

Angioarchitectural Arrangements of the Nasal Septum Mucosa of Rats

Arreglos Angioarquitectónicos del Septum de la Mucosa Nasal de Ratas

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Abstract: Three-dimensional angioarchitecture of the rats' nasal septum was studied using corrosive resin cast technique and scanning electron microscopy. The animals were perfused with Mercox synthetic resin and subsequently the specimens were treated with 20% NaOH solution for several days at room temperature. They were washed in distilled water and dried at room temperature. The specimens were mounted on metal stubs, coated with gold and observed in the scanning electron microscope. The results showed numerous main arteries running parallel to the base, arteriovenoses anastomoses and veins. The arteries and veins could be distinguished according to the nucleus' morphology imprint of the endothelial cells on cast surfaces. It was also possible to observe characteristic elevations of venous valves on the surface of the venous plexus.

Key words: Artery, vein, rat nasal septum, scanning electron microscopy, corrosion cast

Resumen: La angioarquitectura tridimensional del septum de la mucosa nasal de ratas fue estudiada usando la técnica de moldeado con resina corrosiva y la microscopía electrónica de barrido. Los animales fueron perfundidos con resina sintética Mercox y tratados posteriormente con solución al 20% de NaOH, durante varios días, a temperatura ordinaria, lavados luego con agua destilada y secados a igual temperatura. Los especímenes fueron montados en discos metálicos, cubiertos con oro y observados al microscopio electrónico de barrido. Los resultados mostraron numerosas arterias principales paralelas a la base, anastomosis arteriovenosa y venas. Se distinguieron las arterias y venas según la huella de la morfología nuclear de las células endoteliales en la superficies de moldeado. También fue posible observar elevaciones características de válvulas venosas en la superficie del plexo venoso.

Palabras clave: Arteria, vena, septum nasal de ratas, microscopía electrónica de barrido, moldeado por corrosión.

INTRODUCTION

The connective tissue has several functions like to nourish the epithelial cells of the epithelium with blood vessels and to supply the receptors with sensory nerve endings. On the other hand, the epithelium has as function

the protection of the connective tissue. A specific function of the respiratory system is the humidification and thermoregulation of the inhaled air. These special functions have direct relation with nasal vessels. The vascular network of the nasal septum has been reported by Dawes and Prichart (1) in different animals, Hodde and Blecourt (2) in rats, Skladzien et al. (3) in human fetus and Tange (4) in the gerbil.

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The aim of the present study is to describe the three-dimensional angioarchitecture of rat nasal septum using light and scanning electron microscopy.

MATERIALS AND METHODS

In this study, eight septa of adult Wistar rats of both sexes weighing between 200 and 300 g were used. For light microscopy, two specimens were fixed in 10% formalin fixative solution for 12 h and embedded conventionally in paraffin. Then, specimens were cut, stained with hematoxylin-eosin and Azocarmin, and observed in a Zeiss photomicroscope.

For scanning electron microscopy, the animals were anesthetized with sodium pentobarbital and perfused with 0.9% saline solution. Injection of MERCOX® syn-

thetic resin was made under manual pressure. After the polymerization of resin, the nasal septum was removed, rinsed in distilled water and macerated in 20% NaOH solution at room temperature, for several days. The resin casts were rinsed in distilled water, dried at room temperature, mounted in metal stubs, coated with gold and examined in a JSM - 6100, scanning electron microscope.

RESULTS

At the light microscopic level, the rat nasal septum exhibited a pseudo-stratified epithelium, the hialine cartilage in the center and between these two structures the presence of arteries and glands (Fig. 1). At higher magnification, it was possible to observe arteries and their endothelial cells (Fig. 2).

