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CASE REPORT

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Five-headed triceps brachii muscle, with an unusual communication between the musculocutaneous and median nerves in a cross-breed dog cadaver: a case report

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Abstract

In the domestic dog, the medial head (*caput mediale*) of the triceps brachii muscle arises via a distinct tendon from the crest of the lesser tubercle and the accessory head (*caput accessorium*) from the proximal caudal part of the neck of the humerus. Here the author presents a previously unreported additional point of origin of the triceps brachii muscle on both antimeres of an adult male cross-breed domestic dog cadaver. The variant head arose via fleshy fibers from the medial aspect of the neck of the humerus, just caudal to the lesser tubercle and fused at insertion with the caudal aspect of the proximal half of the medial head. Thus, it can simply be considered as the second accessory head of the triceps brachii muscle. The radial collateral artery on the left limb passed distolaterally between the medial and variant heads, whereas it passed caudal to the variant head on the right limb. The communicating branch between the musculocutaneous and median nerves extended in both directions on the left brachium. Besides a potential clinical significance, knowledge of this variant can be useful in understanding the embryogenic and phylogenetic perspectives.

Keywords Anatomical variation, Canidae, *Canis lupus familiaris*, Caput mediale, Variant head

Introduction

The common anatomy of the triceps brachii muscle in the domestic dog consists of the four heads. The medial head (*caput mediale*) with a distinct tendon arises from a point on the crest of the lesser tubercle of the humerus between the insertion sites of the teres major and coracobrachialis muscles, cranial and caudally, respectively. It forms a narrow spindle-shaped muscle belly that terminates in a flat tendon on the medial aspect of the olecranon. The other heads of the triceps brachii muscle with a blended insertion tendon include the long (*caput longum*), the lateral (*caput laterale*), and the accessory (*caput accessorium*) [1–3]. According to the studies on the thoracic limb musculature of wild carnivores (Carnivorans -Order: Carnivora-), the triceps brachii muscle in some species can be composed of up to five separated heads from among the heads listed as follows: the capita longum, magnum, laterale, angulare, accessorium, mediale, and mediale accessorium. The last one lies distal to the caput mediale [4–17]. Souza et al. (2018) in *Lycalopex gymnocercus* only describe four heads [5], the same heads of the dog has been described in most canids (*Chrysocyon brachyurus*

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[12], such as, *Cerdocyon thous* [11]). Besides, a more recent article in Caniforms reports that most species of this suborder (Caniformia) only have four heads, since the caput angulare and the caput mediale accessorium named by most authors are actually the tensor fasciae antebrachii and anconeus medialis muscles, respectively [10]. Even Spoor and Badoux (1986) only describe four heads in a Feliform as *Hyaena hyaena* [9], similar to those present in the domestic dog.

The main blood supply to the four heads of the triceps brachii muscle is from the caudal circumflex humeral artery. Its distal branch, the radial collateral artery and accompanying radial nerve run distally between the terminations of the teres major and latissimus dorsi and the medial and accessory heads of that muscle [3].

According to human reports, the triceps brachii muscle shows rare variations compared to other muscles [18], and to the author's knowledge, such reports of the variation of this muscle have not yet been reported in domestic dogs. The present variation introduces a bilateral development of an additional head of the triceps brachii muscle detected in an adult male cross-breed domestic dog cadaver.

Case presentation

During cadaveric dissection of both thoracic limbs of an adult male cross-breed dog for teaching the anatomy of the intrinsic musculature, an additional point of origin of the triceps brachii muscle was detected in both limbs. The dog was obtained from a private animal shelter for the educational purposes. The appearance characteristics of this dog were mesocephalic and normal, but having a small body size and short legs. It was euthanized by the injection of IV sodium pentobarbital (85 mg/kg) based on the recommendations of the *AVMA Guidelines for the Euthanasia of Animals* (2020 Edition). For a better visualization of the arteries, red-colored gelatin was injected into the cannulated common carotid artery.

