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Ultimobranchial cysts in the thyroid of goats

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Abstract
The gross and histopathological changes in the thyroid glands of 145 goats harvested at slaughter during the period January 2014-June 2014 at Puducherry. The conditions affecting the left and right left lobes were independently examined. Histology of both lobes was not uniform. Normal histoarchitecture was recorded in only 11 lobes (4 left, 5 right and 1 bilateral). Histopathological changes recorded in the thyroid glands were categorized as congenital anomaly, degenerative changes, vascular disturbances, growth disturbances, pigmentation, neoplasm and miscellaneous conditions. Ultimobranchial cysts were most common histopathological condition recorded. These cysts were located predominantly at the hilar region and occurred either as a single cyst or multiple numbers. Microscopically, the cysts were lined by squamous epithelium, and in many cases their lumen contained eosinophilic keratin and cellular debris arranged in a laminated whorl pattern. The cysts were recorded in 85/290 lobes (29.31%) and ranged from 73.3-788.6 µm in diameter (left lobe, n=27) and 78.3-688.6 µm in diameter (right lobe, n=30) with bilateral involvement in 14/290 (4.82%) cases. Only in 20/290 (6.89%), these cysts were grossly recognizable in the hilar region of longitudinally sectioned thyroid lobes.

Keywords: Goat, histopathology, thyroid ultimobranchial cysts

Introduction
The thyroid gland lies on the trachea directly behind, and sometimes overlapping, the larynx. It is formed by two lateral lobes connected centrally by an isthmus located on the lateral surfaces of trachea. In small ruminants, the isthmus is inconstant, consists of connective tissue strand [1]. The parenchyma cells of the thyroid gland are derived from endodermal epithelial cells. The primordium of the thyroid first appears as an evagination on the floor of the foregut between the first two pharyngeal pouches. This ventral out pocketing is called as thyroid diverticulum. A tube-like column of these epithelial cells grows ventrally and caudally into the adjacent mesenchyme. There it divides into two portions, each of which will give rise to a lobe of the thyroid. The tubular connection from the developing gland to the point of origin from the pharyngeal floor is the thyroglossal duct. In most mammals, the duct is never patent. Unlike exocrine glands, which retain a connection with epithelium from which they arise, the thyroid gland loses its original connection to the floor of the pharynx [1]. The thyroid splits into two lateral lobes that in domestic animals usually remain connected ventral to the trachea by a thyroid isthmus. As the primordial thyroid cells shift caudally, they contact tissues associated with the ventral portion of these cells are presumptive calcitonin secreting mesenchymal cells, which become incorporated into the thyroid during this period. The thyroid parenchymal cells organize in solid clusters, each of which subsequently form a lumen and then become follicular. These follicles will be the source of thyroxine. The calcitonin secreting cells disperse between follicles in the thyroid gland, thus the name parafollicular cells or C cells [2]. The structural unit of the thyroid gland is the thyroid follicle. Follicles are hollow spheres whose size depends upon the activity of lining cells. The centre of each follicle is filled with a gel-like material called colloid, the storage form of follicular epithelial secretions. The lining epithelium varies from low cuboidal to high columnar depending on the stage of activity of the gland. A detailed anatomy and histological features of the thyroid gland in animals has been reviewed [3].

Ultimobranchial cysts often are present in the parenchyma of the thyroid and have a keratinizing squamous epithelial lining. They are derived from remnants of the ultimobranchial body that is the fifth pharyngeal pouch that fuses with the lateral thyroid lobes during embryonic development, and distributes calcitonin-secreting C cells into each thyroid lobe. Cysts are spherical to oval in shape occurring either as single or multiple in the central zone of

the thyroid parenchyma. The shape, number and size of the cysts will vary. These contain keratinized cellular strands surrounded a core of non-keratinized cell debris. Sometimes, mineralization of cysts may also be noticed [4, 5].

In an abattoir based study on the pathological conditions affecting the thyroid gland in ruminants, the occurrence of ultimobranchial nodules were reported to be 7.7% (7/90) in goats and 17.8% (16/90) in sheep [6]. The occurrence of ultimobranchial cysts in sheep recorded at slaughter were reported to be 9.09% (8/88) [7], 11.9% [8] 14% (14/100) [9], 17.3% [10] and 64.11% (109/170).[11] Based on histological and immunohistochemical studies, the occurrence of ultimobranchial remnants (ultimobranchial follicles, cysts and tubules, as well as solid nests formed by basophilic immature cells) in the parafollicular system was identified in 64 out of 1101 bulls [12]. From autopsy studies of 21 human foetal thyroids, it was reported that ultimobranchial cysts are located in the upper half of both the thyroids lobes near the upper parathyroid [13]. The incidence of ultimobranchial cysts reported in human foetus varied from 60 to 89% [14, 15, 16].