Figure 1. Light photomicrograph of the rat nasal septum. Observe the presence of the pseudo-stratified epithelium (E), hialine cartilage (C) and arteries (arrows). X 100

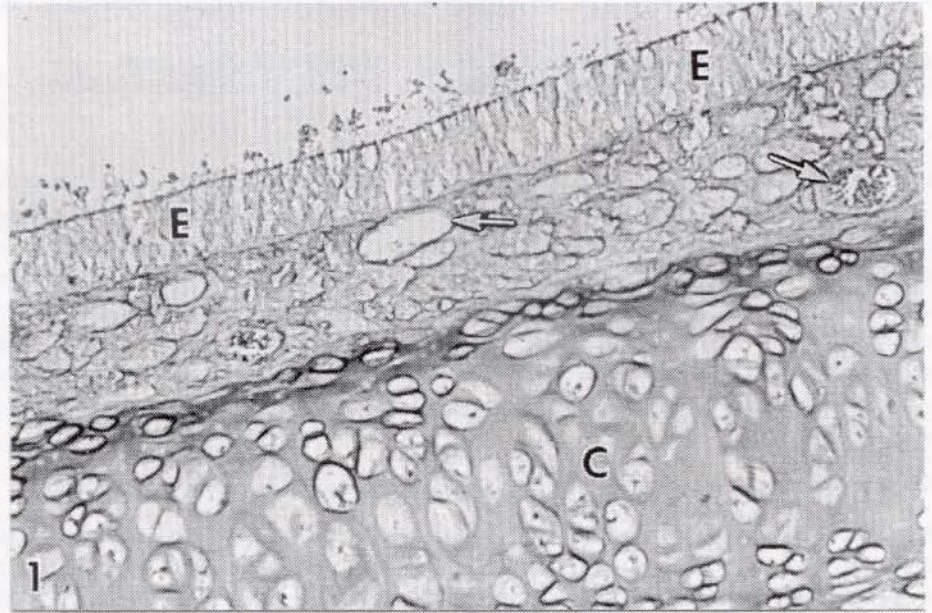
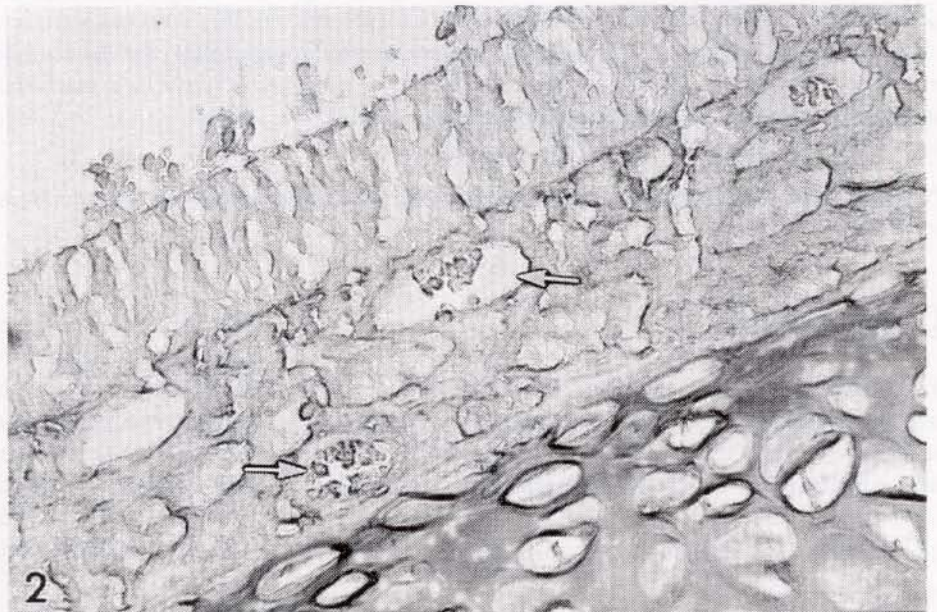


Figure 2. Light photomicrograph of the rat nasal septum. Note the presence of sections of arteries (arrows). X 180



The scanning electron microscope examination of the vascular casts showed that the nasal septum of the Wistar rats was supplied by the internal ethmoidal artery. Each side of septum was supplied by this artery, which branched in four to seven smaller arteries (Fig. 3). The latter ones were seen running along the septum from the apical region to the base, and supplied the surrounding arterioles and capillaries. The capillary network of the lamina propria was extremely dense and complex (Fig. 4). It was possible to observe also the venous plexus (Figs. 5 and 6).