The additional head took its origin through fleshy fibers from the medial aspect of the neck of the humerus, just caudal to the lesser tubercle. It was located at origin between the coracobrachialis muscle cranially and the termination of the subscapularis muscle dorsally and then passed distad to fuse at insertion with the caudal aspect of the proximal half of the medial head (Fig. 1a-c). Thus, it can simply be considered as the second accessory head of the triceps brachii muscle. The variant head was noted to be larger on the left limb than on the right limb (Fig. 1d). Additionally, the medial head on the left limb was partially divided into two medial and lateral bellies, but not on the right side. The radial collateral artery on the left side passed distolaterally between the medial and variant heads, whereas it passed caudal to the variant head on the right side. Along its course, this artery gave off several muscular branches to the heads of the triceps brachii muscle, including the variant head. The radial nerve was also noted to pass laterally between the variant and long heads. The innervation of the variant head was provided via the same muscular branch of the radial nerve to the medial head (Fig. 1b-d). Another variation seen at the middle of the left brachium was a fine communication from the median nerve (M) to the musculocutaneous nerve (MC) running caudal to the brachial artery (Fig. 2). This communication was in the opposite direction to the usual communication from MC to M.

Discussion

In the present variation, the triceps brachii muscle in the domestic dog represents bilaterally an additional accessory head that has not been reported in the anatomy literature so far. A review of the triceps muscle in other carnivores shows that it can consist of four to six different heads [4–17]. Based on the origin points of the caput accessorium represented in the muscle maps of the other carnivores from the proximal parts of the caudal surface of the humeral shaft including the humeral neck in most carnivores [5, 6, 8, 10, 14, 15, 17, 19], the variant head in the case presented here arising from the medial aspect of the neck of the humerus may be derived from the caput accessorium. Additionally, the positional relationship between the radial collateral artery and triceps brachii muscle demonstrates that the artery passes laterally to the caput accessorium and medially to the caput laterale of this muscle in *Canis lupus familiaris* [3, 20], *Cerdocyon thous* [11], *Potos flavus* [10], *Procyon cancrivorus* [19], and *Felis catus* [20]. The anatomical relationship of this artery in these carnivorans also supports the hypothesis that the additional head of this dog is derived from the caput accessorium.

The caput mediale on the left thoracic limb of this dog cadaver was noted to be partially divided into two medial and lateral bellies. According to a study by Ercoli et al. (2015) on three specimens of the lesser grison (*Galictis cuja*), the triceps muscle had up to six fully separated bellies near its origin, caput longum, caput laterale, caput angulare, caput accessorium, caput mediale, and caput mediale accessorium. Furthermore, in their dissections, the caput mediale was also divided into two principal and intermediate parts. The former part consisted of two lateral and medial bellies, originating from the caudomedial aspect of the humeral neck and a sector just distal to the lesser tubercle, respectively. The latter part originated from a longitudinal line caudal to the insertion of the m. teres major and the m. latissimus dorsi [4]. The double belly of the caput mediale in the present study may be homologous with that of the lesser grison described

