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ANGIOGENESIS OF THE CANINE CONCHA AURICULAE

(With 7 Figs., & 1 Plate)

By

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تطـــور الأوعية الدموية في صيوان اذن اجنة الكلاب

نبيـــل كامـــل

تم دراسة تطور وتوزيع الأوعية الدموية المغذية لصيوان الأذن خلال المراحل المختلفة لخمسة وعشرون جنينا من فصيلة الكلاب تراوحت أطوالها مابين ١٣٠ الى ١٤٠ مليمتر بعد حقنها بالمصل المخلوط بالحبـــــر الشيني . وقد أظهر الفحص الميكروسكوبي ان صيوان الأذن في الأجنة التي تراوحت أطوالها ١٣٠ مليمتـــر تستقبل خمسة الى ستة أوعية دموية شريانية صغيرة بينما يجمع منها الدم عن طريق وريدين أحدهم يمتد على حافة الأذن بينما يبعد الآخر بعض الشئ عن الحافة الأخرى. كما لوحظ أن صيوان الأذن في الأجنة التـــى تراوحت أطوالها مابين ١٥٠ ـ ١٨٠ مليمتر تتغذى بثلاثة أوعية شريانية صوحب أحدهم بوريد على الحافـــة الخلفية لصيوان الأذن. أما الاجنة التي ناهزت أطوالها ٢٣٠ مليمتر فقد تميزت فيها الأوعية الدموية الـــى النمط البالغ حيث لوحظ أن الأوعية الدموية الشريانية التي تسير على حافتي صيوان الأذن تلازمها أوردة على امتـداد مسـيرتها. نوقشت النتائج لبيان الدور الذى تلعبه الأوعية الدموية بصيوان الأذن في تنظيم درجة حرارة الجسم.

SUMMARY

The morphogenesis of the vascular elements in the auricle of the external ear of 25 dogs foetuses (Egyptian land-race), ranging from 130-240 mm crown-to-rump (CVR) length was studied.

The vasculature of the Concha auriculae was represented by 5 to 6 primitive arterial branches and two large veins in foetuses of 130 mm CVR length.

In foetuses ranging from 150-180 mm CVR length, the Concha auriculae demonstrated well differentiated three arterial branches. Only the caudal one was accompanied by a satellite vein along side the caudal border of the ear.

On reaching 230 mm CVR length, the V. helicis oralis was observed to approach the corresponding border of the ear where it was accompanied by A. auricularis oralis, otherwise the vascular architecture of the auricular concha during this stage (full-term foetus) presented quantitative more than qualitative changes.

INTRODUCTION

The cutaneous vascular system is a prime regulator of total body temperature (MONTAGNA and PARAKKAL, 1974).

The vascularization of the ear in domestic animals was studied by several authors (CLARK and CLARK, 1934, a, b; CLARK, 1938; FINDALY, 1953; GOODAL, 1955; DANIEL and PRICHARD, 1956; BECKER, 1960; HEINZE, 1960; SAUERLANDER and WISSDORF, 1972). Also AHMED, et al. (1985) and AHMED, et al. (1988) studied the morphogenesis of vasculature of the foetal external ear in swine and camels; respectively.

However, data on the prenatal development of the blood vessels of the external ear of dogs could not be traced in the available literature.

MATERIAL and METHODS

The material included in this investigation consisted of 25 dog foetuses of both sexes ranging from 130-240 mm CVR length. The foetuses were obtained from pregnant Egyptian-land race bitches sacrificed at various periods of gestation. The foetuses were recovered shortly after evisceration. The crown-to-rump (CVR) length was measured and calculated to the nearest milimeter.

The foetuses were injected with a mixture of Indian-ink and Bovine serum (FATH EL-BAB; SCHWARZ and GODYNICKI, 1983). The injection was done through the umbilical vessels or through the thoracic aorta after ligature of its cardial end. The injected foetuses were fixed in 10% formalin solution and the auricles of the external ear were removed, dehydrated and cleared in benzol followed by a 1 to 1 mixture of methyl-benzoate and benzyl-benzoate. Other serial vartical paraffin sections were cut at about 70-100 Um thickness and were stained with Haematoxylin.

The nomenclature used in this study coincides that given by AHMED, et al. (1985).

