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**SOME ANATOMICAL STUDIES ON THE ARTERIAL BLOOD SUPPLY  
 AND VENOUS DRAINAGE OF THE NASAL CAVITY  
 OF THE RABBIT**  
 (With 2 Figures).

By

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 (Received at 17/3/1991)

بعض الدراسات التشريحية للمدد الدموي الشريانية  
 والتصريف الوريدي للتجويف الأنفي للأرانب

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أجرى هذا البحث على عشرة أرانب بالغة من كلا الجنسين وذلك لدراسة منبع ومسار وتفرعات الشرايين والأوردة الممددة للتجويف الأنفي. وقد لوحظ أن الشريان الوريدي الحنكي والشريان المصفاوي الخارجي هما الشرايين الرئيسية الممددة للتجويف الأنفي والتي تمد المحارات الأنفية وكذلك الحاجز الأنفي. أما التصريف الوريدي فيتم أساساً عن طريق الوريد الحنكي الكبير والذي يكون الضفيرة الحنكية والتي تصب بدورها عن طريق الأوردة الحنكية في الضفيرة الجناحية وبالتالي في الوريد الفمجي فالوريد الوداجي. كما أن الوريد الودجي الحنكي والذي يعتبر المصرف الرئيسي للتجويف الأنفي في الحيوانات الأخرى فإنه يكون ضعيفاً في الأرانب ويصرف فقط الجزء الليلي من التجويف الأنفي. وقد لوحظ أيضاً وجود تفاغرا شريانية وريدية على الغشاء المخاطي المبطن للمحارات الأنفية والحاجز الأنفي. ولقد تم مقارنة النتائج المتحصل عليها من مثيلاتها في الحيوانات الأخرى.

**SUMMARY**

The nasal cavity of the rabbit is supplied mainly by the sphenopalatine and the external ethmoidal arteries and partly by the malar artery.

The sphenopalatine artery is one of the terminal branches of the descending palatine artery. In the nasal cavity it divides into a larger A. nasalis caudalis and smaller A. nasalis lateralis et septalis. The caudal nasal artery supplies the rostral 2/3 of the dorsal nasal concha, ventral nasal concha, rostral part of the middle nasal concha, ethmoidal conchae and septum nasi, as well as the lateral nasal wall.

The external ethmoidal artery is one of the terminal branches of the external ophthalmic artery. It supplies the caudal part of the dorsal nasal concha, middle and ethmoidal conchae and the septum nasi, as well as the maxillary sinus.

Blood is drained from the nasal cavity through the dorsal nasal vein, lateral nasal vein, major palatine vein, palatine veins and sphenopalatine

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vein. These veins form venous plexuses in the nasal conchae and the septum nasi.

**INTRODUCTION**

The vasculature of the nasal cavity plays an important role in conditioning the air entering the lungs and in thermoregulation preventing hyperthermia of the brain. For this reason many investigators have studied the vasculature of the nasal cavity in different species of animals. Among of these NICKEL and SCHWARZ (1963) gave a description of the arterial blood supply of the nasal cavity in domestic animals, SCHNORR and HEGNER (1967) in small ruminants, AHMED (1973) in camel and NAWAR, EL-AYAT and IBRAHIM (1975) in buffalo.

The external surface of the nose is supplied by the infraorbital (through the lateral nasal artery) and the superior labial arteries (IBRAHIM, ABDALLA, ABDEL-MONEIM and MANSOUR, 1990). Here the habitance of the rabbit in living in damp cages in a very cold wheather in winter without suffering from chilling as well as in hot wheather in summer is the intension to describe the vasculature of the nasal cavity of this animal as the detailed anatomical study is meagre.

**MATERIALS and METHODS**

The present work was conducted on 10 adult balady rabbits of either sexes and of different ages. The animals were anaesthetized and bled through the common carotid artery and injected with 10% formalin. After a week, they were injected with 60% gum milk latex coloured red and blue for arteries and veins respectively.

The nomenclature used in this study was that adopted by the Nomina Anatomica Veterinaria (1983) as it is possible.

**RESULTS****A. sphenopalatina :**

The sphenopalatine artery (Fig. 1/2) originates from the descending palatine artery 0.5 cm after its origin from the maxillary artery. In two cases it originated directly from the maxillary artery.

After its origin, the sphenopalatine artery courses rostromedially for a short distance to enter the nasal cavity through Foramen sphenopalatinum with its homonymous vein and the caudal nasal nerve. In the nasal cavity and after a short course of about 1 cm the parent artery divides into a larger A. nasalis caudalis and smaller A. nasalis lateralis et septalis.