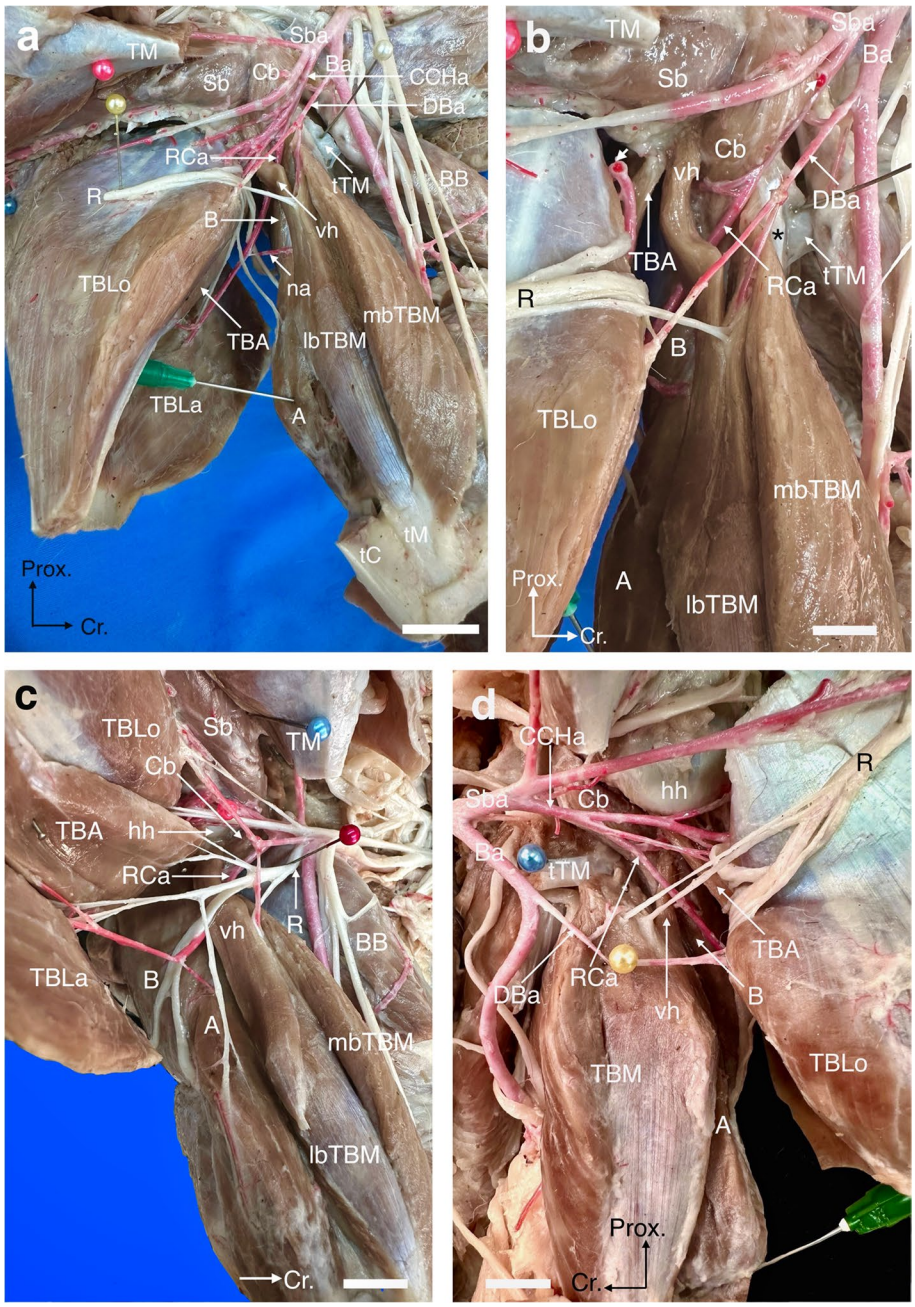

Fig. 1 **a** Medial view of the left brachium showing the variant head (vh) of the triceps brachii muscle and related structures. A, anconeus m.; B, brachialis m.; Ba, brachial artery; BB, biceps brachii m.; Cb, coracobrachialis m.; CCHa, caudal circumflex humeral a.; RCa, radial collateral artery; DBa, deep brachial artery; lbTBM, lateral belly of triceps brachii (medial head) m.; mbTBM, medial belly of triceps brachii (medial head) m.; na, nutrient artery; R, radial nerve; Sb, subscapulris m.; Sba, subscapular artery; tC, common tendon insertion of the accessory (TBA), lateral (TBLa) and long (TBLo) heads of triceps m; tM, tendon insertion of the medial head of the triceps m.; TM, teres major m. and its tendon of insertion (tTM). **b** higher magnification of the medial view of the left brachium after cutting the muscular branches (arrowheads) of the (Sba). Note the RCa passing between the variant and medial heads of the triceps m.; *, tendon origin of the TBM. **c** caudomedial aspect of the left brachium showing attachment site of the (vh) to the caudal aspect of the proximal half of the medial head; hh, humeral head. **d** medial view of the right brachium demonstrating the position of the (RCa) in relation to the (vh). Scale bar: 2cm

