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Research Paper

Bodies In Histopathology: Bringing To Light

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Abstract
The histopathological evaluation of the tissue includes a detailed study of cellular and nuclear structures and their altered presentation in a given pathology. It has been observed that various histopathological bodies are seen in different pathologies. Their presence is often an important diagnostic-aid in identifying the underlying disease. The histopathological bodies are helpful for diagnosing, staging, treatment planning and also predicting the prognosis of the disease. The present paper is an attempt to compile, collate and describe the well-known as well as the lesser-known histopathological bodies.

Keywords: *Histopathology, cellular bodies, nuclear bodies*

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I. Introduction

In histology, bodies are broadly classified into the following categories:
1. Naturally occurring body - a mass of matter found anatomically or physiologically in organs and tissues.
2. Foreign body - a mass or entity that has been introduced from an external source. In other words, any mass found in an organ or tissue in which it does not normally belong.
3. Inclusion body - an abnormal structure in a cell nucleus or cytoplasm having characteristic staining properties and usually associated with certain pathological conditions such as bacterial and fungal infections.
4. Viral inclusion body - an abnormal structure that appears within the cell nucleus, the cytoplasm or both during the course of virus multiplication. These are generally concerned with the developmental processes of the infective virus.
The presence of histopathological bodies is often an important diagnostic-aid in identifying the underlying disease. In many diseases and disorders in pathology, there are some characteristic microscopic features which may be observed as striking alterations in the cellular and/or nuclear morphology, intracytoplasmic or intranuclear contents or deposits and changes in the spatial orientation of cells and the extracellular matrix.

1. Asbestos body

They are crystalline hydrated silicates that form fibers. It Causes localized fibrous plaques, pleural effusions, parenchymal interstitial fibrosis (asbestosis), bronchogenic carcinoma, mesothelioma, laryngeal carcinoma and possibly colon carcinoma. There is increased incidence of mesothelioma in families of asbestos workers. It exists in serpentine / chrysotile (curly, flexible) and amphibole (straight, stiff, brittle) forms; most asbestos in industry are serpentine, but amphiboles are more pathogenic; link with mesothelioma is almost always with amphibole form.

Asbestosis is a chronic, progressive interstitial lung disease caused by inhaling asbestos fibers, which were widely used in construction, shipping, and aerospace industries due to their durability and heat resistance. Once inhaled, these fibers can cause lung tissue scarring, leading to symptoms like shortness of breath, persistent cough, and chest pain. If left untreated, this condition can result in severe respiratory complications, including pulmonary fibrosis and an increased risk of lung cancer or mesothelioma[1,2].

2. Asteroid body

Asteroid bodies are star-shaped inclusions usually 20-20 µm and 20 radiate arms in the cytoplasm of multinucleated giant cells first described in1890. Cunningham who reported in 1951, said that these bodies have organic protein structure possibly complex lipoproteins. About 40 years ago, it was discovered that the shape of asteroid bodies in Langhans-type giant cells is determined by the structure of the cytosphere, an ordered central

subcellular structure consisting of a pool of centrioles, radiating microtubules, and radially arranged Golgi networks. In the 1990s, other investigators observed that the halo of clear vacuoles around the asteroid body contains loosely arranged myelin membranes, possibly representing excessive remnants of cellular membranes formed after the fusion of activated histiocytes. Asteroid bodies are not pathognomonic for a single disease, as these structures may be encountered in various granulomatous inflammatory conditions, including sarcoidosis, amyloidosis, tuberculosis, foreign body-type granulomas, and mycotic granulomas. In hematoxylin and eosin-stained light-microscopic preparations, asteroid bodies are strongly eosinophilic and surrounded by a halo of small clear vacuoles. Their bright red color reflects a high protein content, whereas the halo of clear vacuoles likely represents an artifact due to dissolved lipid material[3,4].

