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رئيس القسم : أ.د / هـ. ولكنز

دراسة تطور الأوعية الدموية فى صيوان أذن أجنحة الخنازير

محمد أحمد ، رودلف شفارتز ، محمد رشاد*

تمت دراسة تطور الأوعية الدموية فى ٣٧ أذن لأجنحة الخنازير تتراوح أطوالها بين ٩٠ ـ ٣٣٠ مليمتر .

وشوهد أن صيوان الأذن فى الأجنحة التى تتراوح أطوالها بين ٩٠ ـ ١٠٠ مليمتر تستقبل مدد شريانى يسرى فى منتصفها بينما يجمع منها الدم عن طريق أوردة ممثلة فى وريدين يمتدان على كلتا حافتى الأذن .

كما لوحظ أن صيوان الأذن فى الأجنحة التى تتراوح أطوالها بين ١٥٠ ـ ٢٠٠ مليمتر تتغذى بشريان مصاحبة بأوردة على كلتا جانبيها .

أما الأجنة التى زادت طولها عن ٢٠٠ مم فقد تميزت فيها الأوعية الدموية بصيوان الأذن الى النمط البالغ .

نوقشت النتائج لبيان أهمية الأوعية الدموية فى الأذن لتنظيم درجة حرارة الجسم .

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THE MORPHOGENESIS OF VASCULATURE OF THE SWINE FETAL EXTERNAL EAR

(With One Table , 6 Figures & 2 Plates)

By

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SUMMARY

The morphogenesis of the vascular elements in the fetal external ear of 37 swine fetuses (German landrace), from 90-330 mm crown-to-rump length, was described.

A simple pattern for the auricular vascular supply in the form of 5-7 arterial branches and two large veins could be recognized in fetuses ranging from 90-100 mm CVR length.

In 150-200 mm length fetuses, the blood vessels were differentiated into a definite pattern of construction and were accompanied by satellite veins on both sides.

The third stage of development showed a progressed pattern of distribution as the arteries presented further regional differentiation along their course, and the veins were connected transversely with several venous arches.

INTRODUCTION

The morphology of the ear veins in pigs was described by BECKER (1960), HEINZE (1960) and SAUERLANDER and WISSDORF (1972). The latter authors studied the ear veins in relation to their clinical importance with the upright and hanging position and their relations with thermoregulation.

Also, the arteriovenous anastomoses of the ear were studied by CLARK and CLARK (1934 a, b) in rabbits; CLARK (1938) in horses, dogs and cats; FINDLAY (1953) in cattle; GOODALL (1955) in calves; DANIEL and PRICHARD (1956) in dogs, cats, calves and horses and HEROUX and PIERRE (1957) in white rats.

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

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MATERIAL and METHODS

A total of 37 swine fetuses (German landrace) were collected from the Hanover abattoir (Table 1).

Sixteen male and twenty one female fetuses ranging from 90-330 mm CVR were recovered shortly after evisceration. the fetuses were injected with a 1:1 mixture of Indian ink and bovine serum either:

a- through the umbilical artery,
b- through the umbilical vein or
c- through the umbilical artery and vein.

The fetuses were then fixed in 10% formalin and the external ears were removed, dehydrated in alcohol and cleared in benzol followed by a 1:1 mixture of methylbenzoate and benzylbenzoate. Descriptions of blood vessels given within this paper coincide sequentially with the physiological flow of blood in the case of arteries and the method by cf. BADAWI & SCHWARZ (1963) in the case of veins. The nomenclature used is that given in the Nomina Anatomica (1977).

RESULTS

The morphogenesis of the vascular architecture within the fetal Concha auriculae of pig could be chronologically follwed in three distinct stages:

Stage I (90-100 mm CVR length):

The arterial supply was mainly distributed on the lateral surface of the Concha auriculae and was consisted of 5-7 branches. These branches reached the auriclar concha at its base and coursed subcutaneously and parallel to its long axis. They gave several bilateral branches along their course towards the apex of the auricular cartilage, where each branch terminally divided into 2-3 twigs. Some arteries detached small twigs which pierced the auricular cartilage to reach the medial surface of the auricular concha. They were distributed subcutaneously in a more or less similar pattern observed on the lateral surface of the concha.