The present study reports the histopathological features of ultimobranchial cysts recorded in the thyroid gland of goats and formed part of a major study on the characterization and classification of gross and histopathological studies of the thyroid and adrenal gland in goats carried out at Puducherry.

Materials and Methods

The thyroid glands were harvested from crossbred goats (n=145) at slaughter houses in Puducherry during the period from January 2014 to June 2014. In all the cases, the right and left lobes of the thyroid gland were dissected out. After gross examination the lobes were longitudinally incised, examined and fixed in 10% neutered buffered formalin (NBF) in separate containers. Representative tissues from each of the lobes were processed by routine paraffin embedding and microtomy [17]. From paraffin embedded tissues, 4-5µm thick sections were prepared and stained by routine Haematoxylin and Eosin (H&E) staining procedure [17]. The H&E stained sections were examined to characterize and classify the microscopic changes and for carrying out histomorphometric studies. All images were captured by using a trinocular microscope (Optika, Italy) fitted with Optika B5 camera and analyzed using Image J software (https://imagej.nih.gov/ij/, National Institutes of Health, USA).

Results and Discussion

A total of 290 lobes of the thyroid glands of 145 goats were examined. Histological changes were independently recorded for the left and right lobes. The histopathological changes were categorized as congenital anomaly, degenerative changes, vascular disturbances, growth disturbances, pigmentation, neoplasm and miscellaneous conditions. The only congenital anomaly recorded in the thyroid lobes was ultimobranchial cysts and was the most common histopathological condition recorded. Ultimobranchial cysts were located predominantly at the hilar region. Cysts were spherical to oval in shape occurring either as single or multiple in the parenchyma (Fig. 1). The cysts were lined by metaplastic squamous epithelium and their lumen contained eosinophilic keratinised debris arranged in a laminated whorl pattern. The follicles adjacent to the cysts showed atrophic changes. In one case, there was mineralization of the cyst, characterized by formation of dense basophilic spherules in the lumen (Fig. 2). Ultimobranchial cysts were recorded in 85 lobes, 29.31% (27 in left lobe, 30 in right lobe and 14 bilaterally). Only in few cases, these cysts were grossly discernible. The shape, number and size of the cysts varied. The size of the cysts ranged from 73.3-788.6 µm in diameter in the left lobe and 78.3-688.6 µm in diameter in the right lobe. However, only in 20/290 (6.89%), these cysts were grossly recognizable in the hilar region of longitudinally sectioned thyroid lobes (Fig. 3).

Ultimobranchial cysts are remnants of ultimobranchial body, which delivers the neural crest-derived C-cells to the postnatal thyroid gland, fuses with each thyroid lobe at the hilus and distributes C-cells throughout each lobe. In abattoir based studies reported from different geographical locations, the occurrence of ultimobranchial cysts were reported in goats, sheep and bulls [6, 7, 8, 9, 10, 11, 12]. Wide variations in the occurrence of the ultimobranchial cysts in the thyroid glands may be due to the differences in species-wise occurrence and importantly the sampling procedures adopted for sectioning of the thyroid. From a practical point of view, it is highlighted that longitudinal sectioning of the thyroid lobes enabled the detection of cysts. This procedure was earlier reported for the evaluation the thyroid lobes in sheep [11] and might explain the higher number of cases recorded 64.11% (109/170) compared to other studies reported in sheep. Nevertheless, the incidence of ultimobranchial cysts in human foetus reported varied from 60-89% [13, 14, 15, 16]. Recently, a congenital neck cyst that originated from ultimobranchial body in a 31 week aged foetus was diagnosed by ultrasonography and histopathology [18]. It has been reported from human studies that papillary carcinomas and ultimobranchial body remnants occur as tiny, solid, or cystic thyroid entities in patients of all ages, may contain papillary structures, and share some common nuclear features. Therefore, it is important to include ultimobranchial bodies remnants in the differential diagnosis of minute thyroid entities and to recognize their morphologic features [15].