3. Barr body

In mammals, males are heterogametic (XY) and females homogametic (XX). One might therefore expect a '*double dose*' of gene products on the X chromosome in females. Dosage compensation is achieved by random inactivation of one of the two X chromosomes in females. The heterochromatized X chromosome appears as a darkly-staining body attached to the nuclear membrane present in females and absent in males. The phenomenon was first described in cats by Dr Murray L. Barr, a Canadian cytogeneticist, and the heterochromatin X chromosomes are now called Barr Bodies. X chromosomes are found on both X chromosomes in males and females. Female somatic cells really aren't implicated in sexual reproduction in the same way male somatic cells are. Lyonisation is used to inactivate one of several two X chromosomes in this case. It is understood as a Barr body when this X chromosome is inactive. Mary F. Lyon, a British geneticist, was the first to discover the X-inactivation procedure.

Barr body testing was used in the 1968 Olympic games in an effort to detect male athletes supposedly trying to "*pass*" as females to gain a competitive advantage. Systematic assessment of Barr body stability identified age-specific reactivation at distal chromosome regions, which probably promotes gene escape. The subsequent increase in expression of conserved and disease-relevant genes in females might provide additional insights into sex-specific disease mechanisms, complementing the role of hormones in explaining sex biases in age-related disease[5].

4. Councilman body

Councilman bodies found in hepatic cells of A.s.seniculcus, naturally infected with yellow fever virus, are identified with the electron microscope. At the fine structure level, these bodies show no limiting membrane or internal vacuole membrane. The only constituents found are particles of different sizes presenting different osmium affinity. There are no lipid droplets or membranous components present within the bodies. No yellow fever virus particles are found in Councilman bodies; thus their formation is not a direct consequence of the presence of viral particles. Named after American Pathologist WIlliam Thomas Councilman, this is also known as Apoptotic body or Councilman hyaline Body. It is an eosinophilic globule that represents a hepatocyte undergoing apoptosis and sometimes necrosis. It is seen most commonly in Yellow fever and other viral hemorrhagic fevers. Also seen in liver biopsy of patients with viral hepatitis along with mid zonal necrosis and lymphocytic infiltration[6].

5. Dutcher body

Dutcher bodies which resemble nuclear inclusions are actually invaginations of cytoplasm into the nucleus. Dutcher bodies are PAS-positive, diastase-resistant nuclear pseudoinclusions. These are strongly associated with low-grade malignant lymphomas, particularly lymphoplasmacytic lymphoma; mucosa-associated lymphoid tissue (MALT)-type lymphoma, or myeloma. Neoplastic plasma cells vary from mature-appearing plasma cells to blast-like cells. Plasmablasts have a high nuclear cytoplasmic ratio, fine nuclear chromatin and variably prominent nucleoli. Occasional plasma cells with Dutcher bodies may be seen in reactive processes, but large numbers should raise the suspicion of a malignant plasma cell dyscrasia. Dutcher bodies are "rarely seen in reactive proliferations" and are "only rarely, if ever, identified in lymphoid hyperplasias. To the best of the author's knowledge, Dutcher bodies have not been described before in plasmablastic myeloma patients[7].

6. Fibrous body

Fibrous bodies are a feature of acidophil and chromophobe adenomas and are usually associated with acromegaly. Ultrastructural examination revealed round juxtanuclear filamentous aggregates, composed of 8-nm filaments and other organelles. Fibrous bodies are thought to be of myofibrillar origin and are composed of tightly packed actin-like filaments. Vacuole-type structures have been reported in biopsy-proven dermatomyositis. Fibrous bodies composed of type II microfilaments with an average width of 115 Å. These spherical structures, measuring up to 4–5 μm occur exclusively in sparsely granulated growth hormone cells and acidophil stem

cells, but as revealed by the immunoperoxidase technique, contain no growth hormone. Fibrous bodies are located in the Golgi region and are consistently associated with Golgi membranes and smooth-surfaced endoplasmic reticulum. Their association with centrioles is thought to be anatomical rather than functional. Several adenoma cells possess spherical formations composed entirely of smooth-walled membranes or transitional forms between smooth tubules and type II microfilaments, suggesting that smooth membranes may play a key role in the production of fibrillar substance. Fibrous bodies appear to be reliable morphologic markers and are valuable in the differential diagnosis of pituitary adenomas[8,9].

