

## Original Article

# Special cutaneous vascular elements in one-humped camel (*Camelus dromedarius*)

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• Received: May 3, 2016 • Revised: May 28, 2016 • Accepted: June 5, 2016 • Published Online: June 13, 2016



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## ABSTRACT

**Objective:** The aim of this study was to investigate the histomorphological structure and functional significance of various special regulatory devices of the vascular terminal branches of the skin in one-humped camel (*Camelus dromedarius*).

**Materials and methods:** Skin samples from different body parts (e.g., front, neck and shoulder, back, belly, chest, thigh, flank and tail) of camel were used in this study. The samples were stained with Harris hematoxylin and trichrome stain. Semithin sections were also prepared from these samples.

**Results:** The vascular elements demonstrated in the current study included-throttle arteries within the dermis on the level of the hair papillae, glomus bodies within the dermis on the level mid-length of the hair follicles, medium-sized arteries on the level of the secretory end-pieces of the epitrichial sweat glands, and tufts of spirally-oriented arterioles in the nearby of the hair follicles.

**Conclusions:** These vascular elements are either designed to control blood pressure (Hemo-dynamic mechanism) or patterned to control body temperature (Thermo-regulatory mechanism).

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## KEYWORDS

Camel, Cutaneous vasculatures, Regulatory device, Thermoregulation

**How to cite:** Fath-Elbab MRF, Abou-Elhamd AS (2016). Special cutaneous vascular elements in one humped camel (*Camelus dromedarius*). Journal of Advanced Veterinary and Animal Research, 3(2): 106-111.

## INTRODUCTION

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The peripheral circulations of various organs in vertebrates have interested many investigators ([El-Etreby, 1969](#); [Sangüeza and Requena, 2003](#); [Mohamden, 2009](#); [Eroschenko, 2016](#)). Yet, the available literature lack any detailed information concerning the skin, especially that of the camel ([Hafez et al., 1955](#); [Talukdar et al., 1972](#); [Mahdi and Khamas, 1986](#); [Braverman, 1989](#); [Braverman, 1997](#); [Michael and Pavletic, 2008](#); [Démarchez, 2011](#)).

The objective of the present study was to investigate the histomorphological structures of the vascular terminal branches of the skin of the camel with special references to their regulatory devices.

## MATERIALS AND METHODS

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The different types of blood vessels shown in this investigation have been deduced from studies of serial sections of the skin of 10 camels ranging between 2 months and 7 years old. The samples were collected from camels slaughtered at Beni-Adi slaughter house, Assiut province, Egypt. The samples were taken from the front, neck and shoulder, back, belly, chest, thigh, flank and tail regions of the body. The collected materials were fixed in 10% neutral buffered formalin and Bouin's solution. The samples were then processed for embedding in parablack blocks. Sections were cut (5 µm) serially. The paraffin sections were stained by Harris's hematoxylin ([Harris, 1900](#)) and eosin and Crossmon's trichrome stains ([Crossmon, 1937](#)).

For semithin sections, samples of the skin (1-2 mm) were subjected for fixing in 2.5% cold glutaraldehyde in phosphate buffer (PB) (pH 7.2) for 24 h. The samples were washed twice in 0.1 M PB, and were post-fixed in 1% osmium tetroxide. Then, the samples were dehydrated in ascending grades of alcohols and embedded in araldite resin. Thin sections (1 µm) were prepared and stained with 1% toluidine blue. The sections were examined and photographed on an Olympus microscope with DP72 camera. The images were imported into adobe Photoshop for labelling.

