TRANSITIONAL EPITHELIUM IN THE RHINO-PHARYNX.*

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In an effort to determine the boundary lines between the squamous epithelium and the ciliated epithelium of the rhinopharynx, an examination was made of the rhinopharynges in the domestic rabbit (eight individuals), in the guinea pig (three individuals), in the domestic cat (four individuals), in the macacus and cebus monkeys (one each), and in man (twelve individuals; adults, children, infants and fetus).

The search for these boundary lines demonstrated the presence of a third variety of epithelium (mentioned by von Ebner¹) which, in the character of its cells, is intermediate between the squamous cells and the ciliated columnar cells. This epithelium which occupies the transitional zone between the epithelium of the oropharynx and that of the nasal fossae, is composed of cuboid cells with either imperfect cilia or no cilia at all.

In all the specimens examined, the squamous epithelium extends as far forward as the fossae of Rosenmuller, the intermediate zone of the epithelium occupies the region of the orifice of the Eustachian tubes, while the ciliated columnar epithelium extends a variable distance backward, approaching the Eustachian tubes.

The intermediate zone of the epithelium lies in a wavy ring around the rhino-pharynx. It bends forward on the anterior and the posterior walls, and backward on the lateral walls at the attachment of the posterior faucial pillars. The zone includes interdigitations and islands of the neighboring varieties of epithelium.

The boundaries of the intermediate zone of epithelium vary in position, as stated by von Ebner, but these boundaries, I find, contrary to von Ebner, are constant inasmuch as they vary between fixed limits. In the several species examined, the variations have specific limitations.

1. In the rabbit, the anterior border of the transition extends far in front of the Eustachian orifices. The posterior border reaches these orifices.

2. In the guinea pig, it ends anteriorly a short distance in front of the Eustachian orifices, and posteriorly a short distance behind these orifices.

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Fig. 1. Human Pharynx. Adult.

Fig. 2. Human fetus at term. The band of intermediate epithelium extends a little farther back than in the adult.

Fig. 3. Macacus monkey. The band of intermediate epithelium lies behind the Eustachian orifice.

Fig. 4. Cebus monkey. The band of intermediate epithelium lies behind the Eustachian orifice.

Fig. 5. Domestic cat. The band of intermediate epithelium lies behind the Eustachian orifice.

3. In the cat, its anterior border crosses the Eustachian orifices, while its posterior border is a short distance behind these orifices.

4. In the cebus and macacus monkey and in man, the position of its anterior and posterior boundaries resembles very closely that found in the cat.

Fig. 6. Guinea pig. The band of intermediate epithelium lies across the Eustachian orifice.

Fig. 7. Domestic rabbit. The band of intermediate epithelium is wide and lies in front of the Eustachian orifice.

The intermediate zone is seen to extend farthest forward in the rabbit, and farthest back in man.

The figures presented here are diagrammatic, projectoscopic outlines of vertical antero-posterior sections of the head with the nasal

Fig. 8. Back wall of rhino-pharynx of rabbit shows transition of squamous epithelium on the right to ciliated columnar epithelium on the left. Mucous glands below.

Fig. 9. An enlargement of No. 8, showing ciliated columnar cells on the left, changing to cuboid cells on the right. Rabbit.

septum preserved. The shaded lines represent the cut edges of the mucous membrane. The blue area represents the band of intermediate epithelium between the ciliated columnar epithelium and the squamous epithelium.

The intermediate epithelial band (represented by blue area) extends forward on the back wall nearly to the septum, and backward nearly to the angle of the rhinopharynx. It passes over the Eustach-

Fig. 10. Epithelium from back wall of fossa of Rosenmüller, showing squamous cells on right and short columnar non-ciliated cells on left overlying lymphoid tissue. Transition of squamous to cuboid epithelial cells. Human.

Fig. 11. Short columnar non-ciliated epithelium from back wall of fossa of Rosenmüller overlying lymphoid infiltration. Human.

ian tube and inclines backwards at the union of the soft palate with the lateral wall. It then inclines forward to a point near the nasal septum on the floor of the rhino-pharynx.