**A. nasalis caudalis :**

The caudal nasal artery (Fig. 1/5) after its origin runs rostrally for a short course where it divides into a smaller R. dorsalis and larger R. ventralis.



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The dorsal branch (Fig. 1/7) courses firstly dorsally then rostrally ventral to the middle nasal concha towards the dorsal one and terminates by dividing into several branches which supply the mucosa of the rostral 2/3 of the dorsal nasal concha and the lateral nasal wall. Some of these branches pass caudodorsally and contribute blood to the mucosa on the rostral part of the middle nasal concha as well as the ethmoidal conchae.

The larger ventral branch (Fig. 1/8) passes rostrally till reaching the ventral nasal concha and continues its course along its ventral border where it terminates by dividing into several branches which distribute within its mucosa. These branches divide in digitate manner and then join to form a network. Some of the blood supplied by this network flows through arteriovenous anastomoses to veins which unite in the region of the nasal vestibule to empty into the dorsal nasal vein.

Arteriovenous anastomoses are observed also in the mucosa of the dorsal nasal concha.

### A. nasalis lateralis et septalis :

The lateral and septal nasal artery (Fig. 1/4) after its origin passes rostrally onto the nasal septum. Here it divides into several branches which distribute in the mucosa of the rostral 2/3 of the septum nasi and the lateral nasal wall. In addition, this artery detaches a branch from its ventral border (Fig. 1/6). This branch contribute blood to the vomeronasal organ.

Arteriovenous anastomoses were observed also in the mucosa of the septum nasi.

### A. ethmoidalis externa :

The external ethmoidal artery (Fig. 1/10) is one of the terminal branches of the external ophthalmic artery which originates from the maxillary artery after its emergence from the alar foramen. After passing through the ethmoidal foramen into the cranial cavity, the external ethmoidal artery divides into R. dorsalis and R. ventralis.

The R. dorsalis (Fig. 1/11) is subdivided into delicate smaller branches which form a plexus (the ethmoidal plexus) on the cribriform plate of the ethmoidal bone. From this plexus branches pass rostrally through the foramina of the plate to the nasal cavity and terminate in the mucosa on the caudal 1/3 of the dorsal nasal concha, roof of the caudal part of the septum nasi, as well as the caudal part of middle and ethmoidal conchae. In addition it detaches branches which supply the maxillary sinus.

The R. ventralis (Fig. 1/12) divides into smaller branches which traverse the cribriform plate of the ethmoidal bone and pass rostrally along the mucous membrane lining the floor of the caudal 1/3 of the septum nasi and the medial aspect of the ethmoidal conchae. Anastomoses was observed between those of the dorsal and ventral rami and those of the dorsal branch of the caudal nasal artery.

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**A. malaris :**

It originates from the infraorbital artery. During its course, it detaches 2 delicate branches which enter the nasal cavity. One of these branches passes rostrally for a short distance dorsal to the nasolacrimal duct, where it terminates. However, the latter branch supplies the maxillary sinus.

The venous plexuses in the nasal cavity of the rabbit are well developed under the mucous membrane of the nasal conchae and nasal septum. Blood from these plexuses is drained by the dorsal nasal vein, lateral nasal vein, greater palatine vein, platine veins and sphenopalatine vein.

**V. dorsalis nasi :**

The dorsal nasal vein (Fig. 2/9) is a superficial vessel which is one of the first tributaries of the facial vein. After its origin it passes in a rostral direction for about 1-2 cm where it gains the dorsal aspect of the M. caninus till reaching the ventral border of the nasal process of the incisive bone. Here it terminates by dividing into 3-5 small branches in the dorsolateral aspect of the nose. It drains the dorsal surface of the nose forming a small plexus, in addition the mucous membrane of the most rostral part of the septum nasi. Rostrally it anastomoses with branches of the lateral nasal and the superior labial veins, as well as the vein of the other side.

**V. lateralis nasi :**

The lateral nasal vein (Fig. 2/8) is a slender one which is situated superficially. It gains the rostral border of the facial vein 0.5-1 cm before its termination in 6 cases, while it joined in common with the dorsal nasal vein in another 4 cases.

The vein drains the lateral aspect of the nose. It anastomoses rostrally with branches of the dorsal nasal and superior labial veins.