The venous drainage of Concha auriculae was composed mainly of two large veins namely; V. helicis oralis and V. helicis caudalis. They coursed subcutaneously on the lateral surface nearby their corresponding borders of the auricular concha (Fig. 1). At the base of the ear, each vein received a large branch which coursed on the lateral surface and parallel to the longitudinal axis of the concha. Before these large veins left the base of the ear, they joined also two another ones which drained the medial aspect of that region.

Vv. helicis oralis and caudalis and their tributaries received bilateral twigs along their course towards the apex of the ear. Each lateral tributary anastomosed inturn with two types of venous twigs which ran perpendicular to the surface of the auricular cartilage. The first type collected blood from a relatively wide-meshed subcutaneous network, however, the second type collected the blood from a narrow perichondral network. In addition, these two large veins and some of their tributaries, received several twigs which drained the medial surface of the concha, after piercing the auricular cartilage. The veins draining the medial surface of the ear were oriented subcutaneously in a similar manner seen on the lateral surface. However, they collected blood from a relatively narrower subcutaneous and perichondral network specially on the convexties of the medial surface.

Stage II (150-220 mm CVR length):

During this stage, the arteries were distributed in a fan-like pattern diverging towards the borders of the ear. They were mostly accompanied by satellite veins (Fig. 4a and Plate 1). The largest artery, Ramus auricularis intermedius oralis, traversed the lateral aspect of the auricular cartilage slightly oral and parallel to the longitudinal axis of the ear. This artery gave off 4-5 collateral and 3-4 termianal branches. The caudal collateral branches penetrated the auricular cartilage, to reach the medial surface of the ear, where they were distributed on the apex and cranial portion of this surface (Fig. 2 and Plate IId).

Some of the rostral collateral branches divided dichotomously during their course towards the middle portion of the rostral border of the ear. Each rostral collateral branch detached lateral and medial twigs which left the parent vessel on a right angle to its longitudinal axis. These twigs divide successively into several branches towards the epidermis and the auricular cartilage, where they built subepidermal and perichondral networks, respectively (Fig. 3e, p). In addition, they communicated with each other within the dermis forming a wide-meshed network.

The terminal twigs of the R. auricularis intermedius oralis distributed, within the apical third of the lateral surface of the ear, in a similar manner as the collateral branches.

The A. auricularis caudalis was observed coursing cranial and parallel to the A. auricularis intermedius oralis, however, it failed to reach the apex of the concha. It was accompanied on both sides by Vv. auricularis caudalis. These vessels terminated on a level parallel to the mid-transverse plane of the ear pinna (plate Ic and Fig. 4).

The caudal portion of the lateral surface of the concha received its blood supply from three arterial trunks, namely, A. auricularis intermedius caudalis, A. auricularis nuchalis oralis and A. auricularis nuchalis caudalis.

The A. auricularis intermedius caudalis coursed caudal and parallel to the long axis of the concha. It didnot reach the apex of the ear and gave rise to rostral and caudal collateral branches. Each of these branches penetrated the auricular cartilage to reach the medial surface of the ear where it distributed on the caudal portion of this surface (Fig. 3 pc and plate IIé).

The A. auricularis nuchalis oralis was relatively short, poorly branched and occupied a position midway between the A. auricularis intermedius caudalis and the A. auricularis nuchalis caudalis (Plate If).

The A. auricularis nuchalis caudalis was observed to be distributed on most of the caudal portion of the lateral surface of the ear. Most of its branches ramified towards the caudal border of the concha in a dichotomous manner. Each of these branches pursued the same course as the oral collateral branches of the A. auricularis intermedius oralis (Plate 1g).

The arteries on the medial surface of the ear derived from both A. auricularis intermedius oralis and A. auricularis intermedius caudalis. They followed no definite pattern of distribution. They divided beneath the epidermis and on the perichondrium giving rise to a subepidermal and a perichondral network, respectively.