The following figures are microscopic sections stained with haematoxylin and eosine.

The position of the transitional band obviously changes with the variation in the upper limit of the peristaltic digestive tube. We observe that it extends farther forward in the lower extreme of the mammalian scale, the rabbit, than in the higher extreme, man; also that the width of the band is greatest in the rabbit, and least in man. Associated with these differences, possibly in a causative relation, the peristaltic digestive tube extends farthest forward in the rabbit, and farthest back, at its anterior end, in man. The posterior border of the intermediate zone in the same position in all these forms of mammals, at a point where the mucous membrane begins to be exposed to food and digestive fluids. Its anterior border lies where the peristaltic motion starts.

This holds good for man, although in the adult we find there is a considerable area of squamous epithelium on the posterior pharyngeal wall between the posterior border of the transitional epithelial ring and the anterior commencement of the peristaltic tube. In the human fetus, this interval between the ciliated epithelium and the anterior end of the peristaltic tube, does not exist.

The position and extent of this transitional band is just what is required to cover the area between the free air portion and the repeatedly washed portion of the rhino-pharynx; that is, the alternately washed and aired portion of the naso-pharynx, between the portion which is only aired and the portion which is exposed to the materials of digestion. This area is, however, wiped at the time of swallowing, by the peristaltic contractions of the tube.

We readily appreciate the clinical and pathological importance which the unprotected area of naso-pharyngeal mucous membrane presents in adult man. The area is covered by stratified squamous epithelium, but is not protected by the peristalsis of the tube.

Clinical experience has taught us that different kinds of epithelial surfaces do best with different kinds of treatment. The post-nasal ciliated epithelium, the firm, buccal, stratified, squamous epithelium, the thick, soft, esophageal, stratified, squamous epithelium, etc., differ in resistance and reaction to re-agents. In the same way the naso-pharyngeal ciliated epithelium, the intermediate epithelium and the rhino-pharyngeal stratified squamous epithelium differ in sensibility and reaction. The ciliated aerial epithelium is very delicate and sensitive, reacting readily to very weak solutions, while the resistant, thick, stratified epithelium of the naso-pharynx is as resistant almost as the mouth.

Furthermore, it has been observed, clinically and experimentally, that when ciliated epithelium has been destroyed over an area, it does not become wholly replaced, but its place is taken by stratified, squamous epithelium which remains permanent.

These observations should warn us of the damage which is invariably done by strong reagents to the ciliated region of the rhino-pharynx.

The physiological protective mechanism of the mucous membrane of the rhino-pharynx works in this way: the mucus, with adherent particles and fluids lying on the ciliated naso-pharyngeal membrane, is wafted forward and expelled at the anterior nares. The fluids and solids and mucous secretions on the intermediate and squamous areas are squeezed backwards by the peristaltic action of swallowing.

This theory supposes that the peristaltic tube in the lower animals overlaps the ciliated tube. In adult man this overlapping does not exist, since there is a wide area of intermediate epithelium and squamous epithelium between the ciliated area and the commencement of the peristaltic tube. This area is dependent on the flow of mucus aided by gravity to cleanse itself. When the mucus becomes abnormally viscid, retroaspiration of the naso-pharynx is resorted to. This action is useful in removing viscid mucus, but it roughens the cilia the wrong way to some extent. The pathological degenerate act of retro-aspiration of the naso-pharynx exists in none of the mammals except in man.

It is obvious that this unprotected condition of the intermediate and squamous area anterior to the peristaltic tube in man, offers a greatly diminished resistance to the entrance of (all) systemic infections which usually commence at this point.

BIBLIOGRAPHY.

1. VON EBNER: Schlundkopf—Pharynx. Koelliker's Handbuch der Gewebelehre des Menschen, IX Edition, Leipsic, 1902, Vol. 3, p. 127.
2. These observations were made in the Pathological Laboratory of the Manhattan State Hospital through the courtesy of Dr. William Mabon, Superintendent, and Dr. Clarence O. Cheney, Pathologist.

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