein was isolated, to assure free venous outflow frequently until clear saline solution was drained out of the arteries. A rubber tourniquet was placed around the proximal third of metacarpus. Arteriography was carried out by 15ml contrast medium (Urographine 30% "sodiumdiatrizoate 40mg/ml and meglumindiatrizoate 260mg/ml in aqueous solution, Australian") was injected through the catheter in each vessel. The veins and arteries were kept occluded by hemostats. Radiographs were obtained in dorso-palmar, palmo-dorsal, medial and lateral views by simply HP radiographic machine(KVp; 55, mAs; 20, ms; 16 sec) at Department of Surgery, Faculty of Veterinary Medicine, Benha University and large cassettes were recommended.

The radiographs were processed manually. Then they were evaluated and studied over the radiographic illuminator and fine details of blood vessel patterns were recorded. All arterial anastomoses were noticed and labeled with the aid of multiple references (Getty, 1975; Nickel et al., 1996; Schaller, 2007), together with (NominaAnatomicaVeterinaria, 2012).

RESULTS:

The results of the present study were performed on four angiographic images of the buffalo metacarpus and digits arteries. The main arterial blood supply of the buffalo digit constitutes the dorsal and palmar digital arteries. The dorsal metacarpal artery III (Fig.1/1) descends in the dorsal longitudinal groove of the large metacarpal bone (fused 3rd and 4th metacarpal bones), and continues over the dorsal aspect of the fetlock joint as common dorsal digital artery III (Fig.1/2). After that this vessel courses in the inter digital space and anastomoses with the inter digital artery III (Fig.1/3). The dorsal metacarpal artery III connected with the palmar metacarpal arteries via sending the distal perforating branch (Fig.1/4) which is joined the deep palmar arch through the distal metacarpal canal. The two axial dorsal proper digital arteries III (Fig.1/5) and IV (Fig.1/6) spring from the common dorsal digital artery III near the middle of the proximal phalanx.

The palmar metacarpal arteries II-IV (Fig.2/ 1, 2, 3) have a common termination into the palmar common digital arteries and are frequently interconnected. The palmar and dorsal metacarpal arteries are connected distally by the distal perforating branch (Fig.2/4). The palmar common digital arteries II-IV (Fig.2/5, 6, 7) arise directly from the superficial palmar arch (Fig.2/8).

The palmar common digital artery III(Fig.2/6) courses on the posterior aspect of the fetlock joint and passes into the inter digital space. Near the middle of the proximal phalanx it gives off two palmar branches of proximal phalanx (Fig.2/9) which join abaxial palmar proper digital arteries. The parent vessel then communicates with dorsal
The Palmar common digital artery III (Fig.2/10) via the inter digital artery (Fig.2/11) and divides into axial palmar proper digital arteries III and IV (Fig.2/12, 13). Each artery gives off dorsal and palmar branches of middle phalanx (Fig.2/14, 15). The two arteries descend along the inter digital surfaces of the chief digits and give the palmar branch of distal phalanx (Fig.2/16) that pass through the foramina at the proximal part of the inter digital surfaces of the distal phalanges, entering the latter and anastomose with the abaxial palmar proper digital arteries III and IV (Fig.2/17, 18) forming the terminal arch (Fig.2/19). From the terminal arch numerous branches pass through the bone to the dorsal surface and ramify in the corium of the wall and sole of the claw. A number of branches emerge through the foramina at the distal border, where they anastomose with each other in arciform fashion forming a uniform network of marginal capillaries.

The Palmar common digital artery II (Fig.3/1) arises from the Superficial palmar branch of radial artery (Fig.3/2) and the superficial palmar arch (Fig.3/3), and descends on the medial side of the digit divides distally into palmar proper digital artery II (Fig.3/4) and III (Fig.3/5). It descends along the abaxial side of third digit and, near the middle of the proximal phalanx receives the palmar branch of the proximal phalanx (Fig.3/6) from the palmar common digital artery III (Fig.3/7) where the dorsal branch of proximal phalanx (Fig.3/8) arises to supply the dorsal abaxial surface of the third digit. The palmar proper digital artery II, terminates at the bulb of claw by anastomosing with the corresponding proper digital artery. It gives off a branch to the dew claw and continues downward offering off many branches to the dorsal part of the claw wall as well as leading numerous branches to caudal part of the claw and sole.