The venous drainage of Concha auriculae was composed of two systems, namely; a superficial and a deep system. The superficial venous system included V. helicis oralis and V. helicis caudalis, which coursed along the rostral and caudal borders of the auricular cartilage, respectively (Figs, 4 and 4a). Hawever, the deep system consisted of the satellite veins which

accompanied the arteries of the auricular concha, namely; A. auricularis caudalis, A. auricularis intermedius oralis, A. auricularis intermedius caudalis, A. auricularis nuchalis oralis and A. auricularis nuchalis caudalis (Plates I and II). Both the V. helicis oralis and V. helicis caudalis coursed subcutaneously on the lateral surface alongside the corresponding border of the auricular concha. They received several tributaries during their course towards the apex of the ear where they communicated with each other (Fig. 4Va and Plate I). Each vein drained the dermis, the perichondrium at the borders as well as the medial surface of the ear concha. The tributaries from the dermis were composed of wide - meshed plexuses which drained the anlage of the hair follicles (Rete hemocapillare bursae pili) and the subepidermal capillaries. The tributaries from the perichodrium were composed of narrow-meshed plexuses. The tributaries from the medial surfaces of the ear reached the parent vein by two ways; either by penetratingthe conchal cartilage (Fig. 3pc) or by curving around the rostral and the caudal borders of the ear.

The ramifications of the vessels of the deep venous system followed the same pattern of their synonymous arteries (Plates I and II).

Stage III (230-330 mm CVR length):

The arteries of the ear demonstrated a progressed pattern of distribution by further regional branching along their course towards the apex and both borders of the conchal cartilage. Not only they were connected with each other with several transverse arches (Fig. 5). but also they gave many branches which either penetrated the conchal cartilage or curved around both the rostral and caudal borders of the ear to reach its medial surface (Plate Ii and Fig. 5i).

The superficial and deep venous systems were connected along their course with several venous arches within the deeper portion of the skin (Fig. 4 Va and Plate Ih, h', h"). These arches were relatively fewer on the medial surface of the ear (Fig. 4a and Plate IIh").

DISCUSSION

The present study was carried out in the course of investigations which were conducted in an attempt to study the vascular elements of the skin of the pig fetuses (SCHWARZ, AHMED, FATH EL-BAB and GODYNICKI, 1982).

The present investigation revealed that the organization of the blood vessels within the skin of the auricular concha of the pig followed a definite basic pattern which developed early in gestation period and reached a more complex form at the end of intrauterine life.

The skin of the auricular cartilage was found to be centrally provided with arterial blood supply, however, the venous blood was drained from the auricular concha through two main veins which oriented themselves around the borders of the ear. In this respect, the general construction of the vascular pattern of the skin of the auricular concha of the pig resembled more or less a "Unit Vascular Zone" described by FATH EL-BAB, SCHWARZ and GODYNICKI (1983) and SCHWARZ, AHMED, FATH EL-BAB and GODYNICKI (1982) in the skin of the flank region in cattle and pig fatuses. However, the three dimentional architecture of the cutaneous network of the ear was simply oriented into two levels. The first level consisted of rete and plexuses of wide fenestrae (macromeshes) which were distributed beneath the epidermis and rete and plexuses of narrower fenestrae (micromeshes)which were distributed on the surface of the Cartilago auriculae. These rete and plexuses were built by the second and third order branches of the arterial and their accompanied venous vessels.

The present study revealed that the venous drainage of Concha auriculae was composed of two systems. The superficial venous system resembled the pattern of orientation described for the plexus venosus dermis profundus in the skin of the flank region of the pig fetuses (SCHWARZ, AHMED, FATH EL-BAB and GODYNICKI, 1982) However, the deep venous system was represented by two venous vessels which accompanied all the arterial branches supplying the ear till the subepidermal and perichondral rete. This mode of arborization of the venous system might be considered as a special relation between their construction and their function. The veins of the superficial system were arranged slightly superficial to their fellows and were connected by several arches. These veins tend to preserve considerable quantity of blood either to get rid of a great amound of temprature or to poreserve this temprature depending upon the atmospheric temprature or the velocity of the circulating blood which follows the body needs. However, the veins of the deep system seemed to performe its public function as they facilitate part of the thermal regulation of blood (MORETTI,1968 & MONTAGNA and PARAKKAL 1974) in addition to their primary function (Private vessel function) to maintain the metabolic requirements of the parenchymal structure (WINKELMANN 1961). Their role in heat regulation is achieved by the interchange of heat between the artery and its accompanying veins. This openion was supported by HEROUX & PIERRE (1957) as they mentioned that cold acclimation had produced a 12 fold increase in number of ear blood vessels of the white rats which were mostly distented capillaries. The present study showed that the arteries of the ear were connected with several arches at the latter stages of intrauterine life. This simulates the mode of arborization of the intestinal blood vessels which allowed a large amount of arterial blood to reach the organ in a considrable short time.