To distinguish arteries and veins, the impression of the endothelial cell nucleus was observed at high magnification on scanning electron microscopy images. The elongated endothelial nucleus image was characteristically seen in arteries (Fig. 7) and the ellipsoid impression was noted in veins (Fig. 8). It was also possible to observe the presence of several anastomoses among arteries (Fig. 9) and veins (Fig. 10). The venous plexus was ar-

ranged in complicated network and in some areas, venous valves were seen (Fig. 11).

DISCUSSION

The use of corrosive resin cast technique plus light and scanning electron microscopy provided an optimal method to reveal the three-dimensional characteristics of the rat nasal septum.

In our observations, the internal ethmoidal artery supplies the nasal septum of rats, what is in accordance to Hodde and Blecourt (2) reports. These authors also reported that in the internal ethmoidal artery there were five to seven branches, while in our study we found four to seven branches running longitudinally.

The capillary network of the lamina propria is dense and complex. This characteristic associated to numerous anastomoses and the air turbination provides the ther-

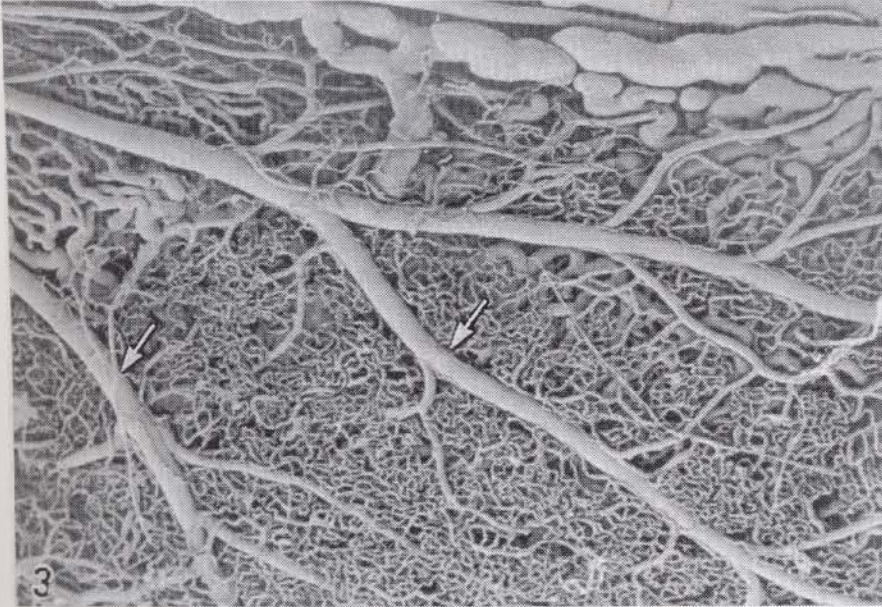


Figure 3. Scanning electron microscopy image of the angioarchitecture of rat nasal septum. Note the branches of the ethmoidal artery running longitudinally from the apex to the base (arrows). X 25

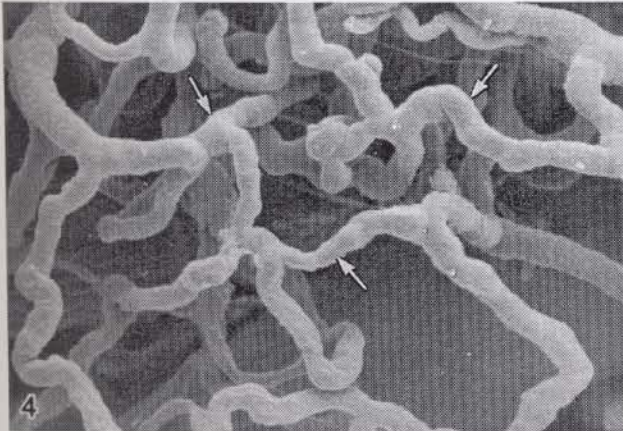


Figure 4. Scanning electron microscopy image showing the capillary network of rat nasal septum cast (arrows). X 345