The Palmar common digital artery IV (Fig.4/1) arises from the superficial palmar arch (Fig.4/2), passes down on the lateral side of the digit and near the fifth digit then divides distally into palmar proper digital artery IV (Fig.4/3) and V (Fig.4/4). palmar proper digital artery IV receive the palmar branch of the proximal phalanx (Fig.4/5) from the palmar common digital artery III (Fig.4/6) where the dorsal branch of proximal phalanx (Fig.4/7) arises to supply the dorsal abaxial surface of the third digit. The palmar proper digital artery IV terminates in a similar distribution to the palmar proper digital artery II.

**Fig. 3:** Angiography from Medio-lateral view of the distal region of the right forelimb of a buffalo showing the arterial pattern of the fore digits. 1) Palmar common digital artery II. 2) Superficial palmar branch of radial artery. 3) Superficial palmar arch. 4) Axial palmar proper digital artery II. 5) Abaxial palmar proper digital artery III. 6) Palmar branch of proximal phalanx. 7) Palmar common digital artery III. 8) Dorsal branch of proximal phalanx. 9) Dorsal branch of middle phalanx. 10) Branch of Torus ungulae. 11) Terminal arch. 12) Distal perforating branch.
Fig. 4: Angiography from Latero-medial view of the distal region of the right forelimb of a buffalo showing the arterial pattern of the fore digits. 1) Palmar common digital artery IV. 2) Superficial palmar arch. 3) Abaxial palmar proper digital artery IV. 4) Axial palmar proper digital artery V. 5) Palmar branch of proximal phalanx. 6) Palmar common digital artery III. 7) Dorsal branch of proximal phalanx. 8) Terminal arch.

DISCUSSION:

The present study served as an initial reference of angiography of digital circulation of buffalo and provides acceptable details of the digital vasculature that in accordance with some authors (Manohar et al., 1973; Prentice and Wyn-Jones, 1973; Gogoiet al., 1982; Singh et al., 1994) in cattle, (Burns and Cornell, 1981; Dehghaniet al., 2007) in goat, (Ackerman et al., 1975; Scott et al., 1978; Rosenstein et al., 2000) in horse, (Alveset al., 2009) in donkey and (Ramadan, 1994; Al-AniFalah, 2004; Dehghaniet al., 2011) in camel.

Knowledge of normal angiographic appearance of digital vasculature is essential for understanding the pathophysiology of the locomotor disorder. Angiography demonstrating various spontaneously occurring vascular diseases such as arterial embolism, arteriosclerosis and various types of vascular shunts. The recurrence of clinical vascular disease prompted this study of angiography in the bovine foot (Manoharet al., 1973). The most prominent arteriographic abnormalities associated with chronic laminitis in cattle included dilation, tortuous and irregular course, and constriction of the claw artery at the exit of the pedal bone. The primary branches of the claw artery were frequently constricted or dilated; constrictions were predominantly seen in the toe area (Boosmaniet al., 1989).
The angiographic findings of the buffalo digit in the present study was also found to be following similar pattern as in the cattle reported earlier by (Gogoi et al., 1982; Manohare et al., 1973; Prentice and Wyn-Jones, 1973; Singh et al., 1994). The blood vessels that seen in cattle could be detected very well in the angiographic images of the buffalo.

The present study revealed that the arterial blood supply of the buffalo digit constitutes the dorsal and palmar digital arteries. The cranial superficial antibrachial artery which courses on the dorso-medial face of metacarpal bone, in the distal half of the metacarpus was not demonstrated in the arteriographical findings of the goat digit (Burns and Cornell, 1981; Dehghaniet al., 2007), and camel (Ramadan, 1994; Al-AniFalah, 2004; Dehghaniet al., 2011, elsewhere they found similar vascular pattern of goat and cameldigits with that of buffalo digital circular pattern.

The terminal arch sends numerous branches pass through the distal phalanx to the dorsal surface and ramify in the corium of the wall and sole of the claw. A number of branches emerge through the foramina at the distal border, where they anastomose with each other in arciform fashion forming a uniform network of marginal capillaries. similar to that observed by(Ackerman et al., 1975; Scott et al., 1978; Rosenstein et al., 2000; Brunner, et al., 2008), in equine, (Alvesetal., 2009) in donkey and (Ramadan, 1994; Al-AniFalah, 2004; Dehghaniet al., 2011), in camel.

**Conclusion and Clinical Relevance:**

The authors would be concluded that the arterial blood supply of digits was derived from the dorsal and palmar metacarpal as well as the cranial superficial antibrachial arteries which configuration the same pattern in horse, cattle, camel and goat. The angiographic study should be performed in any diseased conditions, congenital abnormalities or surgical affections of foot and digits of buffalo to assist the blood vasculature through observation of filling defect of contrast media.

**Contribution of each author**

All authors are equally contributed

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**REFERENCES**


