A COMPARATIVE MORPHOLOGY OF ANAL TONSILS IN PLATANISTIDAE

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ABSTRACT

Anal tonsils, complex lymphoepithelial structures in the anal canal, were found in *Platanista gangetica*, and morphological observations were made macro- and light microscopically. In *Platanista*, the anal tonsils are mainly present and scattered on the oral half of the anal canal, however, they are relatively poorly developed and small in number. The formation of the anal tonsils cannot be found in *Inia geoffrensis*, although accumulations of lymphoid tissue are observed as far as the posterior part of the anal canal. In *Pontoporia blainvillei*, even such accumulations are absent from all parts of the anal canal. Comparative considerations of the anal tonsils are mentioned in Platanistidae and in some other cetaceans.

INTRODUCTION

Ortmann (1960) reviewed the lymphatic apparata and so-called " anal tonsil " in the anal region in many mammals, however, in his description no mention was made of those in Cetacea. Uys and Best (1966) made a pathological observation on Cetacea in which they described the anal tonsil in sperm whales. This structure is present externally around the anal opening. Cowan and Brownell (1974) reported the anal tonsil in the anal canal of gray whales and made comparative and functional considerations on this subject. We made an anatomical observation on the digestive tract of the Ganges susu in 1972, however, we overlooked the anal tonsils at that time. Recently, we have reexamined the previous materials and observed other specimens of this dolphin, and similar structures to that in gray whale were found in the anal canal. No reports on this subject in Cetacea, except for the abovementioned two reports, have been published to date and there still remain many problems of ambiguity in the biological meanings of the anal tonsil. Therefore, a brief morphological description of the anal tonsil in the Ganges susu will be added to the knowledge of that of Cetacea. In addition, comparative observations were done on two other kinds of Platanistidae, Franciscana and Boutu, and also on the striped dolphin.

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MATERIALS AND METHODS

Six specimens of Ganges susu, *Platanista gangetica* (body length; 76.0, 105.5, 106.5, 113.0, 118.0, 127.0 cm) were used in this study. For comparison four Franciscana, *Pontoporia blainvillei* (98.5, 113.5, 121.0, 171.0 cm) and a Boutu, *Inia geoffrensis* (204 cm) were examined. The *Platanista* and the *Pontoporia* were collected by the Cetacean Research Expedition of the University of Tokyo. Specimens of 76.0, 113.0, 118.0 and 127.0 cm in the *Platanista* were collected in the Brahmaputra River (Bangladesh) from 1969 to 1970 and the other in the Indus River (Pakistan) in 1974. The *Pontoporia* were caught off the Uruguayan coast from 1972 to 1973. The *Inia* was offered to us by the Kamogawa Sea World Aquarium in Chiba, Japan. Six striped dolphins, *Stenella coeruleoalba*, collected off the Pacific coast of Izu peninsula, Japan, were also examined as one example of marine dolphins.

Materials were fixed in 10% formalin solution at the site of capture and sent to our laboratory. After macroscopical observations from the interior of the anal canal, the whole length of which was cut serially in about 5 mm thicknesses, detailed examinations were done. Histological pieces were embedded in paraffin and celloidin, and then sectioned and stained with hematoxylin and eosin.

OBSERVATIONS AND COMPARATIVE CONSIDERATIONS

The anal canal, from the posterior end of the rectum to the anal orifice, varies in length with individual body length and is about 4 to 7 cm long in the *Platanista* observed. The epithelium shows an abrupt change at a point between the rectum and anal canal from intestinal glandular mucosa to stratified squamous epithelium in all species of dolphins observed. We have labelled this point the recto-anal epithelial transition (Takahashi and Yamasaki, 1972). Cowan and Brownell, in the gray whale, labelled it as the muco-squamous junction. The oral half of the inner surface of the anal canal in *Platanista* is somewhat irregular and uneven in appearance and several longitudinal folds are present on the posterior half (Fig. 1). The epithelium of the anal canal becomes pigmented towards the anal orifice and continues to the external skin.