RESULTS

The vascular architecture of the foetal Concha auriculae of the dog was mainly distributed at the lateral surface of the conchal cartilage.

At 130 mm CVR length (Fig. 1 a & b) the arterial supply of the Concha auriculae was represented by 5 to 6 branches which reached the lateral surface of the concha at its base. These arterial branches pursued various cources which directed distally towards the tip of the ear. Two arterial branches were observed running along both the cranial and caudal borders of the concha. They reached more or less nearby

the apex of the ear. The arterial branch at the caudal border of the Concha auriculae followed a parallel course with a satellite vein. However, the other arterial branches were distributed centrally on the lateral surface of the ear. Only a single central branch could reach the apex of the ear. The latter mentioned arteries broke down into several bilateral branches during their course towards the apex of the auricular cartilage.

The venous drainage of the Concha auriculae was consisted of 2 veins viz, V. helicis oralis and V. helicis caudalis. The V. helicis oralis coursed subcutaneously parallel to a longitudinal line at the border between the cranial and middle thirds of the conchal cartilage. However, the V. helicis caudalis coursed subcutaneously parallel to the corresponding border of the concha where it was observed in a satellite pattern with an arterial branch. The V. helicis caudalis was more developed than the V. helicis oralis where it drained a larger area which may reach the tip of the ear.

Both Vv. helicis oralis and caudalis drained the blood through 2 varieties of networks; namely a cutaneous and a perichondral venous networks (Fig. 2-3). The beforementioned cutaneous network was obviously more developed than the perichondral one. The perichondral venous network received tributaries from the medial surface of the concha through several tributaries which perforated the conchal cartilage.

In 150-180 mm CVR long foetuses, the arterial supply to the Concha auriculae demonstrated a well differentiated pattern of development where it was represented by three arterial branches namely; A. auricularis oralis, A. auricularis caudalis and A. auricularis intermedius (Fig. 4 a, b, c) and (Plate 1). At this stage of development, the ear received its arterial supply mainly through the A. auricularis intermedius which coursed parallel to the long axis of the concha. This arterial trunk gave rise to several collateral branches along side its course towards the tip of the ear. Although the A. auricularis caudalis was completely accompanied by the V. helicis caudalis along side the caudal border of the ear in a satellite pattern, the A. auricularis oralis sweeped lonely parallel to the corresponding border. Both of the aforementioned arteries reached each other at the tip of the ear.

The medial surface of the Concha auriculae received its blood supply mainly from perforating branches which originated from A. auricularis intermedius which pierced the auricular cartilage at various sites along the course of the parent vessel.

The venous drainage at this stage received tributaries from the anlage of the Rete hemocapillare bursae pili and the Rete hemocapillare papillae pili at both surfaces of the ear.

On reaching 230 mm CVR length, the V. helicis oralis (Fig. 5) was observed to approach the corresponding border of the ear where it accompained A. auricularis

oralis throughout most of its course. Dense vascular net could be observed at the tip of the auricle. It was formed by arborization of branches from both marginal vessels as well as the A. auricularis intermedius. The contribution of the A. auricularis caudalis and its satellite vein (V. helicis caudalis) appeared to be greater than the A. auricularis oralis and its satellite vein (V. helicis oralis). Several transverse branches were observed connecting both V. helicis oralis and V. helicis caudalis (Fig. 6). The latter vein presented a beeded nature near the base of the ear, otherwise the vascular architecture of the concha presented quantitative more than qualitative changes (Fig.7).

DISCUSSION

The present work reveaied that in dog foetuses of 130 mm CVR length, the vasculature of the Concha auriculae was represented by 5 to 6 primitive arterial branches and 2 large veins. The V. helicis oralis coursed subcutaneously parallel to a longitudinal line at the border between the cranial and the middle thirds of the Conchal cartilage. However, the V. helicis caudalis coursed subcutaneously parallel to the corresponding border of the ear. Similar observations were obtained by AHMED, SCHWARZ and FATH EL-BAB (1985) in 90-100 mm CVR length swine foetuses and AHMED; SELIM; ANIS; SOLIMAN and MORSY (1988) in 140-210 mm CVR length camel foetuses. They, however, reported that the two helicine veins coursed parallel to the corresponding borders of the concha auriculae of both swine and camel foetuses. Moreover, a third vein (the intermediate helicine vein) could be demonstrated in the ear of camel foetuses.