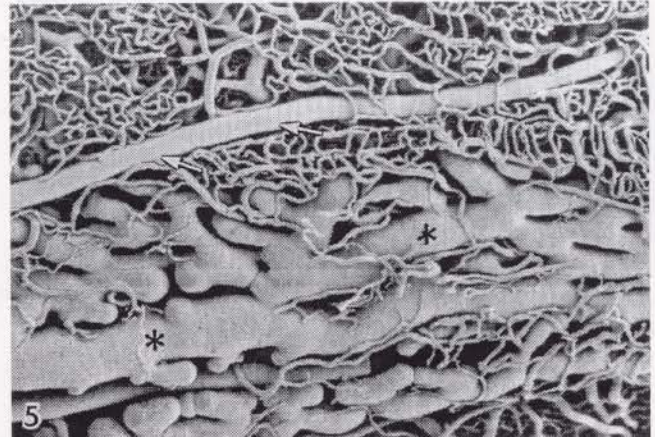


Figure 5. General view of the vascular network showing the large venous plexus (*), an large artery (arrows) and thin capillaries. X 45

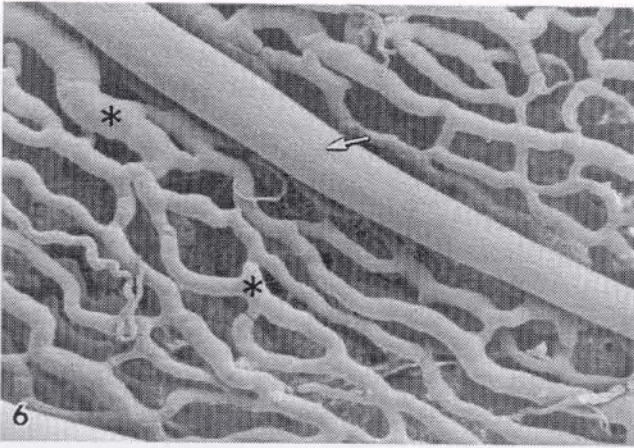


Figure 6. Scanning electron microscopy image of venous plexus showing venules (*) and an artery (arrow). X 85

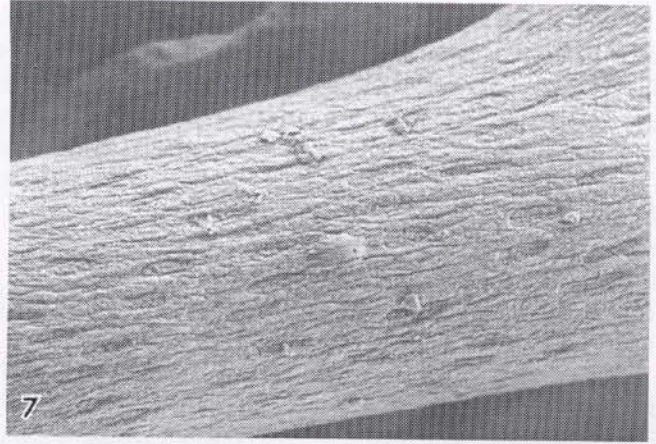


Figure 7. Scanning electron microscopy image at high magnification of an artery. Note the elongated nuclear imprints of endothelial cells in the surface. X 515

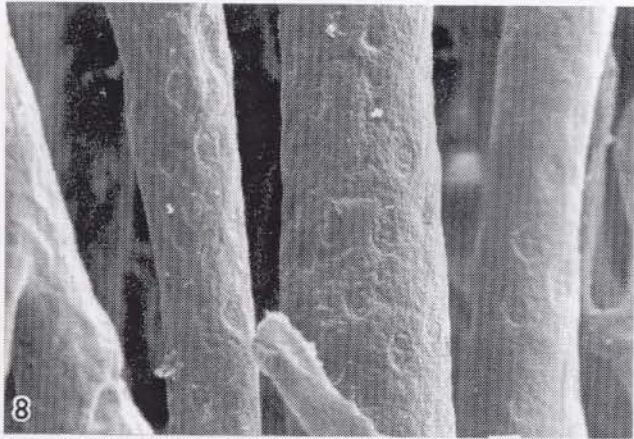


Figure 8. Higher magnification of some veins of rat septum. Observe the ellipsoid or roundish nuclear imprints of endothelial cells. X 460