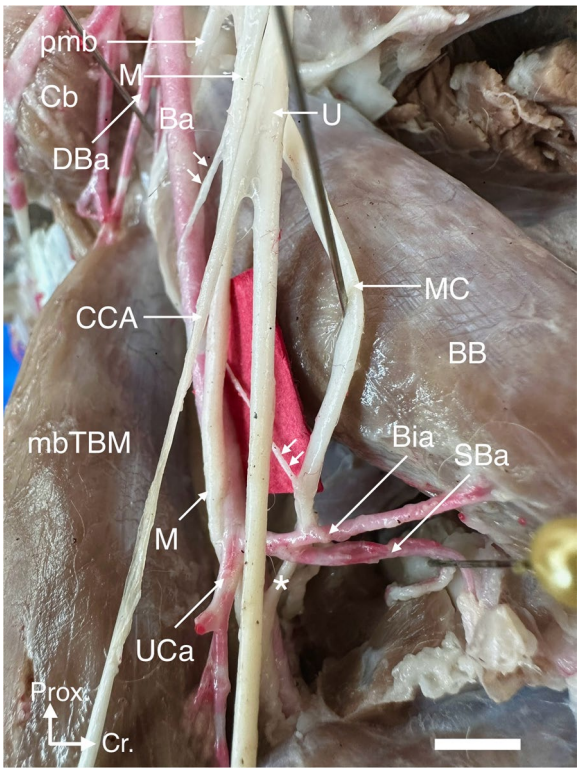

Fig. 2 Medial view of the left brachium showing communications between the median (M) and musculocutaneous (MC) nerves in both directions (arrowheads and asterisk). Ba, brachia artery; BB, biceps brachii m.; Bia, bicipital artery; Cb, coracobrachialis m.; CCA, caudal cutaneous antebrachial nerve; UCa, ulnar collateral artery; DBa; deep brachial artery; mbTBM, medial belly of triceps brachii (medial head) m.; pmb, proximal muscular branch of the (MC) to the (BB); SBa, superficial brachial artery; U, ulnar nerve. Scale bar: 2cm

by Ercoli et al. (2015). From a phylogenetic point of view, this variation may indicate a transformation in the evolution of the caput mediale of the triceps muscle in the dog, as in the cladogram, Canidae and Mustelidae (such as *Ga. cuja*) are located at the base and top of Caniformia, respectively [21].

Additional muscular slips are noted to potentially cause neurovascular compression. Some authors of human studies have conjectured that the radial nerve and deep brachial vessels can be entrapped by tendinous or muscular slips of the triceps muscle [18, 22, 23]. However, it is also known that compression of the deep brachial artery by an additional head of the triceps muscle may not directly affect the blood supply due to the several vascular anastomoses around this region [18]. In the present dog with this variant, no specific clinical symptomatology was observed. Similarly, the variant distribution of the arteries to the triceps brachii muscle has been described by some authors in caniforms without reports of compression signs in their dissections [10, 11]. Furthermore, in the present case, the radial nerve passed caudally to this variant head on both sides, whether the close relationship of the latter to the nerve may be a risk factor for its compression during some sporting movements needs further investigation.

In the left side of the specimen presented here, in addition to the usual communication from MC to M, a communication was noted to arise from M to MC in the mid brachium. The former communication has also been observed in several other canids [24–28], but the latter one was observed only as a variation of the author's previous report in the domestic dog [29]. Regarding the possible phylogenetic relationship of this variant, since in some variant cases of carnivorans of the families Mustelidae, Mephitidae and Procyonidae, the median and musculocutaneous nerves might form a common trunk at the level of the brachium, such as in ferret (*Mustela putorius*), skunk (*Mephitis mephitis*) [28] and coati (*Nasua nasua*) [30] (Vélez García et al. 2023), the occurrence of such nerve communications in the case presented may have been derived from a primitive arrangement that probably existed as a common trunk in the last common ancestor of Carnivora, Ungulata, and Pholidota [31].

Conclusion

The development of the second accessory head of the triceps brachii muscle presented here can contribute to the understanding of phylogenetic and ontogenic issues in the evolution of the thoracic limb muscles in carnivorans.

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Author's contributions
Y.K. performed the experiments, analyzed the data and wrote and revised the manuscript.

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Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
All procedures in this study were in accordance with the ethical guidelines outlined in the Basel Declaration. The recommendations of the *AVMA Guidelines for the Euthanasia of Animals* (2020 Edition) were also followed.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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