In dog foetuses of 150-180 mm CVR length, the Concha auriculae was found to have well differentiated three arterial branches. The caudal artery was the one to be accompanied by a satellite vein along side the caudal border of the ear. In contrast to these findings, AHMED, et al. (1985) and AHMED, et al. (1988) demonstrated that the Concha auriculae was supplied by five arterial branches in 150-220 mm CVR length swine fetuses and six arterial branches in 235-385 mm CVR length camel foetuses. These differences might be attributed to qualitative and quantitative cutaneous structural variations among these species. They added that the cranial and caudal arterial branches coursed parallel to the corresponding border of the ear of swine foetuses in a satellite pattern with their veins. On the other hand, the arterial and venous vessels of the Concha auriculae of the camel foetuses and Aryshire calves did not show the satellite pattern of vessels seen by AHMED, et al. (1985) in swine foetuses (AHMED, et al. 1988 and GOODAL, 1955). This pattern however, was observed as early as 230 mm CVR long dog foetuses at the cranial border of the Concha.

Although the skin and hair coat of dogs and cats play a role in heat regulation, they do not function in the same manner as in the animals which do not pant (MULLER

and KIRK, 1976). Dog and cat do not possess the extensive superficial arteriovenous shunts of man and pigs which are designed to disseminate heat in hot weather. Therefore, their heat regulatory mechanisms and their response to thermal burns vary markedly (HAM, 1944).

The organization of vascular elements within the auricle of the external ear of dog foetuses provides insights into their probable function. The satellite pattern between the 2 main large veins and their accompanying arteries supposed its public function as they facilitate part of the thermal regulation of blood (MORETTI, 1968 and MONTAGNA and PARAKKAI, 1974) in addition to their primary function (Private vessel function) to maintain the metabolic requirments of the parenchymal structure (WINKELMANN, 1961). Their role in heat regulation is achieved by the interchange of heat between the artery and vein. The present study revealed that the V. helicis caudalis presented a beeded nature near the base of the ear. This denotes the presence of valves at these sites. The valves play a role in the process of thermoregulation of the body through their function as mechanical restrain of the blood flow.

Morphogenetic studies on the cutaneous vascular architecture in domestic animals do not only provide insights into the problem of acclimization through heat disspation, convection and conduction, but also provide interpretation of the bases for the lesions of some cutaneous disease.

The present work revealed that, the cutaneous envelop of the Concha auriculae of dog foetuses was found to be centrally provided with arterial blood supply, however, the venous blood was drained from the ear through two main veins which oriented themselves around the borders of the ear in a satellite pattern with their arteries. In this respect, the general construction of the vascular pattern of the skin of the Concha auriculae of the dog resembled more or less a "Unit Vascular Zone" described by SCHWARZ; AHMED; FATH EL-BAB and GODYNICKI (1982); FATH EL-BAB; SCHWARZ and GODYNICKI (1983); MOUSTAFA (1986) and KELANY (1987). In this respect the Concha auriculae or this "Unit Vascular Zone" was supplied with more than one arterial blood supply. This organization may substantially influence the appearance and sequence of development of the lesions in several cutaneous diseases. In addition it may also enlighten interpretation of the different propabilities of healing process in the skin.

The present investigation showed dense vascular net at the tip of the Concha auriculae. It was formed by arborization of branches of both marginal arteries and veins as well as the central artery. This arrangement provides a relative rich vascularity to this vital region of the auricle, a mean which aid heat disspation to ensure the optimium temperature for the auricle. Also this connection between arteries and veins enlighten interpertation of different propabilities of healing process occuring in the cutaneous envelop of the ear.

In conclusion, a complete study of the vasculature of the fetal external ear must involve further histomorphological investigations.

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LEGENDS

Fig. (1 a & b): The lateral surface of the left (a) and right (b) Concha auriculae of 130 mm CVR long dog foetus, showing a = arterial branches (arrows) Vho- V. helicis oralis, Vhc = V. Helicis caudalis (x 18).