**V. palatina major :**

The greater palatine vein (Fig. 2/21) is the main vessel draining the nasal cavity. It represents the direct continuation of the descending palatine after its origin from the maxillary vein. It passes in a rostral direction on the medial surface of the perpendicular plate of the palatine bone. Then it continues its course on the lateral aspect of the palatine process of the maxilla within the texture of the hard palate where it anastomoses with that of the other side forming an arch. From the convexity of this arch several branches are given off to form a plexus (plexus palatinus). Anastomosis also takes place rostrally with branches of the superior labial vein. Connections with the nasal venous plexus were also observed through 10-15 small branches which traverse foramina situated on the nasal process of the maxillary bone. The plexus palatinus drains the hard and soft palates, floor of the nasal cavity, lateral nasal wall, dorsal and ventral nasal conchae.

**Plexus palatinus :**

The palatine plexus (2/22) is situated in the submucosa of the hard palate.



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It is formed by 12-15 small branches arising from the arch which is formed by the union of the greater palatine veins. These branches are closely backed together and anastomose to form the plexus. They connect with the nasal venous plexus through 10-12 delicate branches which traverse the accessory palatine foramina on the os maxillaris.

### Vv. palatinae :

The palatine veins (Fig. 2/15) are 2-3 in number which arise from the rostral aspect of the pterygoid plexus. They pass in a rostradorsal direction on the medial surface of the perpendicular plate of the palatine bone where they reaches the palatine plexus and drain it.

### V. sphenopalatina :

The sphenopalatine vein (Fig. 2/20) is a slender vessel which is tributaries of the descending palatine vein. It traverses the Foramen sphenopalatinum in common with its homonymous artery and caudal nasal nerve to gain the caudal part of the nasal cavity. It drains the caudal part of the septum nasi, middle and ethmoidal conchae. It has connections rostrally with branches of the major palatine vein.

### Plexus pterygoideus :

The pterygoid plexus (Fig. 2/14) is formed directly by the V. maxillaris. It lies in the pterygoid fossa between the ramus of the mandible laterally and the M. pterygoideus medialis medially and about 1-1.5 cm ventral to the temporomandibular articulation. It gives off V. alveolaris mandibularis, Rr. pterygoideae and Vv. palatinae.

## DISCUSSION

In rabbit, the sphenopalatine artery is the main arterial blood supply to the nasal cavity which supplies the nasal conchae and the septum nasi. It is one of the terminal branches of the descending palatine artery after it originates from the maxillary artery. The same origin is described in domestic animals by SIMOENS, DE VOS and LAUWERS (1978-1979), in horse by GHOSHAL (1975), in mule by ATTIA (1982) and in camel by AHMED (1973). The sphenopalatine artery arises from the maxillary artery in rabbit, cat, dog, goat, sheep and pig (DAWES and PRICHARD, 1953); in buffalo (NAWAR et al., 1975); in horse (BRADLEY and GRAHAME, 1946) and in donkey (ABDEL-MOATY, 1980). However, it arises from the infraorbital artery in cattle (WILKENS and MUNSTER, 1981) and rat (DAWES and PRICHARD, 1953).

In the nasal cavity and after a short course, the sphenopalatine artery divides into a larger A. nasalis caudalis and smaller A. nasalis lateralis et septalis. In this connection, and according to SCHNORR and HEGNER (1957) the artery is divided into dorsal, ventral and aboral branches in small ruminants. However, according to KHAMAS and GHOSHAL (1982) in sheep the artery divides into dorsal, ventral and septal branches (lateral, caudal, septal branches). In buffalo the artery divides into R. dorsalis, R. ventralis, R. aboralis and R. septi nasi (NAWAR et al., 1975), while

in camel the artery is divided into *A. nasalis caudalis* and *A. nasalis septalis* (AHMED, 1973). In addition, there is a diversity of opinion between MILLER, CHRESTENSEN and EVANS (1964) who claimed that the previous artery divides into dorsal and ventral branches in dog and DAWES and PRICHARD (1953) who declared its division into 3 branches in the same animal. According to ATTIA (1982), the sphenopalatine artery in mule detaches the *A. nasalis septalis*, *A. nasalis caudalis* and continues its course as *A. nasalis lateralis*. GHOSHAL (1975) in horse mentioned that the sphenopalatine artery divides into the caudal, lateral and septal nasal arteries similar to that mentioned in the present study while ABDEL-MOATY (1980) in donkey recorded that it divides into a medial and lateral branches.

