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Review Article

Dentistry Section

Rushton Bodies: An Update

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ABSTRACT

Rushton bodies are peculiar, eosinophilic, linear, curved or straight, polycyclic, glassy structures occurring with variable frequency in the epithelial lining of odontogenic cysts, whose presence occasionally contributes to the diagnosis. Presence of these structures depends upon the sectioning plane of specimen. They are easily identifiable by their peculiar morphological and staining patterns. There is considerably ambiguity about the nature and epithelial, vascular, odontogenic or keratinous origin of these hyaline bodies. This article highlights the occurrence, light and electron microscopic features and histogenesis of Rushton bodies.

Keywords: Hyaline bodies, Odontogenic cysts

INTRODUCTION

Rushton bodies are seen exclusively in odontogenic cysts and are most commonly observed in radicular cysts with a reported frequency of 10% followed by dentigerous cysts (4-10%) and odontogenic keratocysts (OKC) (7%) [1,2]. Though these are restrictedly expressed in odontogenic cysts, one case of plexiform ameloblastoma was reported, by Takeda et al., [3].

In majority of the cases encountered, hyaline bodies are confined to the cystic epithelium only, which appear as small, white smooth dome-shaped swellings protruding into the cystic cavity [3]. Morgan and Johnson observed that, the epithelium surrounding these bodies is invariably non-keratinized and even in keratinized cysts like OKC, keratinisation abruptly ended at the zones of Rushton bodies [4]. They rarely occur in the fibrous capsule [2].

These hyaline bodies were first noted by Dewey in 1918 and were mentioned in early literature by Lund in 1924. But they were described in detail by Martin A Rushton in 1955. Hence these hyaline bodies are named as Rushton hyaline bodies or Rushton bodies [1,4-7].

Though they are of little diagnostic use, their specific association with the epithelial lining of odontogenic cysts strongly implicates the role of odontogenic epithelium in the genesis of these structures. However little is known about what stimulates their production and their low incidence suggests some rare local events to be the cause [8].

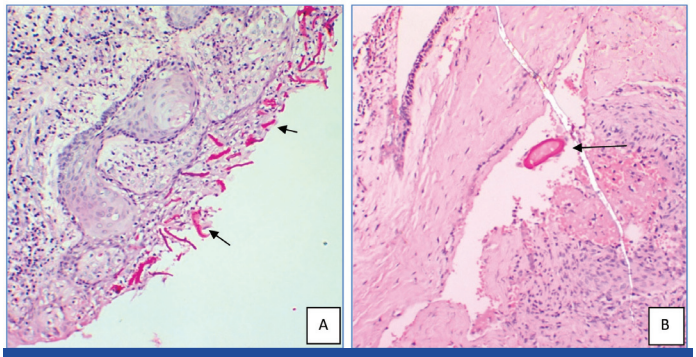
MORPHOLOGY

According to Rushton they are eosinophilic bodies measuring 0.1mm in length and having certain characteristic shapes which may occur singly or admixed. He described three morphologic patterns. One is linear, straight or curved into various types sometimes like a hairpin [Table/Fig-1a]. The second type of appearance is like broken up pieces of plate and the third is circular [Table/Fig-1b] or polycyclic agglomerations, sometimes laminated [7]. Later, a fourth pattern of morphology was described by Morgan and Johnson as an elongated type, lining cleft like spaces, which are probably cholesterol clefts [4].

Importance of knowing the morphology of these structures lies in differentiating them from other bodies with considerable histological similarity, especially the Russell bodies. These structures can be differentiated by their typical homogenous nature, round shape and PAS positivity which are not observed in rushton bodies [9].

Ultrastructurally, two types of hyaline bodies can be identified that is the lamellated and homogenous types. The lamellated type shows alternating electron dense and electron lucent areas which may be straight, curved, irregular or polycyclic. The peripheral band is always electron dense. The number of bands varies between different bodies and the thickness varies between band of different bodies as well as in different areas in the same body. The homogenous type presents as electron dense homogeneous bands surrounding various structures such as granular material, mineralised masses and cholesterol clefts [4,10,11].

Hyaline bodies are attached to the plasma membrane of the adjacent epithelial cells via hemidesmosomes and show a homogeneous electron dense layer (35 nm thick) resembling lamina densa of the basement membrane. Electron dense fine granules, resembling ferritin granules are frequently seen in the cytoplasm of epithelial cells near hyaline bodies [4,10,11].



[Table/Fig-1]: Rushton bodies (arrows) in the epithelium of Radicular cyst (20x objective). a) Showing linear and curved types. b) Showing circular type

STAINING

Hyaline bodies are eosinophilic and take up gram negative staining. They give positive reaction with various stains [Table/Fig-2] [4,7,10,11].They give negative results for Von Kossa's method for calcium and Periodic Acid Schiff method for mucopolysaccharides. On immunohistochemical staining they show positivity for hair keratin, keratin 17 and haemoglobin α chain [5]. They appear blackish brown and refractile on staining with CD44 [12].

ORIGIN

Hyaline bodies are morphologic curiosities present within the epithelial linings of odontogenic cysts. Although of no much diagnos-

tic value, the presence of these bodies has stimulated a variety of studies to determine their origin, structure and possible role in the pathogenesis. They have generated most interest as they are not readily associated with other local lesions and appear to be specific to odontogenic cysts [8].