Fig. (2 & 3): The Concha auriculae of 130 mm CVR long dog foetus showing perichondral venous network (p), cutaneous venous network (Cu), penetrating blood vessel (R), conchal cartilage (C), lateral surface (L), medial surface (M), (2 : x 16, 3 : x 10).

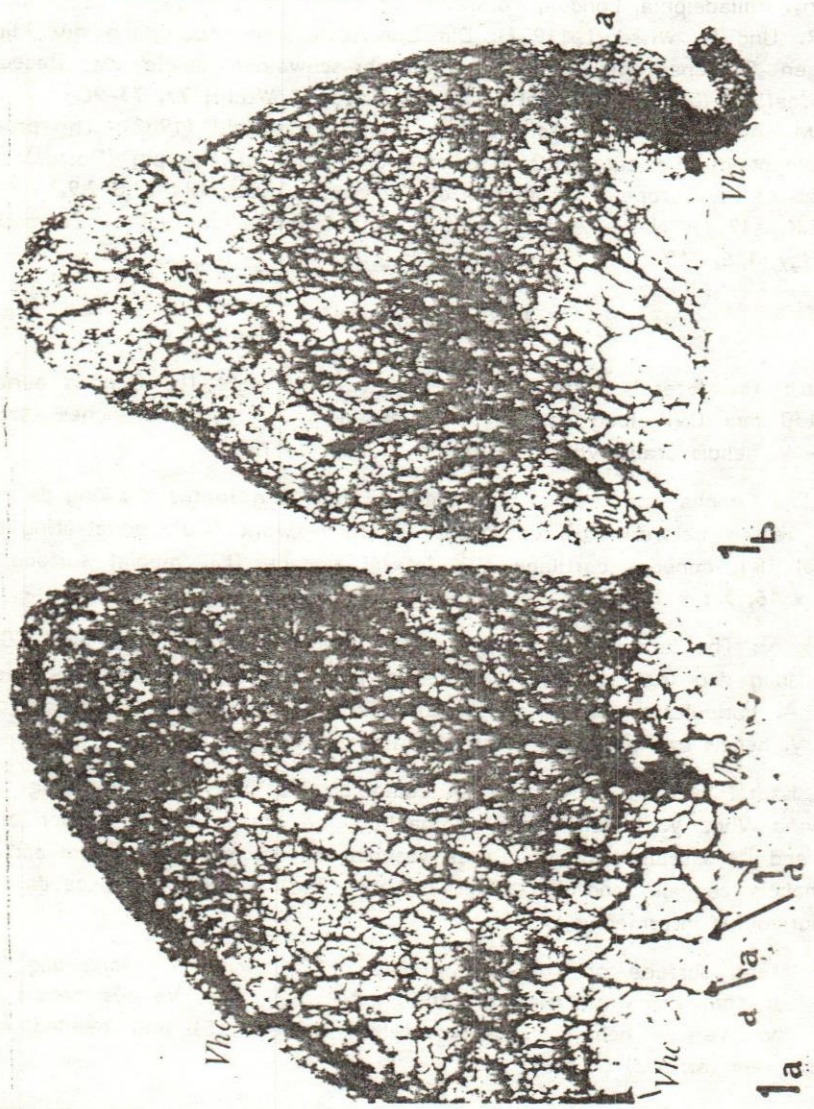
Fig. (4 a, b & c): The lateral surface of Concha auriculae of 180, 160 and 150 mm CVR long dog foetuses respectively, showing : Aal A. auricularis intermedius, Aao A. auricularis oralis, Aac A. auricularis caudalis, Vho V. helicis oralis, Vhc V. helicis caudalis, (a x 90, b 100 and c x 120).

