

Superficial veins of the foot in the baboon *Papio anubis*

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*Although the baboon is considered a good animal model in biomedical research, no description of the superficial veins of the foot in *Papio anubis* is found in the available literature. The current study was conducted to document the anatomy of these veins in the baboon foot.*

*A macroscopic anatomical investigation was carried out on 20 hind legs (10 cadavers) of the adult *Papio anubis* (9 males and 1 female). The circulatory system of the entire body was filled with coloured latex. Traditional methods were used for the preparation of the veins of the legs. These were then compared with the venous system of the lower extremities in humans as presented in the literature.*

*The medial and lateral metatarsal veins, the dorsal venous network, the long saphenous vein and the short saphenous vein in *Papio anubis* were described according to their origin, course, opening, length and diameter. The network observed was divided into three types with respect to the connections between the superficial veins. The investigation revealed no symmetry in the venous system of the baboon foot.*

*The short saphenous vein appeared to be the main vein of the hind leg in *Papio anubis* and the long saphenous vein ran as a double vessel.*

Key words: anatomy, baboon *Papio anubis*, superficial veins of the foot, short saphenous vein, long saphenous vein

INTRODUCTION

The baboon has been considered a good animal model in biomedical research [9], but no description of the superficial veins of the foot in *Papio anubis* is found in the available literature. Knowledge of the anatomy of the venous system is important because, as the biomedical model used in research, the baboon is administered medicaments through the venous vessels. We have, however, found research into the veins of the hind leg in apes such as *Macaca fascicularis*, *Macaca rhesus*, *Macaca cynomolgus* and *Macaca mulatta* [7, 12, 16, 20]. The present study was therefore undertaken to fill the gap in baboon research and to document the anatomy of the superficial veins of the

leg in these apes. In addition, a comparison is drawn between the venous anatomy of baboons and humans as two species of primates, although the reasons for the similarities and differences could form the subject of a further study.

The superficial venous system of the human lower limb originates from multiple small veins in the skin and the muscles of the foot, leg and thigh. These small vessels run into the larger ones, namely the great saphenous vein and the small saphenous vein [17]. These in turn open into the profound venous system at the saphenofemoral and saphenopopliteal junctions [13], or as perforators drain through the muscular fascia [11]. The superficial veins run in the subcutaneous tissue

just below dermis in a compartment delimited by the membranous layer of the superficial fascia [2–5, 17].

MATERIAL AND METHODS

The macroscopic anatomical investigation was carried out on 20 hind legs (10 cadavers) of the adult *Papio anubis* (9 males and 1 female). The circulatory system of the entire body was filled with coloured latex (the arteries via the common carotid artery and the veins via the internal jugular vein). Traditional methods were used to prepare the veins of the legs. The results were compared with the venous system of the lower extremities in humans as presented in the literature. Observations focused on the beginning, the ending, the course and the number of vessels. The length and the external diameter of the veins were measured. The venous system of the *Papio anubis* foot and leg were photographed. In describing the vessels examined we have used the anatomical names of human and ape veins presented in the literature [4, 6, 20].

RESULTS

The venous system of the baboon foot was found to begin in the toes. Two veins of each digit, termed the “dorsal digital veins” of the foot, ran dorsolaterally to each toe. The diameter of each of these veins was less than 1 mm. The external vein of the first digit ran as the medial marginal vein and that of the fifth digit as the lateral marginal vein of the foot. The dorsal digital veins, which were situated on the lateral surfaces of the digits, connected together to form the dorsal metatarsal veins.

The medial marginal vein of the foot (MMV) ran as a continuation of the external vein of the first digit at the medial part of the foot. This vein was 9–10 cm long and 0.5 mm wide and formed a single trunk. The end of MMV connected to the dorsal venous arch and ran as the long saphenous vein (LSV).

The lateral marginal vein (LMV) ran as a continuation of the fifth digit external vein at the lateral part of the foot. This vein was 7–8 cm long and 1 mm wide and, like MMV, formed a single trunk. The end of the LMV connected to the dorsal venous arch and formed the short saphenous vein (SSV).

The dorsal venous arch (DVA) ran between the ends of MMV and LMV. It was situated on the dorsal surface of the foot and drained from the dorsal metatarsal veins or from a larger trunk formed from the union of these veins. The DVA was 4–5 cm long and 1–3 mm wide (Fig. 1).