## RESULTS

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At the flank region, throttle arteries are demonstrated within the dermis on the level of the hair papillae (**Figure 1**). They possess a markedly thick wall surrounding an eccentric, obviously narrow flattened lumen. The endothelium is represented, in cross sections by a single layer of inverted pear-shaped cells with their wide portion protruding into the lumen. The cytoplasm is pale and the

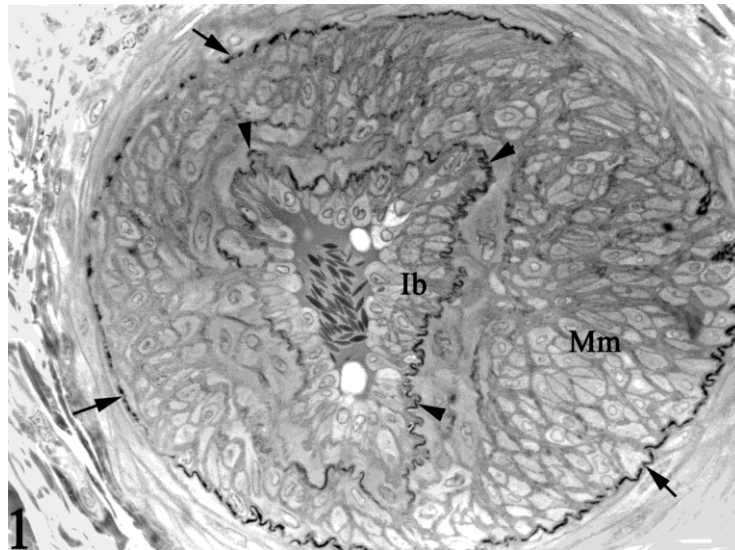
nucleus is large, rounded and vesicular. The endothelium is surrounded by a cushion-like thickening (bolster) of longitudinally directed smooth muscle fibers separated from the thick, double muscular media by a well-developed undulating internal elastic membrane. The tunica media is composed of a thick, inner, longitudinal and a thinner outer circular smooth muscle layer. These muscular layers are separated by a well-developed elastic lamina. The adventitial tunic demonstrates several blood vessels (vasa vasora). They are represented by arterioles, venules and capillaries. Several lymphatic vessels demonstrate themselves within adventitia.

At the frontal region, glomus bodies are demonstrated within the dermis on the level mid-length of the hair follicles (**Figure 2A, B**). The peculiarly thick wall of these vessels surrounding an eccentric, very narrow lumen consists of the following layers: the endothelium, consisting of about 5 cells, is surrounded by a thick intimal cushion-like thickening composed of 7-9 layers of epithelioid glomus cells and some longitudinally-oriented smooth muscle cells. The glomus cells are pale cells with large vesicular nucleus, and are rounded or polyhedral in shape. The tunica media being relatively thin is composed of circularly arranged smooth muscle fibers. The adventitial tunic is thin and heavily infiltrated by mast cells (**Figure 2B**).

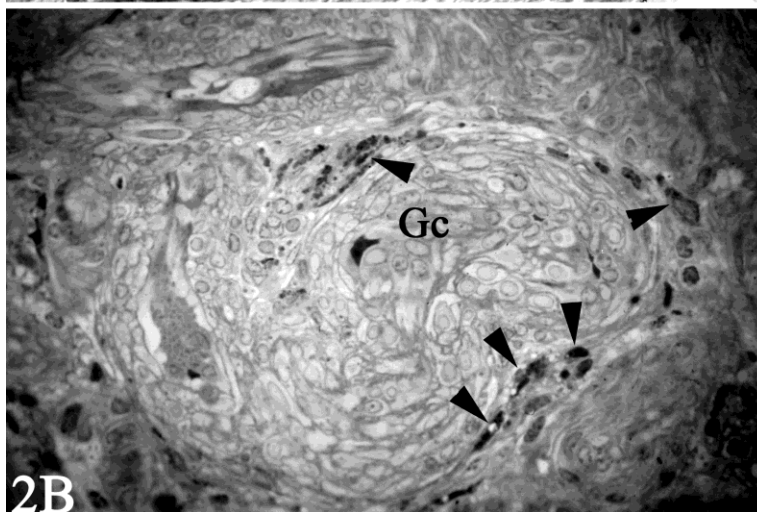
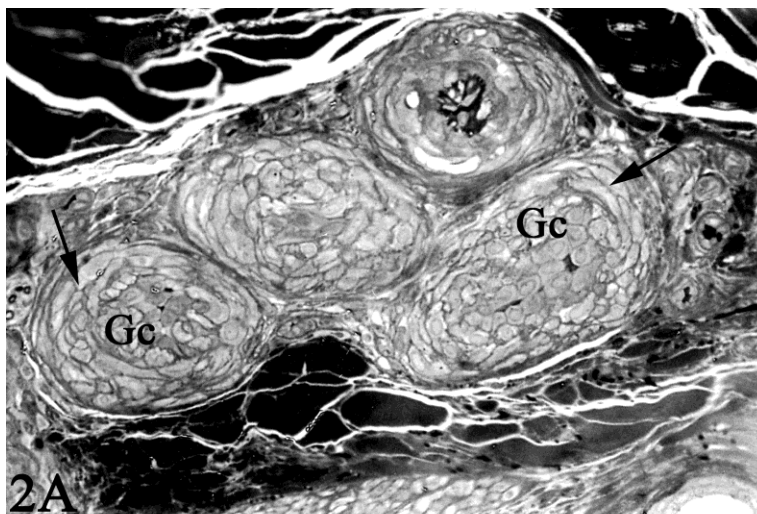
At the shoulder region, medium-sized arteries are demonstrated on the level of the secretory end-pieces of the epitrichial sweat glands (**Figure 3**). The wall of these arteries is formed mainly by a thick tunica media consisting of 7-9 layers of circularly-oriented smooth muscle fibers. The tunica intima consists of flat endothelial cells surrounded by complete or interrupted layer of concentrically-arranged elastic fibers namely, the internal elastic membrane. The fibrillar adventitial tunic harbours abundant arterioles and venules a long side several mast cells.