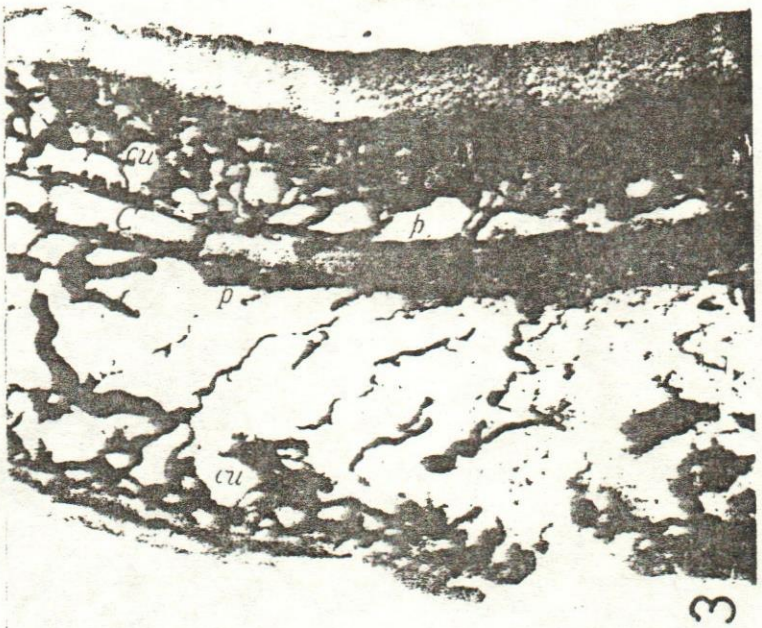
Fig. (5): The lateral surface of Concha auriculae of 230 mm CVR long dog foetus showing Vho: V. helicis oralis approached the corresponding border of the ear and its satellite A. Dvn: Dense vascular net at the tip of the ear. Vhc. V. helicis caudalis and its satellite artery (Aac) A. auricularis caudalis. Aal A. auricularis intermedius (x 90).

Fig. (6): The lateral surface of Concha auriculae of 230 mm CVR long dog foetus showing: communicating tributries (CT) between Vho: Venous helicis oralis and Vhc: Venous helicis caudalis, satellite pattern (S) and beeded nature of the vein (arrows) (x 8).

Fig. (7): Concha auriculae of 240 mm CVR long dog foetus showing: M: Medial surface, L: lateral surface, C: Auricular cartilage, P: Perforating blood vessel, R: Rete hemo-capillarie bursae pili (arrows) (x 4).

Plate (1): Diagramatic illustration on the lateral surface of the right Concha auriculae of 180 mm CVR long dog foetus showing. Vhc: V. helicis caudalis, Vho; V. helicis oralis, Aac: A. auricularis caudalis, Aao: A. auricularis oralis, Aal: A. auricularis intermedius (x 4).





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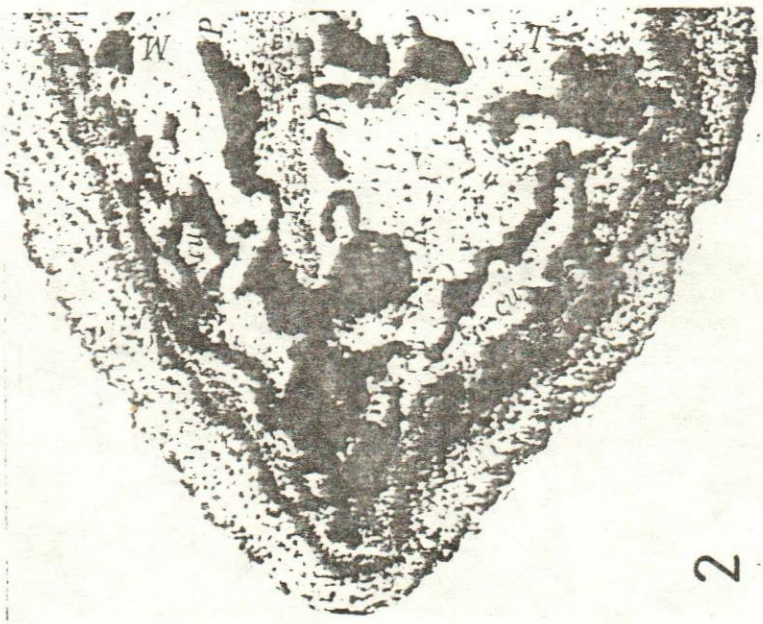