The LMV, MMV, dorsal metatarsal veins and DVA were connected in various ways to form the dorsal venous network of the foot (Fig. 2). According to

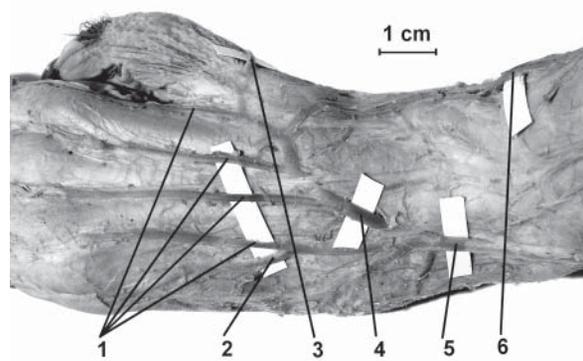


Figure 1. The dorsal venous network of the left foot in *Papio anubis*; 1 — the metatarsal veins; 2 — the lateral marginal vein; 3 — the medial marginal vein; 4 — the dorsal venous arch; 5 — the short saphenous vein; 6 — the long saphenous vein. The dorsal view of the left foot in *Papio anubis*. Bare 1 cm.

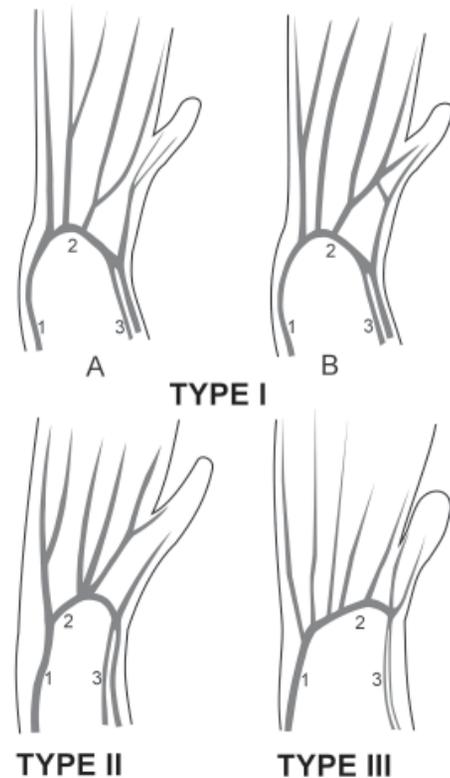


Figure 2. Scheme of the three types of dorsal venous network of the foot of *Papio anubis*. Type I — in variant A two metatarsal veins join to form one larger metatarsal trunk. Two metatarsal trunks course into the dorsal venous arch forming two junctions with it. In variant B two metatarsal veins form a metatarsal trunk that joins the dorsal venous arch, while one metatarsal vein opens into the dorsal venous arch separately. The other metatarsal vein (the first) joins the lateral marginal vein. Type II — three metatarsal veins, which reach the dorsal venous arch and join it at one spot, form a single junction with the dorsal venous arch in its middle part. Type III — each of four metatarsal veins opens separately into the dorsal venous arch, forming four junctions with it; 1 — the short saphenous vein; 2 — the dorsal venous arch; 3 — the long saphenous vein.

the relationship between these veins, we divided the dorsal venous network of the foot into the following three types:

- type I, the most common (50% of all feet), where two metatarsal veins forming one larger metatarsal trunk joined DVA. We distinguished two variants within type I, variants A and B. In variant A two metatarsal veins joined to form one larger metatarsal trunk. Two metatarsal trunks flowed into DVA, forming two junctions with DVA. In variant B two metatarsal veins formed a metatarsal trunk that joined DVA while one metatarsal vein opened into DVA separately. This type was found as variant A in 4 feet (20%), 3 left and 1 right, and as variant B in 6 feet (30%), 3 left and 3 right;
- type II, where three metatarsal veins joined and reached DVA at one spot, forming only one junction with DVA in its middle part. These veins ran approximately radially towards one point. The fourth metatarsal vein joined LMV. This type was found in 6 feet (30%), 2 left and 4 right;
- type III, where each of the four metatarsal veins opened into DVA separately, forming four junctions with DVA. The courses of these veins were approximately parallel. This type was found in 4 feet (20%), 2 left and 2 right.