Complex lympho-epithelial structures in the anal canal, anal tonsils, are found in *Platanista*, with the exception of one 76 cm specimen. A well developed structure (Fig. 2) similar to that of the gray whale observed by Cowan and Brownell was found. This structure may correspond to the ' first type ' described by them, however, the development and the number of the tonsils in *Platanista* is rather poor and less, respectively, than that of the gray whale. There seems to be no sexual difference. In *Platanista* the anal tonsils are present but scattered in the oral three-fifths of the anal canal, except for the zone adjacent to the recto-anal transition, approximately 2 to 3 mm in width.* The tonsils are rather well developed in the

* In our previous paper on the intestinal tract of *Platanista* (1972) there was no mention of this structure because we had observed only the part adjacent to the recto-anal transition where no tonsils were present.

oral half of the anal canal and they decrease in size and number towards the posterior. There are a few structures which form an independent elevation and these are usually found grouped in the irregular or longitudinal folds of the anal canal, forming oval masses 2 to 3 mm thick, 4 to 5 mm wide and 5 to 6 mm long. In the gray whale, distinct openings of the tonsilar crypts are abundant in Figure 1 of Cowan and Brownell's article. In *Platanista* they are very small, usually pinhole in size, and few distinct ones are found on the inner surface of the anal canal. Although it is fairly difficult to distinguish the existence of the tonsilar crypt with the naked eye, especially in younger animals, when viewed through a stereomicroscope small openings can be recognized on the surface. When viewed on a cross-cut surface of the anal canal masses of lymphatic nodules, being yellowish gray in color, are rather easily distinguishable.

Anal tonsils in the gray whale, of which the anal canal is 30 to 40 cm long, are found on the posterior part of the muco-squamous junction extending over about 10 cm in width (Cowan and Brownell). In sperm whales, they are present as numerous lumps and exist externally around the anal opening (Uys and Best). The location and the distribution of the tonsils may vary considerably among different species of some cetaceans which may have anal tonsils.

The sample shown in Figure 2 is of a well developed, independent tonsil in *Platanista* (113 cm) which we observed. It shows a distinct epithelial elevation, about 5 mm across and 3 mm high. The tonsil is composed of a mass of lymphatic nodules with a few germinal centers. The mass is about 4 mm in diameter. Its capsulation of connective tissue which is continuous with that of the submucosa is poorly developed. The tonsilar surface is covered with stratified squamous epithelium, invaginated into the subjacent lymphoid tissue to form a central crypt, which ramifies into a small number of subdivisions. Invaginated epithelium from the free surface becomes thinner and almost disappears at the mid-portion of the crypt. In cases of younger specimens (105.5, 106.5 cm), tonsils are small in size, 1 to 3 mm across, and they are grouped in places in the submucosa (Fig. 3). The crypts, some of which are slightly tortuous in course, ramify near the surface to the adjacent tonsils which are separated by connective tissue, or the crypts of two or three tonsils open onto the surface by a common opening. Lymphatic nodules without crypts are often present next to the tonsils. In the deeper portions of the crypts in younger specimens secondary papillae of their epithelia are poorly developed and the limit between the epithelium and lymphoid tissue is obscured by an infiltration of the epithelium with lymphocytes. Small numbers of mucous glands are present at the bottom of the structure. In younger cases, glands are seen near the masses of lymphatic nodules. In the case of the 76 cm specimen, there can be seen a very few small aggregations of lymphocytes without the formation of lymphatic nodules in the submucosa.

Thus, *Platanista* has anal tonsils, which are mainly present in the oral half of the anal canal, although relatively poorly developed and small in number. Since the anal tonsils were not formed in the 76 cm specimen and in younger stage they are small in size, it seems that the anal tonsils develop with age in *Platanista* as far

as we have been able to observe.

Cowan and Brownell referred to the relation of the anal tonsils in Cetacea with the avian bursa of Fabricius. They described the morphologic homology and suggested the functional homology between the two structures. Assuming that the anal tonsils of *Platanista* develop with age, the relationship between the anal tonsils and the bursa, which may degenerate with age, may be converse, and this problem should be discussed based on further observations of the anal tonsils in other cetaceans.

On the other hand, in *Inia*, although we observed only a single case of a specimen of 204 cm in body length, diffuse accumulations of lymphoid tissue are observed in the submucosa to the posterior region of the anal canal. Crypt-like epithelial invaginations can often be observed, but they are not always associated with accumulations of lymphoid tissue. Germinal centers are poorly developed. In the *Inia* observed, well outlined organs of lymphoid tissue such as in *Platanista* could not be observed (Fig. 4).

In contrast, in *Pontoporia* no accumulations of lymphoid tissue can be observed in any part of the anal canal and only a very few aggregations of lymphocytes can be seen in all animals examined, as we briefly pointed out in a previous paper (Yamasaki *et al.*, 1975). The submucosa is highly vasculized (Fig. 5).