Tufts of spirally-oriented arterioles are observed in the nearby of the hair follicles (**Figure 4A, B, C**). The endothelium is composed of 3-5 flattened cells. The tunica media is formed of 3-4 layers of circularly arranged smooth muscle fibers. The adventitial tunics of these vascular elements are infiltrated by several mast cells. Some capillaries find their way inbetween the before mentioned arterioles.

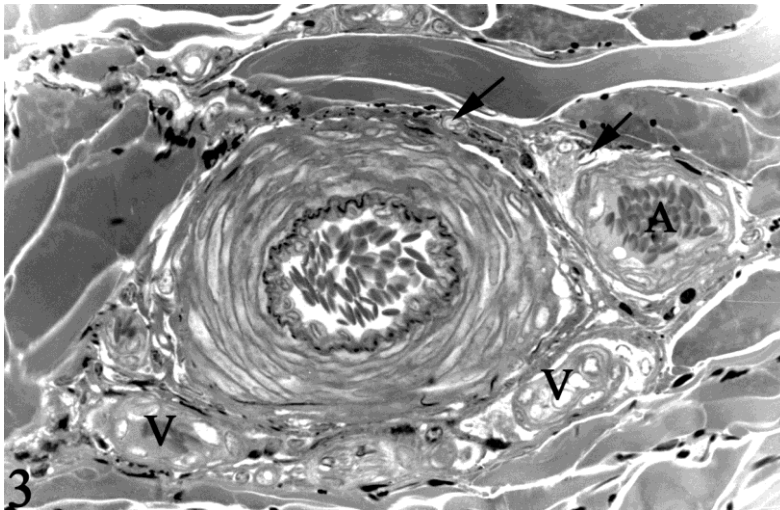
Throttle or occlusive arteries are recorded within the dermis (**Figure 5**) at a level deeper than that of the hair papillae. These vessels show an elastic longitudinal muscular intima bolster. The latter device is composed of an intimal cushion-like thickening which is made up of