The dorsal venous network extended to the larger vessels of the leg. The LSV lay in the medial part and SSV on the lateral part of the leg. No symmetry between two feet was observed in the dorsal venous network.

The plantar venous network consisted of the plantar digital veins of the foot, which were situated plantolaterally to the digits. Two plantar digital veins connected together to form the plantar metatarsal veins which ran to the plantar vein. These veins formed the plantar venous network. The plantar vein had its outflow in the middle of LSV. Small veins of the plantar skin reached MMV, LMV and the distal parts of LSV and SSV (Fig. 3).

The SSV ran as a single vessel on the lateral and the posterior parts of the leg, from the lateral part of the foot to the popliteal fossa. It originated behind the lateral malleolus and appeared to be a continuation of LMV after its connection with DVA. It emptied into the popliteal vein at the saphenopopliteal junction just above the popliteal fossa. The length of this vein ranged from 22 cm to 24.5 cm and the width from 3 to 5 mm (Fig. 4).

The LSV ran as a double vessel medially on the leg and the thigh. Distally, near to the medial malleolus of the tibia, LSV began as a two-trunk vessel

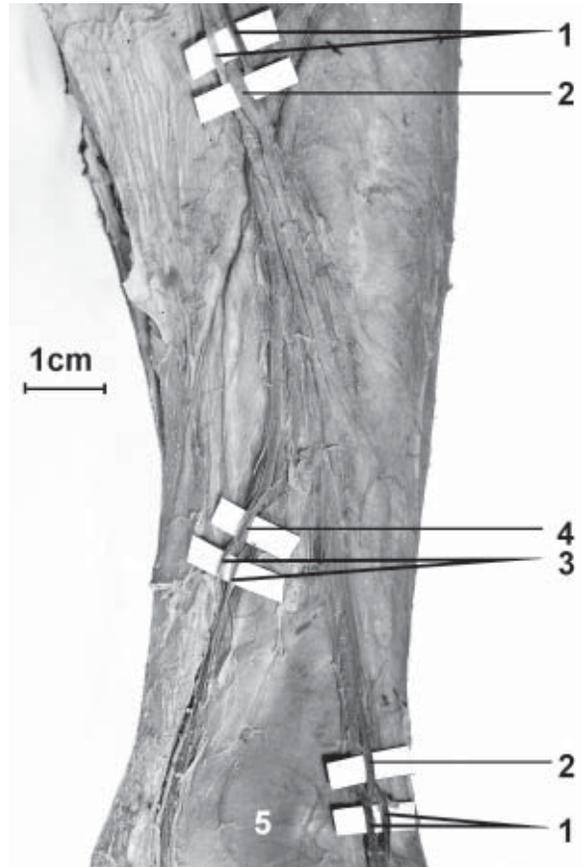


Figure 3. The superficial vessels of the medial side of the left leg in *Papio anubis*; 1 — the long saphenous vein; 2 — the femorocrural artery; 3 — the plantar vein; 4 — the plantar artery; 5 — the medial malleolus. Medial view of the left leg in *Papio anubis*. Bare 1 cm.

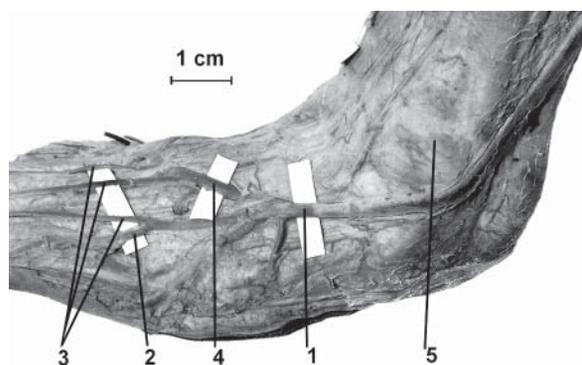


Figure 4. The beginning of the short saphenous vein in *Papio anubis*; 1 — the short saphenous vein; 2 — the lateral marginal vein; 3 — the metatarsal veins; 4 — the dorsal venous arch; 5 — the lateral malleolus. Lateral view of the foot in *Papio anubis*. Bare 1 cm.