In *Stenella coeruleoalba*, well outlined anal tonsils with distinct germinal centers are present on the oral over about three-fourths of the anal canal. Many openings of the tonsilar crypts are clearly visible to the naked eye at the region corresponding to the tonsils on the inner surface of the anal canal. Anal tonsils in this species of *Stenella* are far more well developed compared with those in *Platanista*.

There is a remarkable difference in the lymphoid tissue in the anal canal in Platanistidae as mentioned above. It is interesting as to whether anal tonsils are present in other kinds of *Stenella* or not. Ortmann (1960) has already reviewed the considerable variations in the presence of anal tonsils in all the species of mammals he observed, although no mention was made of those in cetaceans.

There seems to be a close relationship between the existence of the anal tonsils and the distribution of the lymphoid tissues in the entire intestinal tract. Therefore, observation of the anal tonsils should be done along with that of the whole intestinal tract in each species.

There are so few descriptions on this subject that further comparative observations on other cetaceans should be done and are needed to clarify biological meanings from immunological, ecological and phylogenetical standpoints.

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EXPLANATION OF PLATE

PLATE I

Fig. 1. Inner surface of the oral three-fourths of the anal canal of a *Platanista gangetica* (body length, 105.5 cm). The oral half of the surface is uneven in appearance and longitudinal folds are present on the posterior half. Anal tonsils in *Platanista* are mainly present in the oral half of the anal canal. An arrow shows one of the tonsilar crypts which are usually fairly difficult to distinguish with the naked eye. A recto-anal epithelial transition is clearly visible at the top of the photograph. Hollows seen in the longitudinal folds at the bottom of the figure are not tonsilar crypts. ×3.3

Fig. 2. A photomicrograph of a well developed anal tonsil of a *Platanista* (113 cm). Although no opening of the crypt is seen in this section, the surface epithelium invaginates into the subjacent lymphoid tissue to form a central crypt, which ramifies into subdivisions. Germinal centers can be seen in places within the lymphoid tissue. ×15

Fig. 3. A cross section of the anal canal of the *Platanista* in Figure 1. In younger specimens anal tonsils are rather small in size compared with the larger animals. A tonsilar crypt shown by the arrow corresponds to the arrow in Figure 1. Anal tonsils are grouped in places within the submucosa. Small glands are visible near the anal tonsils. ×9

Fig. 4. A cross section of the oral part of the anal canal of an *Inia geoffrensis* (body length, 204 cm). Accumulations of lymphoid tissue are present but formation of the anal tonsil cannot be seen in the *Inia*. Germinal centers are poorly developed. ×9

Fig. 5. A cross section of the oral part of the anal canal of a *Pontoporia blainvillei* (body length, 171 cm). No lymphoid tissue can be seen in any part of the anal canal. Submucosa is highly vasculized. ×9


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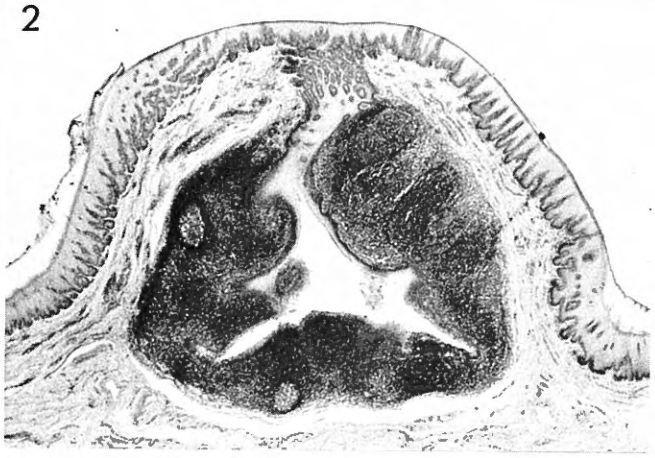
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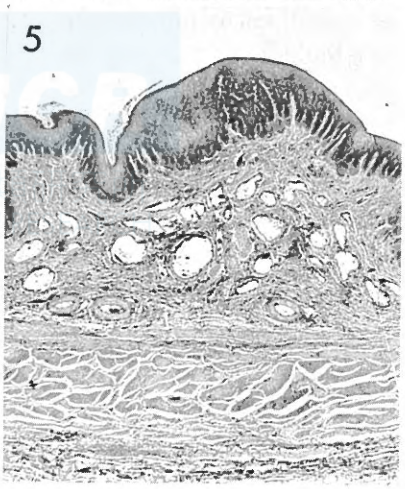
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