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Anatomical localisation and histology of the ovine tonsils

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Abstract

The topography and histologic structure of the various tonsils were studied anatomically and microscopically in 15 sheep aged between 9 and 15 months. The palatine, pharyngeal and paraepiglottic tonsils were readily visible macroscopically. They consisted mainly of secondary lymph nodules and were encapsulated in dense connective tissues. The epithelium covering the tonsils and their crypts was frequently infiltrated heavily by lymphocytes. The tubal tonsil and the tonsil of the soft palate were macroscopically visible after fixation in 2% acetic acid. These tonsils consisted of scattered lymph nodules, aggregations of lymphocytes and diffuse lymphoid tissue. They were not encapsulated, and therefore the borders of these tonsils could not be clearly delineated. The lingual tonsil was not macroscopically visible in sheep and consisted of scattered small aggregations of lymphocytes.

Keywords: Tonsil; Lymphoid tissue; Sheep

1. Introduction

Transmissible spongiform encephalopathies (TSEs), such as bovine spongiform encephalopathy (BSE) in cattle, scrapie in sheep and Creutzfeldt–Jacob disease in humans, are progressive and fatal neurological diseases which show a typical vacuolisation of neurons and an accumulation of the disease-specific isoform (PrP^{Sc}) of the body-specific prion protein (PrP^{C}). Studies have revealed that the strain of the transmissible agent responsible for the new variant of Creutzfeldt–Jacob disease (nvCJD) is identical to that of the BSE agent (Zeidler and Ironside, 2000). No cases of natural infection of BSE in sheep have been detected so far, but sheep have been experimentally infected with BSE by oral, intracerebral and intravenous inoculation. Most of the studies to date show little difference between BSE and scrapie in terms of distribution of infection throughout the body, clinical signs and pathology (Baylis et al., 2002; Houston and Gravenor, 2003; Hunter, 2003). In contrast to BSE in cattle where deposition of the PrP^{Sc} protein is limited to the central nervous system, it has been shown in sheep that PrP^{Sc} is present in nearly all lymphoid tissues (Foster et al., 2001). Furthermore, the gut-associated lymphoid tissue (GALT) of the oropharynx and the gut are believed to be the preferential sites of replication of the scrapie agent in sheep. The palatine tonsils rank among the primary sites where PrP^{Sc}

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could be detected after oral infection (van Keulen et al., 2002). Biopsies of tonsils and the conjunctival lymph nodules of the third eyelid can be used in sheep to detect prion protein in the preclinical stage of scrapie (Schreuder et al., 1998).

The general distribution of the BSE agent in experimentally infected sheep makes it impossible to remove all the potentially infected tissue from sheep meat intended for human consumption. In order to restrict the risk of BSE-infected sheep entering the food chain, all member countries of the European community are required to examine a fixed number of slaughtered and dead sheep and goats for TSE on an yearly basis (European Commission, 2002). Requirements also order the removal of specified risk material of sheep, consisting of the skull including the brain, the eyes, the tonsils and the spinal cord of animals aged over 12 months, and the spleen of the animals of all age groups (European Commission, 2000).

The tonsils (tonsillae or amygdalae) consist of an accumulation of lymphocytes which are usually concentrated in lymph nodules (noduli lymphatici) and are present in the mucosae of the oropharynx, nasopharynx and laryngopharynx. They are a part of the integrated pharyngeal mucosal immune system (Ogra, 2000) and form a ring of lymphoid tissue in the pharyngeal wall which was first described by von Waldeyer-Hartz (1884), and is therefore called the ''Waldeyer ring'' (Perry and Whyte, 1998). This location involves an important role for tonsils as secondary lymphoid tissue in the immunological response against antigens which enter the body by the oral or nasal route (Brandtzaeg, 1984; Bernstein et al., 1999). Six tonsils are described in sheep: the palatine tonsil (tonsilla palatina), the lingual tonsil (tonsilla lingualis) and the tonsil of the soft palate (tonsilla veli palatini) in the oropharynx, the pharyngeal tonsil (tonsilla pharyngea) and the tubal tonsil (tonsilla tubaria) in the nasopharynx, and the paraepiglottic tonsil (tonsilla paraepiglottica) in the laryngopharynx (Barone, 1997; Thomé, 1999).

The topography and structure of these tonsils in sheep are poorly documented. The palatine tonsil is described as a tonsil with the size of a hazelnut which has three to six crypts (Ellenberger and Illing, 1911). According to Thomé (1999), the lingual tonsil and the tonsil of the soft palate both consist of a small number of lymph nodules or a small amount of lymphoid tissue. The tonsil of the soft palate is located at the ventral side of the soft palate (Thomé, 1999). The pharyngeal tonsil forms an elevation at the caudal part of the pharyngeal septum with several invaginations of the epithelium (Barone, 1997; Thomé, 1999). The distribution of lymphoid tissue and the epithelium of this tonsil has been examined by Chen et al. (1990, 1991). The tubal tonsil is a slightly elevated, diffuse aggregation of lymph nodules which is restricted to the mucosa at the pharyngeal opening of the auditory tube according to Thomé (1999), but it can extend to the dorsal surface of the soft palate according to Barone (1997). Koch (1970) mentioned crypts in the tubal tonsil. Chen et al. (1989) described nodular aggregations of lymphoid tissue at the opening of the auditory tube and Stanley et al. (2001) studied the clustered lymph nodules which are concentrated just caudal to the opening of the auditory tube. The paraepiglottic tonsil has been described as a crypt tonsil (Ellenberger and Illing, 1911) which is located ''where the food ball passes after lifting of the soft palate'' (Koch, 1970). Except for Chen et al. (1989) and Stanley et al. (2001), most authors do not mention the microscopic structure of the ovine tonsils, but refer to data about bovine tonsils. In the present study, we describe the topography and the microscopic structure of the various tonsils in sheep.

2. Materials and methods

2.1. Animals

The heads of 15 sheep aged between 9 and 12 months were collected from the slaughterhouse. Ten of these heads were used for the macroscopic examination and the tonsils of the five remaining heads were excised for microscopic examination.

2.2. Macroscopic examination

The skin and mandibles were removed from all 10 heads and five heads were sectioned in the median plane. The heads were rinsed with tap water for 2 min and fixed in 2% acetic acid for 24 h to visualise the lymph nodules (Cornes, 1965; Chauhan and Singh, 1970). The location of the lymph nodules was noted,