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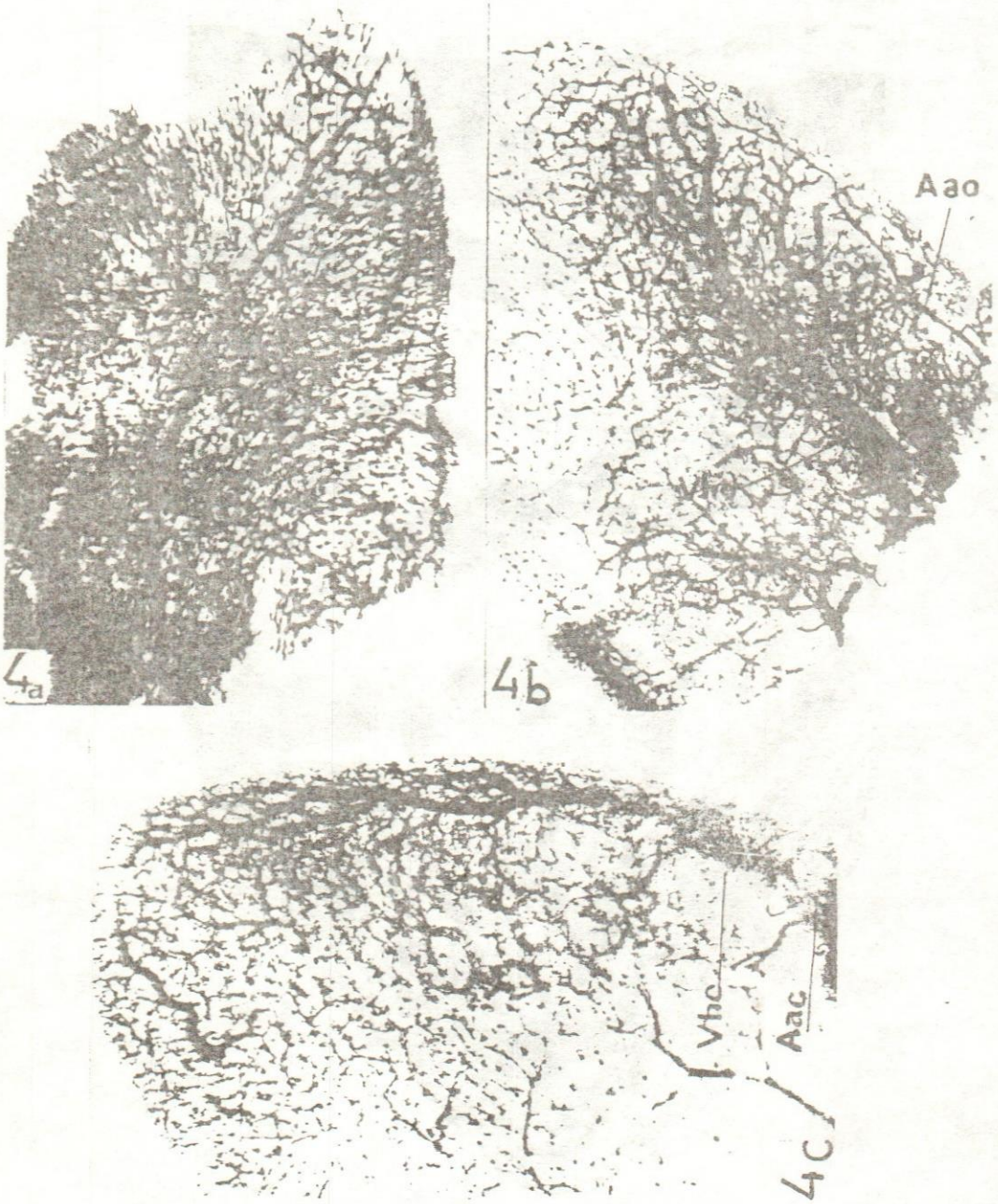
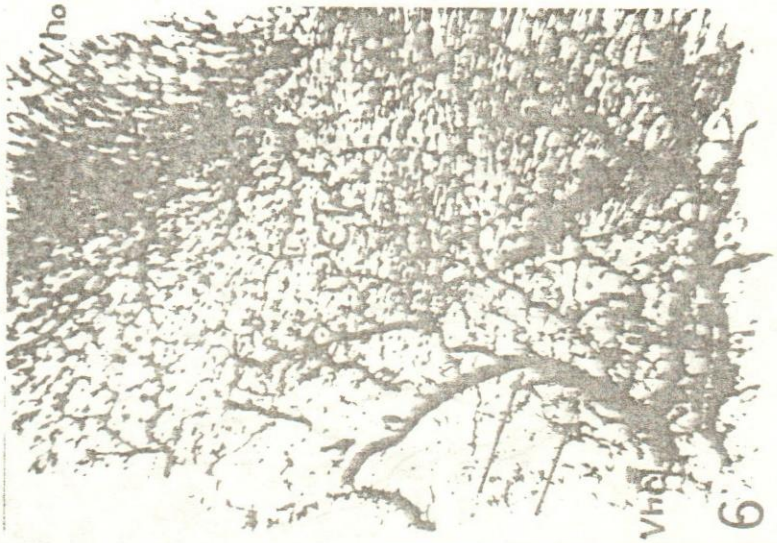