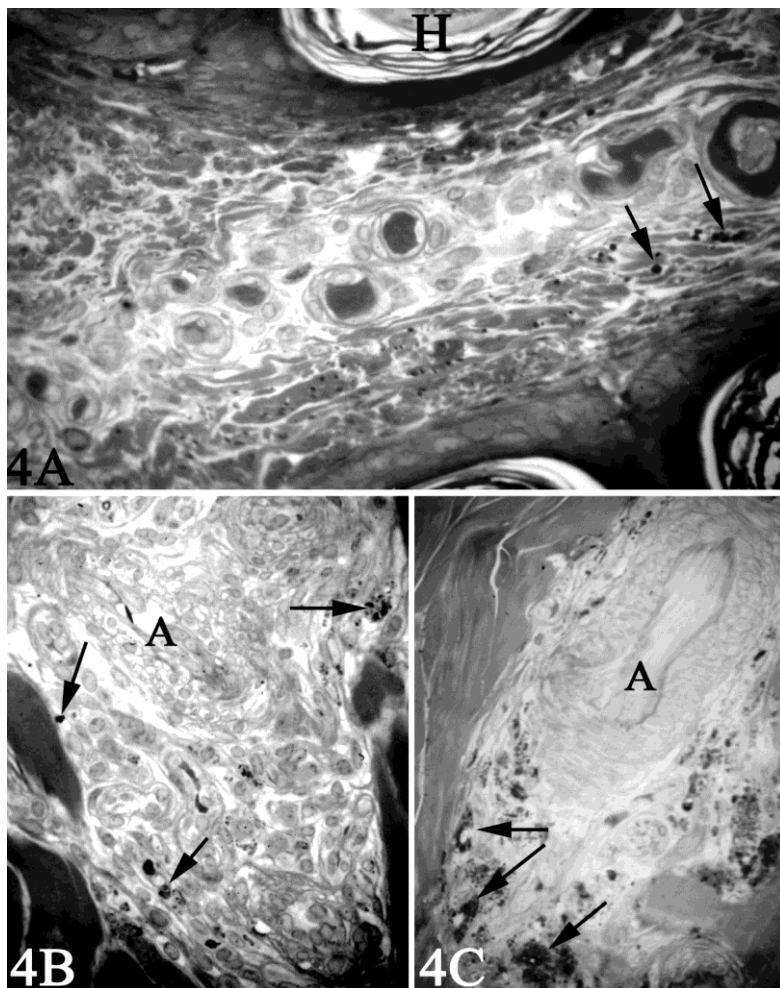
**Figure 1:** A throttle artery with longitudinal muscular intima bloster (Ib) separated from the thick double muscular media (Mm) by a well-developed undulating internal elastic membrane (arrowheads). The outer circular and the inner longitudinal muscle layers of the tunica media are separated by an elastic lamina (arrows). Flank region, Toluidine blue, X250.



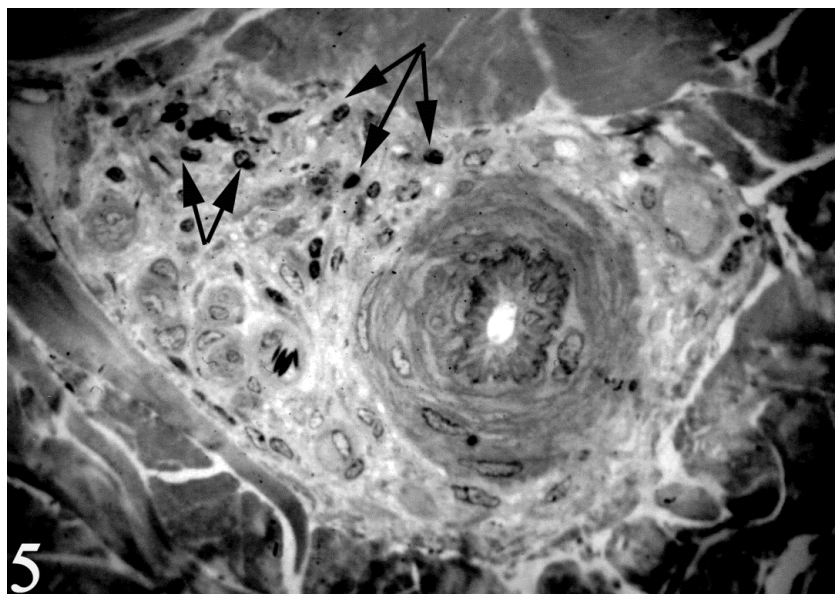
**Figure 2A, B:** Glomus vessels of typical structure demonstrated on the level mid-length of the hair follicles. The wall of these vessels consists of several layers of glomus cells (Gc) surrounded with concentric layers of smooth muscle cells (arrows), mast cells (arrowheads). Flank region, Toluidine blue, X250.