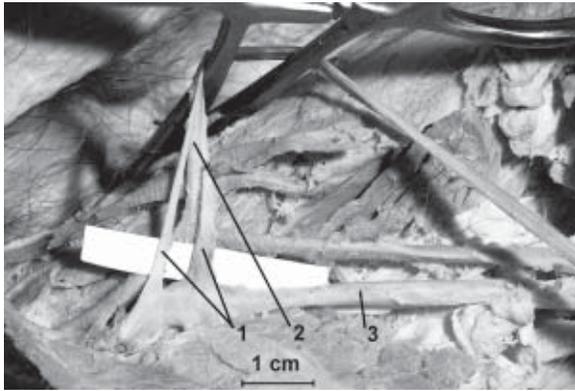


Figure 5. The area of the saphenofemoral junction (vessels deflected with Péan clamp; 1 — two trunks of the long saphenous vein; 2 — the femorocrural artery; 3 — the femoral vein. Medial view of the left thigh in *Papio anubis*. Bare 1 cm.

after the connection of DVA with MMV. Proximally, two trunks of LSV emptied into the femoral vein with two saphenofemoral junctions. The femorocrural artery, which ran as an accompanying artery, was enclosed by these trunks. The length of LSV ranged from 20.5 cm to 21.4 cm and the width of one trunk from 1.5 to 2.5 mm (Fig. 3, 5).

The popliteal vein and the femoral vein belonged to the deep venous system. Veins from the muscles and small veins from the skin, which numbered from 7 to 13, extended to LSV and SSV.

DISCUSSION

The descriptions of the superficial veins of the human lower limb in the literature have usually been associated with their clinical aspects, such as varicose veins, thrombosis and by-pass. We have not found any study of vein disease in *Papio anubis*, nor have we found any description of the anatomy of the baboon leg veins. We supposed that the explanation for this might lie in possible differences between the anatomy of the superficial veins of the leg in human and apes.

The great saphenous vein is the main superficial vein of the lower limb in humans. It is a long vein, which runs along the medial aspect of the leg and the thigh and increases in diameter gradually as it approaches the saphenofemoral junction [18]. It generally runs as a single vein, but duplication or even triplication of various levels of the lower extremity have been reported [8, 15, 19]. Five types of outlet are known of the great saphenous vein and its tributaries into the femoral vein [14]. Tributaries of the great saphenous vein have been found in both adults [13, 14] and foetuses [1].

The small saphenous vein is not as significant as the great saphenous vein, which is involved seven times as often in varicose veins [17]. Four types of outflow of the small saphenous vein into the popliteal vein have been described in humans [10, 15, 17].

In apes SSV was found to be the main vein of the leg. It was a single large vessel, which emptied into the deep veins above the popliteal fossa. In contrast, LSV was double and thin. The vessel's width did not vary as it approached the saphenofemoral junction.

We found only one type of SSV outflow into the popliteal vein and one type of LSV outflow into the femoral vein in *Papio anubis*, and the superficial veins entered the profound veins separately.

Załuska and Urbanowicz [20] classified the superficial venous system of the foot into 5 types in humans and into 8 types in *Macaca rhesus* and *Macaca cynomolgus*. They took into consideration not only relation of the dorsal metatarsal veins and the dorsal venous arch but also the variety of connection between the dorsal metatarsal veins. Our study of this problem showed three types of superficial venous system in *Papio anubis*.

The veins of the foot of both the *Papio anubis* and the *Macaca* formed a superficial system that ran as the long and small saphenous veins. We did not notice the veins of the foot running proximally in the leg along the anterior and posterior tibial artery, which belong to the profound venous system, as is the case in humans. The deep veins of the leg were formed by tributaries arising from the muscles of the leg at two thirds of its height.

CONCLUSIONS

1. In our material three types of the superficial venous system of the foot were found in *Papio anubis*. Among them type I was the most common, occurring in 50% of all feet, where two metatarsal veins forming trunks joined DVA at two junctions.
2. The SSV, which ran laterally on the leg and opened into the popliteal vein, was the main vein of the leg in *Papio anubis*.
3. In *Papio anubis* LSV ran as a double vessel on the medial side of the leg and the thigh and opened into the femoral vein.
4. No symmetry was observed in the dorsal venous network in *Papio anubis*.

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