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

Table (1)

Materials available for study

No. fetuses	CVR (mm)	Weight (g)	Sex
2	90	85	2 f
4	100	90	1 f, 3m
3	150	125-320	1 f, 2m
2	160	110-320	2 f
3	170	125-360	1 f, 2m
2	180	125-410	2 f
4	200	270-490	2 f, 2m
2	210	540-565	2m
2	220	300-490	1 f, 1m
4	230	315-685	2 f, 2m
2	260	518-865	2 f
2	270	080-111	1 f, 1m
2	280	715-1123	1 f, 1m
1	300	1175	1 f
1	310	960	1 f
1	330	970	1 f,

F = female fetuses

m = male fetuses.

Fig. (1)

Fig. (2)

Fig. (3)

Fig. (4)

Fig. (4 a)

Fig. (5)

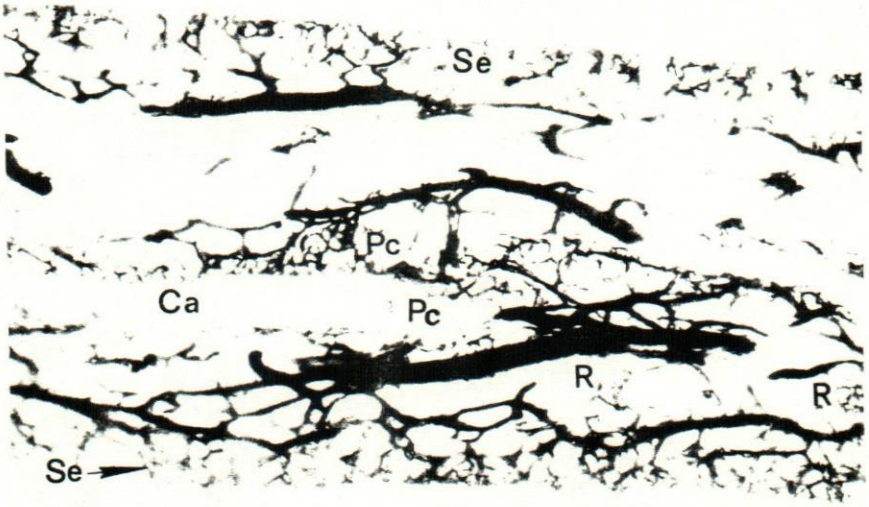

Fig. (6)