- Prussian blue (pale to strong reaction)
- Aldehyde fuschin (positive after oxidation with permanganate)
- Combined Aldehyde fuschin- Alcian blue method (strong purple)
- Tannic acid phosphomolybdic acid-Amido black (light blue to black)
- Papanicolaou stain (orange G)
- Masson's trichrome (red)
- Weigert's elastin solution
- Orcein
- Modified Mallory's stain for keratin
- Rhodamine B
- Thioflavine T
- Congo red

[Table/Fig-2]: Positive stains for Rushton bodies

There is certain amount of uncertainty regarding the origin of Rushton bodies. It was first noted by Dewey (1918), who considered them to be originating from hyaline degeneration of newly formed capillaries. Rushton (1955), who described them in great detail, has noted a similarity between hyaline bodies and secondary enamel cuticle of Gottlieb in appearance and the liability to fracture and suggested that they might be composed of keratin or keratin like substance [2,13].

Medak and Weinmann (1960) observed that the hyaline bodies are similar to cotton fibres and suggested that it could be material left behind during previous surgery but many cysts with hyaline bodies were reported in patients with no history of surgical interventions. Wertheimer et al., (1962) found histochemical similarities between hyaline bodies and keratin and hence supported the view that these bodies are a secretory product of odontogenic epithelium and are formed in a manner similar to that of secondary enamel cuticle [2,5,10].

Bouyssou et al., (1965) and Sedano et al., (1968) believed that hyaline bodies were of haematogenous origin as they exhibited histochemical reactivity for haemoglobin. They suggested that Rushton bodies are derived from the thrombi in the varicose venules of the connective tissue strangulated by the proliferating epithelium. Dent et al., (1967) stated that the histochemical reactions were not specific for haemoglobin [2,5,10].

Browne and Matthews (1985) conducted a study in which 14 dental cysts containing intraepithelial hyaline bodies were stained for keratin, factor VIII related antigen, haemoglobin and fibrinogen using immunoperoxidase techniques. All the tested antigens were negative for all the sections excepting fibrinogen which was detected in the cores of some circular and polycyclic forms. Their observations neither supported the keratinous nature nor the haematogenous origin of the hyaline bodies. However they proposed that the core staining for fibrinogen supports that these bodies are produced by cellular reaction to extravasated serum [2,14].

If it is to be agreed that the hyaline bodies are of vascular or haematogenous origin, the puzzling feature about their distribution is that they are rare in the connective tissue and more often seen in the epithelial lining which is devoid of blood vessels. And if their pathogenesis is as described then more surprising is that they are exceptionally rare in lesions other than odontogenic cysts [2].

Sakamoto et al., (2012) demonstrated that hyaline bodies are amyloids that are formed as a consequence of two independent biologic events: one being the unusual alteration of the epithelial differentiation so as to provide hair keratin and the other is haemorrhage so as to provide haemoglobin. Their results hence reconciled the long standing debate between the two theories i.e., keratinous nature vs. the haematogenous origin, thus concluding that both the substances are required for genesis of hyaline bodies [6].

Observations following ultrastructural studies by Jensen and Erickson (1974) did not support either the epithelial cell production or haematogenous origin of the hyaline bodies and they also demonstrated that the hyaline bodies are not composed of keratin and neither do they bear any structure similarity to secondary enamel cuticle [5].

Morgan and Johnson (1974) concluded that hyaline bodies are a secretory product of odontogenic epithelium deposited on the surface of particulate matter, such as cell debris or cholesterol crystals, in a manner analogous to the formation of dental cuticle on the unerupted portions of the enamel surfaces. There was no evidence in favour of either a keratinous or haematogenous origin [4].

El-Labban (1979) suggested that the granular type is from degenerating RBCs and the lamellar pattern may result from segregation of components within the mass rather than by an incremental form of growth. No opinion was expressed regarding the keratinous nature of hyaline bodies and neither to the view that they were a secretory product of the odontogenic epithelium [15].

Philippou et al., (1990) showed that hyaline bodies are a product of epithelium of odontogenic cysts and have direct contact to the outer layer of the adjacent cyst epithelium via its intercellular bridges [16].

Histochemical studies by Morgan and Johnson gave results which were supporting the fact that hyaline bodies are probably unrelated to keratin production although the participation of odontogenic epithelium in their formation remained likely because they were not found in non-odontogenic cysts [4]. Reactions of structures in the study by Kulkarni et al.,(1980) showed that they were similar to dental cuticle but differed from keratin [9].

Microradiographic analysis by Allison (1977) showed that there is progressively increasing density of hyaline bodies towards the core. Isodensitracing confirmed the laminar configuration of hyaline bodies and these findings hence confirmed the hypothesis that hyaline bodies originate as an epithelial secretion [17].

CONCLUSION

Rushton hyaline bodies are eosinophilic bodies of various shapes seen in the epithelium of odontogenic cysts and are believed to represent a secretory product of odontogenic epithelium. Though many histological, histochemical and ultrastructural studies have been conducted, since the discovery of these bodies almost seven decades ago, to confirm the origin of Rushton bodies, till date their histogenesis has not been elucidated.

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