**Figure 3:** Medium-sized artery. Notice the tunica adventitia harbouring abundant arteriole (A), venules (V) and blood capillaries (arrows). Front region, Toluidine blue, X250.



**Figure 4A, B, C:** Tufts of spirally-oriented arterioles (A) in the vicinity of the hair follicles (H). Notice the mast cells (Arrow). Front region, Toluidine blue, X250.



**Figure 5:** Throttling or occlusive artery within the dermis at a level deeper than that of the hair papillae, mast cells (arrows). Front region, Toluidine blue, X250.

longitudinal smooth muscle cells infiltrated with fine elastic and collagenous fibers. The pad-like structure is located subendothelially and is demarcated from the relatively thick muscular media (4-5 layers) by distinct internal elastic membrane. The relatively thick adventitia, being highly vascular, presents mast cells.

## DISCUSSION

The circulation of the skin presents arrangements which accommodate various functional requirements: increased blood flow in hot conditions to facilitate heat loss, nutrition of the skin and appendages, and decreased blood flow in cold conditions to minimise heat loss ([Rhoades and Bell, 2009](#); [Young et al., 2014](#)).

The histomorphological investigations of the cutaneous vasculature in one-humped camel revealed several blood vessels having special regulatory devices that may have unique functions.

The present study revealed several blocking devices as longitudinal-muscular intima bolsters. The latter devices seemed to have an active dynamic function engaged in the regulation of blood flow and blood pressure by throttling or occlusive mechanism.

In the skin of the camel, some vessels possessed two distinct muscular tunica media; these are- (i) an outer circular and (ii) an inner longitudinal layer. Similar types of vessels were also reported in different organs of animals, for example horses ([Heidenreich, 1960](#)), dogs ([Dahme, 1957](#)), buffaloes ([El-Etreby, 1969](#)), deers ([Kress, 1961](#)), and camels ([Mohamden, 2009](#)).

The glomus organs observed in the present study are supposed to possess a complex function, by which humeral, thermoregulatory, and hemodynamic functions are seemed to be involved.

The presence of highly vascular adventitial tunic of some arteries of special structure, represented by plentiful arterioles, and capillaries, may reflect a peculiar device supposed to serve a regulatory function for body temperature. On the other hand, the vascular device represented by the tuft of spirally oriented arterioles and capillaries may present an angioarchitectural pattern which plays a role in controlling the blood pressure. Generalized constriction of arterioles markedly increases peripheral resistance to blood flow proving an important role in the regulation of systemic blood pressure.

The local and general reflex responses are involved in thermoregulatory regulations ([Romanovsky, 2014](#)). The cutaneous blood vessels become more sensitive to catecholamines and arterioles when these are cooled. As a result, the venules constrict to regulate the body temperature. As a consequence, blood is directed into the deep veins from the skin that run alongside the arteries. As a result, heat is transferred from the arterial blood to venous blood without reaching the skin ([Talukdar et al., 1972](#); [Mahdi and Khamas, 1986](#); [Barrett et al., 2012](#)).

## CONCLUSION

In conclusion, the vessels of special structure are supposed to possess an important regulatory function for peripheral circulation. Some vessels exert an active

function on the blood flow and pressure regulation through their throttling or occlusion effect. This mechanism is attained either through the contraction of smooth muscle fibers or by the presence of glomus cells which cause a reduction in the diameter of the lumen by their ability to swell. Other blood vessels serve to play an important role in regulation of the body temperature; a thermoregulatory function. A matter which proves of vital importance in camels which live and raise into severe adverse (arid) climatic conditions.

## CONFLICT OF INTEREST

Nothing to declare.

## ACKNOWLEDGEMENT

We would like to thank the technicians in the Department of Anatomy and Histology, Faculty of Veterinary Medicine, Assiut University for their help during sampling and processing.

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