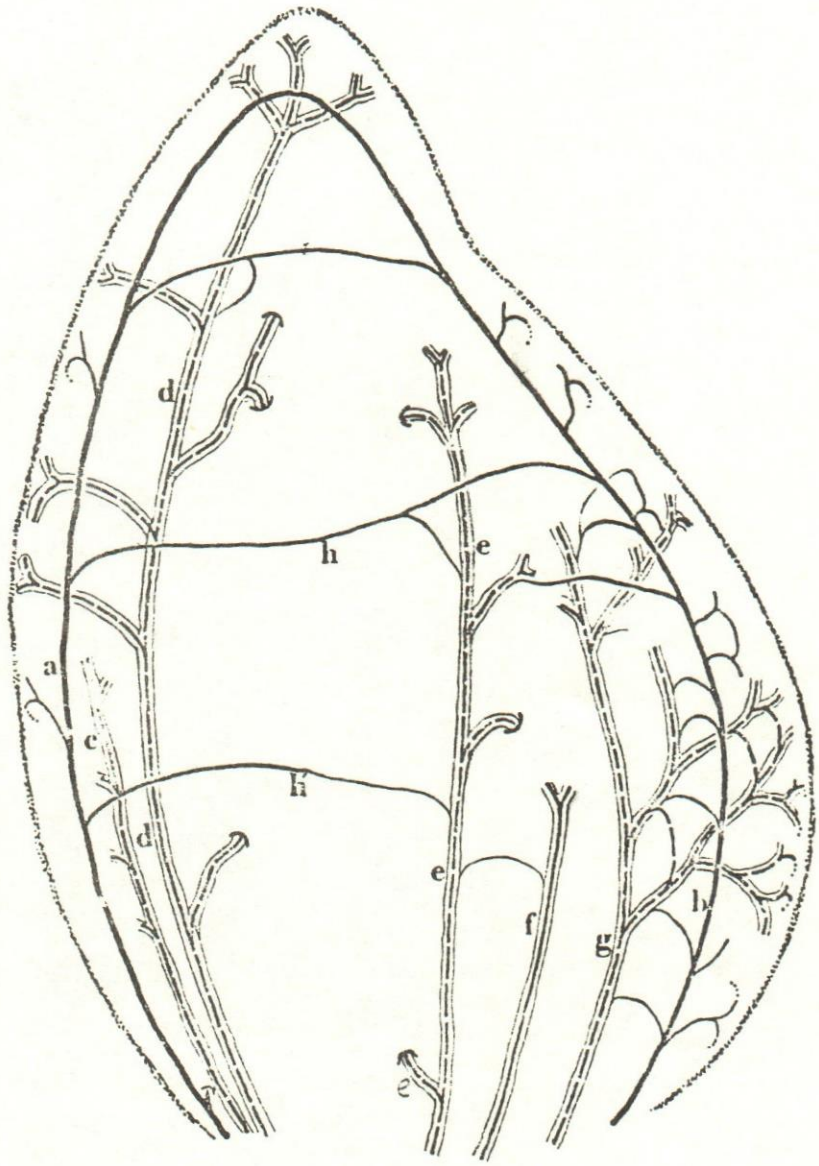

Plate I

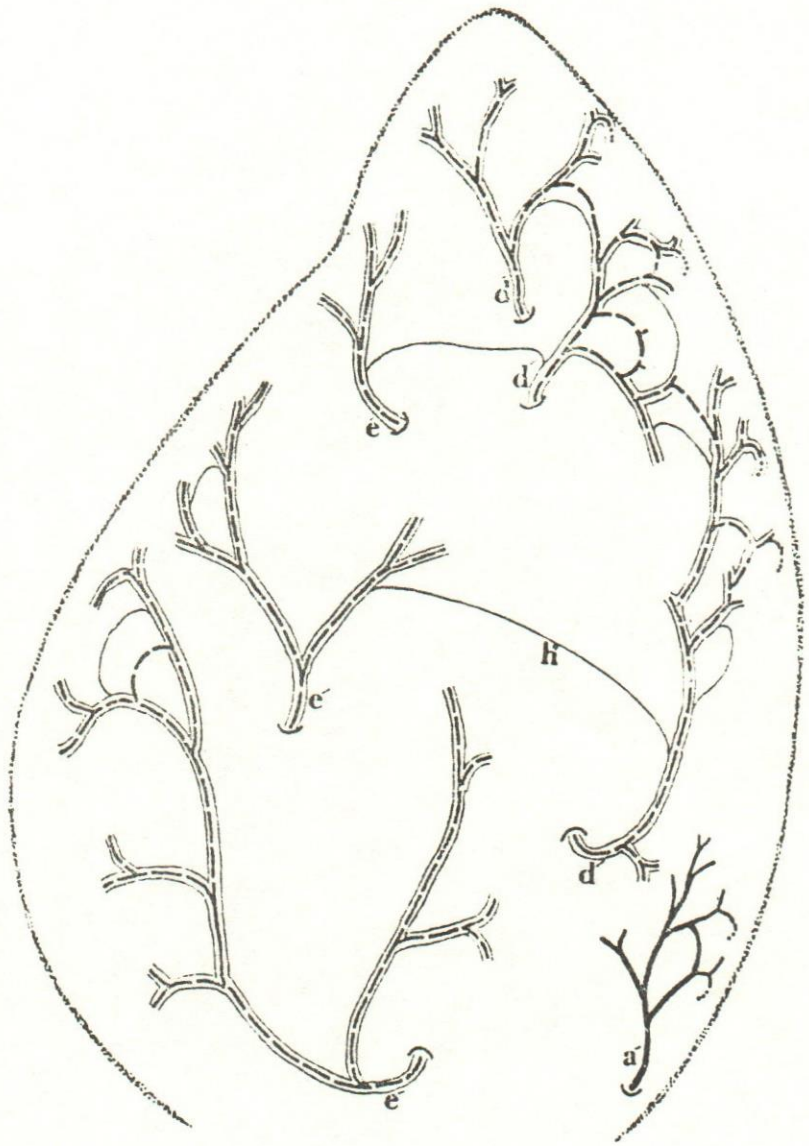

Plate II