Rhinology, 25, 13-16, 1987

Nasal venous drainage in the dog

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SUMMARY

In the dog, blood from the nasal mucosa may drain via several passageways. Venous outflow measured from the dorsal nasal veins was 30 ± 1.4 ml/min (of both sides; n = 10) while that from the sphenopalatine veins was 12 ± 1.0 ml/min (of both sides; n = 10). Nasal venous pressure measured from the dorsal nasal veins was 20 ± 1.2 mm Hg (n = 10) while that from the sphenopalatine veins was 10 ± 0.7 mm Hg (n = 10). Occlusion of the dorsal nasal venous outflow increased significantly the sphenopalatine venous outflow whereas occlusion of the sphenopalatine venous outflow had no effect on the dorsal nasal venous outflow. These findings suggest that there are probably two venous systems in the nose; a system of high flow and high pressure draining the anterior nasal cavity and a system of low flow and low pressure draining the posterior nasal cavity.

INTRODUCTION

The venous system of the nose is far more complicated than the other venous systems of the body. In the dog, blood from the nasal mucosa may drain anteriorly via the dorsal nasal vein, posteriorly via the sphenopalatine vein, ventrally into the palatine plexus and even through veins of the underlying bones of the nasal cavity (Batson, 1954; Miller et al., 1964; Ritter, 1970). Measurement of venous outflow from the sphenopalatine vein of the cat and the dog has been described (Malm, 1973; Wang and Lung, 1984). However, venous outflow from the other passageways has never been quantitatively studied.

In the present study, we measured venous outflow and pressure not only from the sphenopalatine vein but also for the first time from the dorsal nasal vein of the dog. As it is technically difficult to measure the venous outflow into the palatine plexus as well as into the veins of the underlying bones of the nasal cavity, their measurement was therefore left out in the study.

METHODS

The experiments were carried out with mongrels (body weight ranging from 15 to 20 kg) of either sex. The animals were anaesthetized with sodium pentobarbitone

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Paper presented at the 11th Congress of the European Rhinologic Society and 5th ISIAN, Athens (Greece), June 1986.

(25 mg/kg) intravenously. Cervical tracheotomy was performed and the animal was allowed to breathe spontaneously. The tracheal cannula was connected to a Fleisch pneumotachograph (Gould) which measured airflow and converted it tidal volume by electric integration. A femoral artery was cannulated for measurement of systemic arterial blood pressure via a pressure transducer (P23ID), Gould). Heparin (1000 units/hr) and supplementary doses of the anaesthetic were given via a femoral venous catheter.

A skin incision was made above the nasal bones on both sides to expose the dorsal nasal veins. Blood from the dorsal nasal veins was allowed to bypass into the left facial vein. A cannulating-type electromagnetic flow sensor (SL7515, Statham) was inserted along the bypass circuit to measure the total dorsal nasal venous outflow. An infraorbital incision was made on both sides along the zygomatic arch to expose the sphenopalatine veins as previously described (Wang and Lung, 1984). Blood from the sphenopalatine veins was allowed to bypass into the right facial vein. A cannulating-type electromagnetic flow sensor (U2030, Medicon) was inserted along the bypass circuit to measure the total sphenopalatine venous outflow. A four-way stop-cock was placed distal to the flow sensor along each bypass circuit for temporary occlusion of the venous outflow. Tubes were interposed in the bypass circuits at the level of the four-way stop-cock for the measurement of their respective venous pressures via the pressure transducers (P23BB, Statham). All flow and pressure variables were recorded on a Dynograph (Beckman) and only the mean values were calculated. Data were expressed as mean $\pm$ SE. Student's t-test was used to determine the level of significance of difference between the means. P values less than 0.05 were accepted as significant.

RESULTS

Table 1 shows the normal values of the dorsal nasal and spenopalatine venous blood flows and pressures as well as their changes to venous outflow occlusions. Figure 1 is an experimental record illustrating the results.

Table 1. Nasal venous responses to nasal venous outflow occlusions.

