



Liesegang rings: The misnomer in calcifying epithelial odontogenic tumor?

Abstract

Calcifying epithelial odontogenic tumor (CEOT) is a benign epithelial odontogenic tumor which is characterized by the presence of islands and sheets of epithelial cells, amyloid like material and calcifications. These calcifications have a concentric lamellar pattern because of which they have been known by some as liesegang rings. However, classic liesegang rings seen in other extragnathic sites though have a lamellated pattern are different in composition as well as appearance. This brief communication aims to highlight the key differences between liesegang rings seen in other lesions with that of those seen in CEOT.

To the editor,

Calcifying epithelial odontogenic tumor (CEOT) is a rare benign odontogenic neoplasm of epithelial origin. Histologically, it is characterized by the presence of sheets and islands of epithelial cells, acellular, eosinophilic amyloid like material and the striking pathognomic calcifications from which the tumor derives its name.^[1] These calcifications have been described as having a concentric lamellar pattern and have been called as liesegang rings (LRs).^[2] We will refer to these rings as CEOT-LRs in this article.

The term LR is attributed to the German biochemist RE Liesegang who first described the liesegang phenomenon in 1896. He observed, *in vitro*, concentric, laminated rings produced by the periodic precipitation of certain chemicals around a central nidus in colloidal gels.³ Although, the term LR is used for the calcifications in CEOT, LR in other sites (Classic LR) are quite different.

Classic liesegang rings (CLRs) are acellular, laminated structures which are known to occur in cystic, hemorrhagic, inflammatory, and necrotic tissue processes. These rings characteristically have central amorphous cores which are surrounded by peripheral concentric layers with radial cross striations. Although they can be of variable shapes, they are usually spherical and can range in size from 5 to 800 μm. The laminated nature of these rings is further accentuated by papanicolaou, hematoxylin and eosin, Diff-Quick, Masson's Trichrome, and Gram's stain.^[3-5]

Although this phenomenon is common *in vitro*, *in vivo* occurrence is rare but similar physicochemical factors may be involved, including chemical concentration, matrix medium, temperature, pH and the presence of impurities.^[6] Nucleating

particles decrease the concentrations of soluble products in the surroundings leading to decrease in the nucleation rate and precipitation between adjacent regions of sub and super saturation resulting in the formation of ring-shaped structures.^[7] They can accompany various lesions such as renal, breast, eyelid, conjunctival cysts, necrotic renal tissue, inflamed synovium, peritoneal endometriotic implants, and mucocele of the paranasal sinuses. The largest reported series has been in the kidneys of 29 cases.^[8] The exact composition of these rings is not known with immunohistochemical and histochemical analysis for keratin, mucopolysaccharides, amyloid, glycogen, and epithelial membrane antigen yielding negative results.^[3] However, studies regarding the presence of iron, calcium, and hemoglobin have yielded variable results.^[5]

Comment

A brief search of literature reveals that the use of the term "liesegang rings" in tumors has been exclusively restricted to odontogenic tumors that is mainly in CEOT. However, the only common facts between the CLRs seen in other sites and that of CEOT-LRs are the concentric lamellar structure. On the contrary there appear to be many differences between the two, the following of which are explained below:

1. Under hematoxylin and eosin stain CEOT-LRs are basophilic in nature while CLRs are eosinophilic. In fact, CEOT-LRs have been reported to be psammoma like especially under FNAC while psammoma bodies, which are also basophilic, are to be considered in the differential diagnosis of CLRs.^[3,9]
2. Calcifications in CEOT are of the dystrophic type wherein the calcification occurs around degenerating epithelial cells. CLRs, on the other hand, have been reported to consist more of organic matrix and studies on the presence of calcium in these rings have yielded varied results with these structures even staining negative for Von Kossa. They are thought to develop as a result of hemorrhage or periodic deposition of organic materials derived from necrotic tissue.^[10]
3. CLRs are known to be negative for amyloid while LR of CEOT are frequently found to be arising in the amyloid areas.
4. Slootweg has reported some calcifications in CEOT which are more cementum like. These they suggested resembled the cementicles seen in the periodontal ligament. However,

they reported that during the calcification of amyloid the congo red positivity was lost in these cementum like calcifications.^[11] El-Labban suggested that the outer layer of these calcified bodies consisted of typical banded collagen with an arrangement like that seen in Sharpey's fibers of cementum.^[12]

5. Although LRs are considered to be pathognomic to CEOT when it comes to odontogenic lesions, this term has sometimes been used for adenomatoid odontogenic tumor (AOT) where concentric lamellar calcifications have also been reported. In fact, the AOT/CEOT hybrid lesions have been reported to have LRs.[1] Scivetti *et al.* studied LRs in odontogenic cysts using confocal laser scanning study.^[13] However, we felt that these structures which they referred to as LRs were actually the Rushton bodies or hyaline bodies seen in radicular cysts.

Although many authors of published reports of CEOT use the term liesegang rings for these calcifications, others have used terms such as "liesegang calcification pattern," "liesegang ring calcifications," and "liesegang calcification" which appear to be more apt for these calcifications.^[1,14,15]

To conclude, we question the use of the term "liesegang rings" when it comes to CEOT because the etiology, the appearance, staining patterns, etc., all seem to be different. These calcifications are formed due to a liesegang like phenomenon rather than being true classic *in vivo* liesegang rings. We suggest that the term "liesegang pattern of calcification" to be more appropriate when it comes to the presence of concentric lamellar basophilic calcifications found in odontogenic tumors.

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