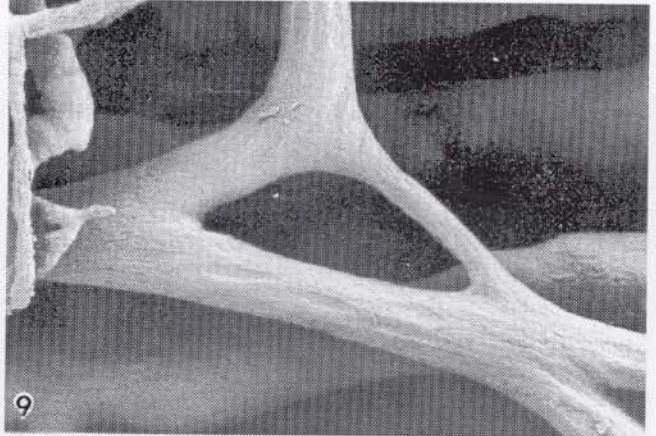


Figure 9. Scanning electron microscopy image of an anastomose between arteries. Note the elongated nuclear imprints of endothelial cells. X 460

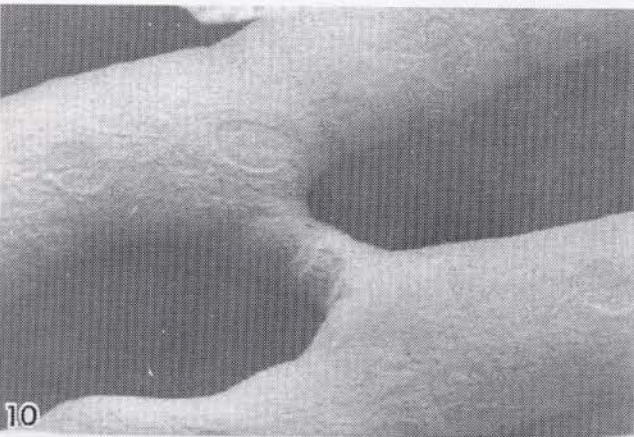


Figure 10. Scanning electron microscopy image of one of the several anastomoses between veins revealing the ellipsoid or roundish nuclear imprints of endothelial cells. X 800

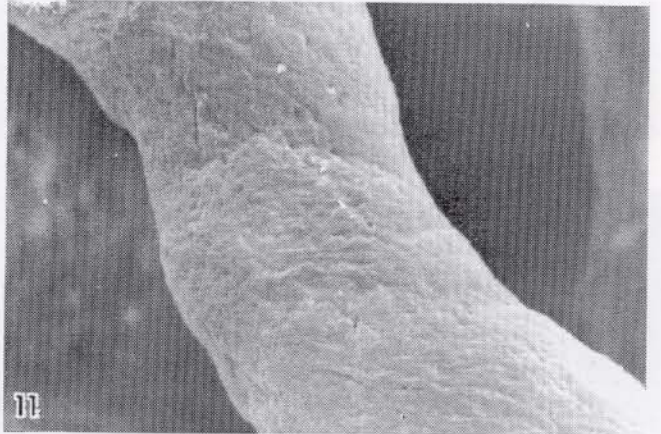


Figure 11. Scanning electron microscopy image at high magnification showing the surface of a venous valve. X 1.490

moregulation of air. The humidification is achieved by activities of nasal glands and this network of large fenestrated capillaries underneath the epithelium (5).

The high fidelity of vessel walls that corrosive resin cast technique provides makes possible to differentiate arteries and veins based on the appearance of the endothelial cell nuclear imprints. The elongated or spindle-shape are characteristic of arteries and the ellipsoid or roundish shape are mainly observed in veins (6, 7). Kishi et al. (8) also reported a hexagonal pattern of the nuclear impressions of endothelial cells in venules.

Although the presence and function of venous valves in the vascular network of lingual mucosa of *Capra hircus* (9) and in hard palate of dogs (10) were already confirmed, the function of the valves in the rat septum is probably associated to blood flow. Valves make the blood flow in only one direction what increases the blood supply and the thermoregulation of air.

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