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View from Beneath: Pathology in Focus

Ossification of the epiglottis

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Abstract
The epiglottis is formed of elastic cartilage. Unlike the hyaline cartilage which forms the thyroid cartilage, cricoid and arytenoids, the elastic cartilage of the epiglottis does not undergo ossification with age. A case of ossification of the epiglottis is presented and heterotopic ossification in the head and neck is discussed.

Case report

A 71-year-old man with a history of cerebrovascular disease and deep vein thrombosis collapsed and died unexpectedly. At necropsy he was found to have severe occlusive coronary artery atheroma and systemic hypertension. Examination of the larynx revealed a rigid epiglottis.

When 69 years of age he had been found to have iron deficiency anaemia. At this time his serum calcium was normal. The only medication he had been prescribed was warfarin. Radiology of his spine showed Paget's disease of the fourth lumbar vertebra.

Pathology

The epiglottis was difficult to cut and required decalcification

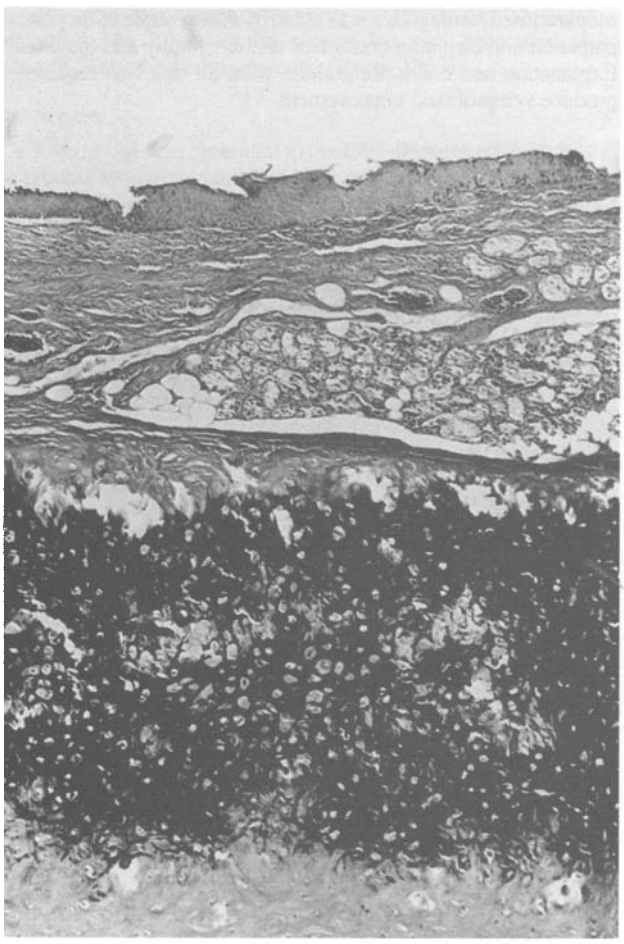

FIG. 1
Normal epiglottis with prominent elastic cartilage. Elastic van Gieson ×40.

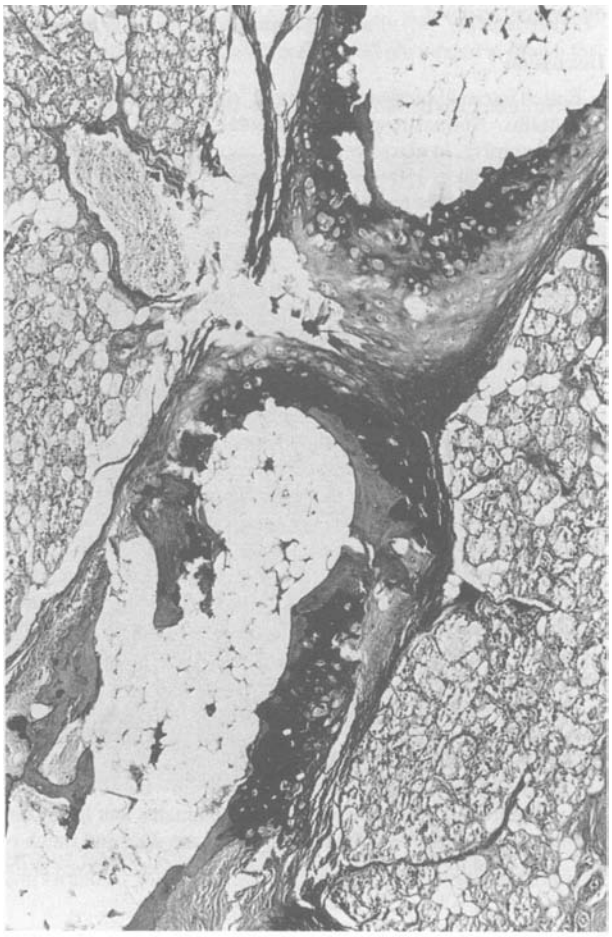

FIG. 2
Elastic cartilage of the epiglottis partially replaced by lamellar bone. Bone marrow is present. Elastic van Gieson ×40.