Experimental studies in rats showed that vitamin A deficiency had a direct effect on the normally non-keratinized stratified squamous epithelium of ultimobranchial cysts resulting in subsequent production of keratohyalin granules and tissue cornification [19]. Although ultimobranchial tissue was obviously altered by experimental manipulation of dietary vitamin A, thyroid follicles in the same gland were not affected. This suggested that ultimobranchial tissue was more susceptible to the recurring alterations in internal milieu that might occur throughout life. The authors also suggested that, recurring morphological alterations might predispose to the development of squamous cell carcinoma in the thyroid gland. Recent studies have questioned the neuroendocrine origin of C cells or ultimobranchial follicular cells. New lineage tracing data from genetic studies in mice indicated that the genuine progenitors to C cells arise in the foregut endoderm germ layer [20]. Further, it was indicated that these cells have also the potential to transform into medullary thyroid cancers or mixed tumors of the thyroid gland.

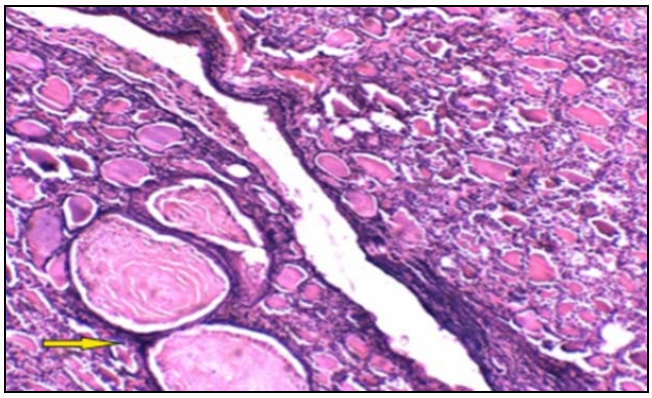

Fig 1: Thyroid gland showing ultimobranchial cysts (arrow) in the hilar region. H & E x100

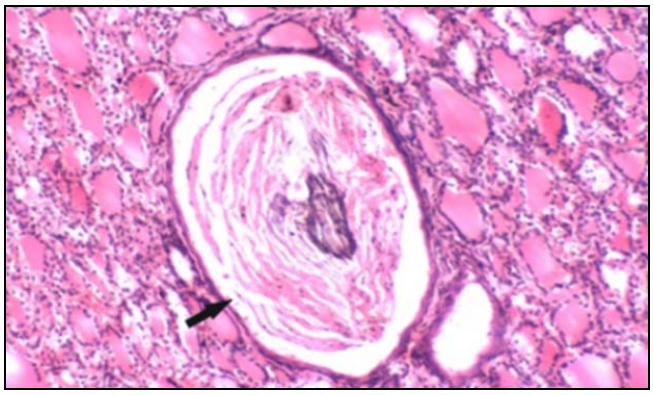

Fig 3: Squamous metaplasia, keratin, mineralization and cellular debris in the lumen of an ultimobranchial cyst (arrow) H & E x 200

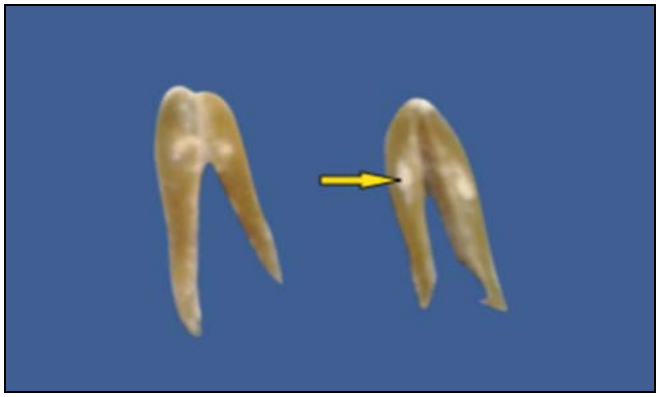

Fig 3: Ultimobranchial cysts (arrow) grossly recognizable in the hilar region of longitudinally sectioned thyroid lobes.

Conclusion

Histopathological features of ultimobranchial cysts recorded in the thyroid glands from goats were studied. They occurred with equal frequency in the left and right lobes and accounted for 29.31% (85) lobes. Although incidental, the ultimobranchial cysts may have a role in the development of other pathological conditions of the thyroid gland.

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