	DvF	DvP	SvF	SvP
normal	30 ± 1.4 (10)	20 ± 1.2 (10)	12 ± 1.0 (10)	10 ± 0.7 (10)
bilateral occlusion of dorsal nasal vein	-	35 ± 2.4* (10)	28 ± 2.8* (5)	12 ± 1.0 (10)
bilateral occlusion of sphenopalatine vein	30 ± 2.0 (5)	20 ± 1.3 (10)	-	20 ± 2.1* (10)

Values are given as mean $\pm$ SE. Flow in ml/min. Pressure in mm Hg. Number of animals in parenthesis. * $P < 0.05$, when compared to the corresponding normal value. DvF - dorsal nasal venous blood flow. DvP - dorsal nasal venous blood pressure. SvF - sphenopalatine venous blood flow. SvP - sphenopalatine venous blood pressure.

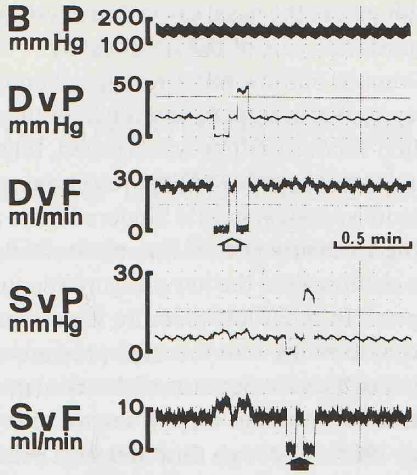

Figure 1. Effects of venous outflow occlusions on the dorsal nasal and sphenopalatine venous blood flows and pressures. Open arrow: arrest of the dorsal nasal venous outflow; downward deflection of the DvP tracing shows the facial venous blood pressure change while the upward deflection shows the dorsal nasal venous blood pressure change during the arrest. Solid arrow: arrest of the sphenopalatine venous blood flow; downward deflection of the SvP tracing shows the facial venous blood pressure change while the upward deflection shows the sphenopalatine venous blood pressure change during the arrest. Traces from above downwards: systemic arterial blood pressure (BP), dorsal nasal venous blood pressure (DvP), dorsal nasal venous blood flow (DvF), sphenopalatine venous blood pressure (SvP), and sphenopalatine venous blood flow (SvF).

DISCUSSION

The total venous outflow from the dorsal nasal veins of both sides was found to be of the average value of 30 ± 1.4 ml/min while that from the sphenopalatine veins 12 ± 1.0 ml/min. The total arterial inflow to the nasal mucosa (both sides) via the terminal internal maxillary arteries has been reported to range from 40 to 60 ml/min (Wang and Lung, 1984). Therefore, under normal condition, the majority of the venous blood (about two-third of the arterial inflow) drains via the dorsal nasal veins, a smaller portion (about one-quarter of the arterial inflow) via the sphenopalatine veins with the remaining via the palatine plexus and the veins of the underlying bones of the nasal cavities.

Nasal venous pressure measured from the sphenopalatine veins was found to be of the average value of 10 ± 0.7 mm Hg which is in agreement with the value reported by other workers in the cat (Malm, 1974). Nasal venous pressure measured from the dorsal nasal veins was found to be much higher, reaching the level of 20 ± 1.2 mm Hg. The observations that blood flow and pressure are much higher in the dorsal nasal veins than in the sphenopalatine veins suggest that there may be two venous systems in the nasal mucosa; a system of high flow and high pres-

sure draining the anterior part of the nasal cavity and a system of low flow and low pressure draining the posterior part of the nasal cavity.

When the dorsal nasal venous outflow was arrested, sphenopalatine venous outflow was found to increase significantly to about half of the total arterial inflow. When the sphenopalatine venous outflow was arrested, there was no significant change in the dorsal nasal venous outflow. These results may imply that if the outflow from the high pressure venous system is hindered there might be a diversion of blood flow from the high pressure venous system into the low pressure sphenopalatine veins but if the outflow from the low pressure venous system is hindered blood flow will be diverted to other low pressure venous pathways such as the palatine plexus instead of draining into the high pressure dorsal nasal veins.

Microscopic examination of the vascular casts of the nasal mucosa has shown that arteriovenous anastomoses are located only in the anterior region of the nasal cavity (Wang and Lung, 1985). The high flow and high pressure of the anterior venous system may be due to the presence of the arteriovenous anastomotic flow.

ACKNOWLEDGMENTS

The work was supported by Hong Kong University Research Grant Fund (335/034/0023 & 311/030/8080/14).

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