In this investigation the caudal nasal artery divides into a smaller dorsal and larger ventral branches. The former supplies the mucosa of the rostral 2/3 of the dorsal nasal concha, the rostral part of the middle nasal concha, ethmoidal conchae and septum nasi, as well as the lateral nasal wall, while the latter distributes to the ventral nasal concha. According to KHAMAS and GHOSHAL (1982) the *R. dorsalis* in sheep supplies mainly the dorsal nasal concha and the lateral nasal wall. On the other hand, MILLER *et al.* (1964) represented the lateral branch in dog as the *R. dorsalis*. In camel the *R. dorsalis* detaches 2-4 twigs which represent the caudal septal arteries (AHMED, 1973).

The *R. ventralis* in sheep (KHAMAS and GHOSHAL, 1982) and in buffalo (NAWAR *et al.*, 1975) supplying branches to the floor of the nasal cavity and the ventral nasal concha. Some of these branches direct dorsally and anastomose with others of the *R. dorsalis*.

According to HURLMAN (1912) in cat, STEVEN (1964) in cattle and BRADLEY and GRAHAME (1946) in horse and ABDEL-MOATY (1980) in donkey, NAWAR *et al.* (1975) in buffalo the external ethmoidal artery is one of the terminal branches of the external ophthalmic artery, a condition which is in agreement with that mentioned in the present study. However, ATTIA (1982) in mule stated that, it is a side branch from *A. ophthalmica externa*. EL-AYAT (1977) in buffalo described its origin from *A. supraorbitalis*. In camel as mentioned by AHMED (1973) the external ethmoidal artery is formed by the union of 2 arteries one from the *rete mirabile arteriae ophthalmicae* and the other from the *A. maxillaris*.

The external ethmoidal artery in the present work divides into *R. dorsalis* and *R. ventralis*. This is similar to that described by NAWAR *et al.* (1975) in buffalo and AHMED (1973) in camel. In dog the artery is reinforced by the internal ethmoidal artery according to NICKEL and SCHWARZ (1963) and MILLER *et al.* (1964).

The dorsal nasal vein in this study is the first tributaries branches of the facial vein which is in agreement with that mentioned by WILKENS and MUNSTER (1981) in domestic animals, MILLER *et al.* (1964) in dog, as well as SISSON and GROSSMAN (1969) in horse and ATTIA (1982) in mule. According to FRENZEL (1967) the dorsal nasal vein in cat is a tributary of the angular vein of the eye.



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The lateral nasal vein drains into V. facialis as described by FRENZEL (1967) in cat, RUMPLER (1967) in dog, HESCHEN (1958) in sheep and WILKENS and MUNSTER (1981) in domestic animals. However, this vein gains V. dorsalis nasi in camel (ABDALLA, 1980).

The joining of the sphenopalatine vein to the descending palatine is similar to that mentioned by EL-AYAT (1977) in buffalo and ABDALLA (1980) in camel. However, SISSON and GROSSMAN (1969) in horse and ABDEL-MOATY (1980) in donkey stated that the sphenopalatine vein is one of the tributaries of V. facie profunda. In the present work, this vein is a slender one which drains only a small part of the nasal cavity in contrary to that described by WILKENS/MUNSTER (1981) in all domestic animals in which the sphenopalatine vein forms a rich venous plexus on the nasal conchae and the septum nasi.

The greater palatine vein in rabbit drains into V. palatina descendens and considers its direct continuation. It is similar to that described by WILKENS and MUNSTER (1981) in domestic animals, ATTIA (1982) in mule, EL-AYAT (1977) in buffalo and ABDALLA (1980) in camel. However, HESCHEN (1958) in sheep, Le ROUX (1959) in cattle stated that the V. palatina major drains into V. buccinatoria. In rabbit as in all domestic animals except small ruminants, the greater palatine vein does not pass through the major palatine canal as mentioned by WILKENS/MUNSTER (1981). The connection between the palatine and nasal plexuses takes place through the accessory palatine foramina on the os maxillaris as described in mule (ATTIA, 1982) and camel (ABDALLA, 1980). In dog it takes place through the palatine fissure (RUMPLER, 1967).

The joining of the palatine veins in the rabbit is similar to that recorded by WILKENS and MUNSTER (1981) in domestic animals, EL-AYAT (1977) in buffalo and ATTIA (1982) in mule.

Concerning with the nature of the nasal venous plexuses, the present investigation shows that, they are characterized by the great size and high numbers of veins compared with those of neighbouring arteries similar to the statements of DAWES and PRICHARD (1953) in rabbit, cat, rat, dog, sheep, goat and pig and ATTIA (1982) in mule. They are well developed in the caudal part of the nasal cavity and decreases gradually in a rostral direction similar to the statements of ATTIA (1982) in mule and contrary to the statements of FATH EL-BAB (1970) in camel in which the venous plexuses are relatively abundant in the mucous membrane lining the oral portion of the nasal cavity, decrease aborally, and fewer in the mucous membrane covering the nasal conchae. The present work shows also that the venous plexuses are well developed in the ventral nasal concha as that described in human by FOSTER (1967) and BLOOM and FAWCETT (1968).