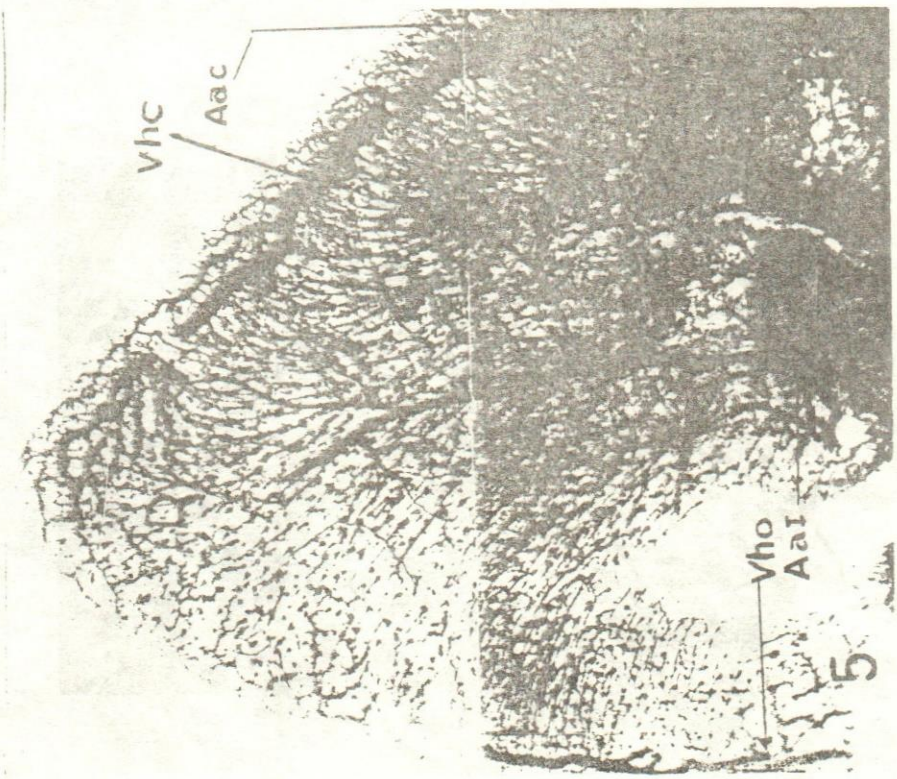
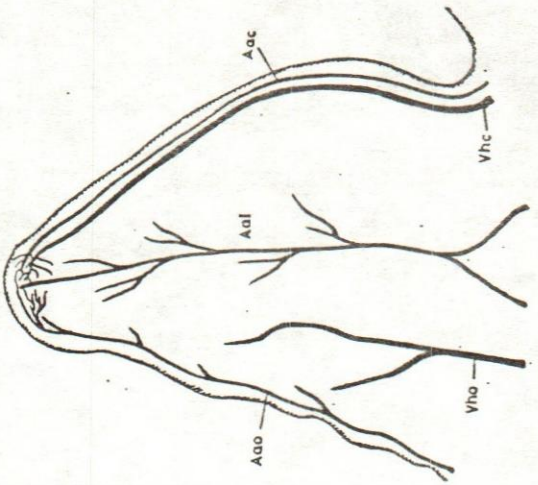

Aao
Vhc
Aac
4a
4b
4c

ANGIOGENESIS OF THE CANINE CONCHA AURICULAE







(Plate I)