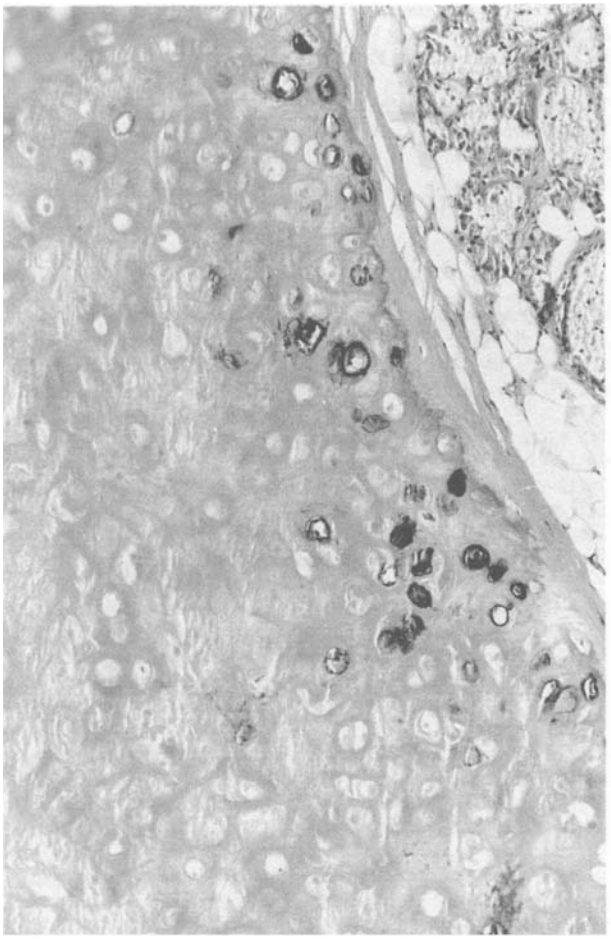

FIG. 3

Elastic cartilage of the epiglottis showing calcification of chondrocytes. Haematoxylin and eosin ×100.

to allow histological sections to be made. These showed the normal elastic cartilage (Fig. 1) of the epiglottis replaced by lamellar bone (Fig. 2). Bone marrow was present in some areas (Fig. 2). Where elastic cartilage was present, calcification of the chondrocytes could sometimes be seen (Fig. 3).

Discussion

The larynx is composed of a cartilaginous framework. Cartilage is found in a number of forms, hyaline cartilage, fibrocartilage and elastic cartilage. Hyaline cartilage is the most widely distributed as articular cartilage. Fibrocartilage is found in the menisci of the knee, the annulus fibrosus and at the insertions of ligaments and tendons in to bone. Elastic cartilage is found in the ligamentum flavum, the external ear and the Eustachian tube. In the larynx, the thyroid, cricoid and arytenoid cartilages are composed of hyaline cartilage. The epiglottis, corniculate and cuneiform cartilages are elastic. The body of the arytenoid is also formed of elastic cartilage. Fibrocartilage and elastic cartilage mechanical function is different to hyaline cartilage, functioning principally as resistors of tension. Hyaline cartilage is subject to and resists compressive forces. The hyaline cartilage of the larynx ossifies with age to a certain degree in all adults, and increases with age. It usually starts in the thyroid cartilage, followed by the cricoid and occurs last in the arytenoids (Taylor, 1935). Woven bone is formed first followed by lamellar bone. Elastic cartilage does not normally undergo ossification as an ageing process.

Bone is formed in two ways: by endochondral ossification and by intramembranous ossification. In endochondral ossification which is typified by long bone ossification, a cartilage model grows first. The cartilage cells then swell while the intercellular substance of the cartilage becomes basophilic and calicifies. The swollen chondrocytes are removed by macrophages and woven bone is laid down in the lacunae that are opened up. Calcified cartilage becomes interwoven with the newly formed bone and is eventually removed. The second form of ossification is intramembranous ossification where there is bone formation without a preceding cartilaginous substrate. This form of ossification occurs in flat bones such as ribs and the mandible. In both forms of ossification the woven bone initially formed is replaced by lamellar bone. Heterotopic bone formation can be produced experimentally by a number of mechanisms, including trauma, induction from living cells and with extracts of bone and teeth. In the first two types the mechanism of induction is unknown. In the latter a specific inducer substance, bone morphogenetic protein (BMP) has been isolated. When implanted into a heterotopic site, BMP induces undifferentiated mesenchymal cells into a bone morphogenetic pathway of development, causing heterotopic bone to be formed. BMP initiates a cascade of events which is modified by endocrine and paracrine factors. The bone produced histologically and biochemically has all the characteristics of normal bone, including the formation of bone marrow (Ekelund *et al.*, 1991).

Calcification and ossification of elastic cartilgae have been recorded in the pinna, giving rise to the term 'the petrified auricle'. This subject was reviewed by DiBartolomeo (1985). He found nine cases in the literature where ossification had been confirmed histologically and added a further two cases. In these cases, there was frequently a history of cold injury, and this was postulated as a predisposing cause of ossification. Calcification of the cartilage was more frequently associated with the petrified auricle and a number of conditions were associated with this, including frostbite, hypothyroidism, Addison's disease, hypopituitarism, trauma, radiotherapy, acromegaly, diabetes mellitus, ochronosis ansd disorders of calcium metabolism. Cohen *et al.* (1989) and Talmi *et al.* (1990) have recently reported further cases of the petrified auricle in association with Addison's disease.

Heterotopic ossification is seen in the respiratory tract in the condition tracheopathia osteochondroplastica (Michaels, 1987a). In this condition ingrowths of cartilage derived from the tracheal rings occurs and ossification frequently takes place. This gives rise to irregular protuberances into the lumen of the airway. The cricoid cartilage may be involved in this process. Metaplastic cartilage formation has been reported in the soft tissues of the epiglottis (Lee and Ramsey, 1990).

Ossification of the epiglottis would appear to be a most unusual event. Nineteenth century anatomists recognized ossification of laryngeal cartilages, but did not see ossification in the epiglottis (see Taylor, 1935) and Michaels (1987b) states in his book on histopathology o f the ear, nose and throat larynx that ossification of the epiglottis does not occur. Ossification of the elastic cartilage must therefore represent heterotopic ossification, a pathological process in which bone is formed in tissues which do not normally ossify. The cause of the heterotopic ossification in this case remains unknown and did not apparently have any ill effects.

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