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### LEGENDS

**Fig. (1):** Diagram showing the arterial blood supply of the nasal cavity in rabbit:

- |                            |                                      |
|----------------------------|--------------------------------------|
| A. Dorsal nasal concha.    | B. Ventral nasal concha.             |
| C. Middle nasal concha.    | D. Ethmoidal conchae.                |
| 1- V. palatina ascendens.  | 2- A. sphenopalatina.                |
| 3- A. palatina major.      | 4- A. nasalis lateralis et septalis. |
| 5- A. nasalis caudalis.    | 6- Ventral branch of 4.              |
| 7- R. dorsalis of 5.       | 8- R. ventralis of 5.                |
| 9- A. ophthalmica externa. | 10- A. ethmoidalis externa.          |
| 11- R. dorsalis of 10.     | 12- R. ventralis of 10.              |

**Fig. (2):** Diagram showing the veins of the head of the rabbit.

- |                                  |                                 |
|----------------------------------|---------------------------------|
| 1- V. jugularis externa.         | 2- V. linguofacialis.           |
| 3- V. maxillaris.                | 4- V. lingualis.                |
| 5- V. facialis.                  | 6- V. labialis inferior.        |
| 7- V. labialis superior.         | 8- V. lateralis nasi.           |
| 9- V. dorsalis nasi.             | 10- V. angularis oculi.         |
| 11- V. auricularis caudalis.     | 12- V. massetericus.            |
| 13- V. superficialis temporalis. | 14- Plexus pterygoideus.        |
| 15- Vv. palatinae.               | 16- V. alveolaris mandibularis. |
| 17- Rr. pterygoidea.             | 18- V. Ophthalmica externa.     |
| 19- V. palatina descendens.      | 20- V. sphenopalatina.          |
| 21- V. palatina major.           | 22- Plexus palatinus.           |

BLOOD SUPPLY OF THE NASAL CAVITY OF RABBIT

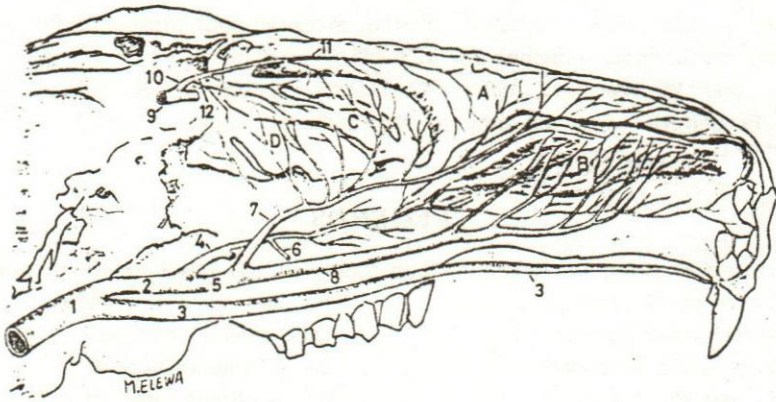


Fig. (1) Diagram showing the arterial blood supply of the nasal cavity in rabbit .

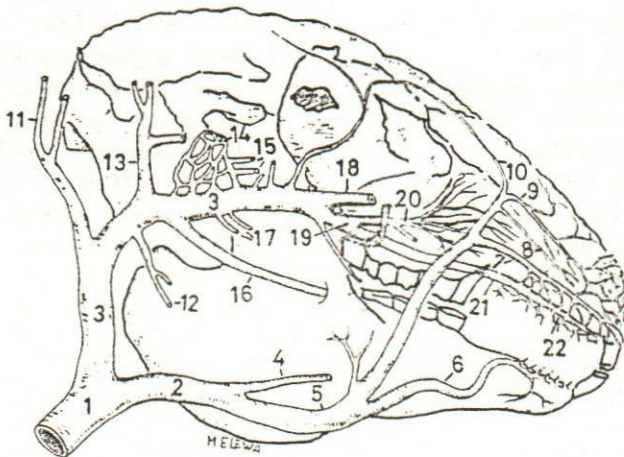


Fig.(2) Diagram showing the veins of the head of the rabbit .