7. Gamna Gandy body

Gamna-Gandy bodies (GGBs), also called tobacco flecks or siderotic nodules, appear as yellow-brownish and spheroidal foci within the splenic parenchyma, are composed of deposits of iron pigments and calcium salts, and are associated with granulomatous inflammatory reactions with multinucleated foreign-body giant cells and fibrous tissues. GGBs can vary in size, ranging from 10 to 49 microns in the largest dimension. The first description of GGBs dates back to 1902 when Marini described the siderotic nodules in the spleen. Three years later, the French physician Charles Gandy found these structures in the spleen of a patient with biliary cirrhosis, but the significance of these structures was not elucidated. In 1910, the same finding was described in the lung during the autopsy of a patient who died of endocarditis. At that time, GGBs were associated with a fungal etiology since they microscopically resembled spores. In 1921, the etiology of this pathological finding was better described when Carlos Gamna, an Italian pathologist, found GGBs in the spleen of a patient who died of chronic hemolytic anemia. Gamna observed that the amorphous material was composed of iron and calcium sulfate deposits and was therefore named *Splenogranulomatosi siderotica*. In 1963, the name "Gamna-Gandy bodies" became established and has been widely used ever since. They are seen in portal hypertension, sickle cell disease, and various carcinomas.[10,11]

8. Gupta bodies

Gupta bodies: Also called "dust bunnies," these are aggregates of filamentous, branching material with a woolly appearance with club formation at one end and seen in cervical smears in women, infected with *Actinomyces israelii* as a result of long-term use of intrauterine contraceptive devices[12].

9. **Hamazaki-Wesenberg body** (alternatively termed yellow-brown bodies, yellow bodies, Hamazaki corpuscles)

They are structures of unknown significance, which have been documented in the sinuses of lymph nodes in numerous anatomic locations and myriad medical conditions, including appendicitis, cirrhosis, lymphoid tumours, colon carcinoma and numerous others, most famously sarcoidosis. Initially described by Hamazaki in 1938 in mesenteric lymph nodes, and later noted by Menne in 1952 in 70% of mesenteric lymph nodes removed during appendectomies, there was renewed interest in these formations in the 1960s when it was hypothesised that these bodies were specific for sarcoidosis. Hamazaki-Wesenberg bodies present a potential pitfall for cytopathologists unfamiliar with the characteristics of these bodies and the resemblance of some abutting forms to fungal organisms[13].

10. Hirano bodies

These are brightly eosinophilic 15-30 μm in length,rod-shaped or elliptical cytoplasmic inclusions that may appear to overlap the edge of a neuron. They are immunoreactive for actin, actin-associated proteins, and caspase-cleaved TDP43. Ultrastructurally, Hirano bodies consist of a regular lattice of multiple layers of parallel 10–12 nm filaments, the filaments in one layer being transversely or diagonally oriented with respect to those in the adjacent layers.

Hirano bodies are most numerous in the CA1 field of the hippocampus. Their density in the stratum lacunosum increases until middle-age and declines gradually thereafter, except in chronic alcoholics, in whom the density may continue to increase. In the elderly, the number of Hirano bodies increases in the stratum pyramidale, and they are particularly numerous in this region in Alzheimer disease, Pick's disease, neurogenerative disorders, some sub-types of Creutzfeldt–Jakob disease, and Guam parkinsonism–dementia[14,15].

11. L D Body

Leishmania donovani is a flagellated protozoa in the sandfly and a non-flagellated (amastigote) intracellular organism in the cytoplasm of the reticulo-endothelial cells in humans. The oval nucleated amastigotes within the bone mrrow, liver, spleen or lymph nodes are known as Leishman-Donovan (LD) bodies. Leishmania Donovani (LD) Bodies Detection is a diagnostic test performed to detect the presence of the Leishmania donovani parasite in the body. Leishmania donovani is responsible for visceral leishmaniasis, also known as kala-azar, which is a potentially fatal disease if left untreated. This disease is characterized by

irregular bouts of fever, substantial weight loss, swelling of the spleen and liver, and anemia. Theses bodies can be stained by Giemsa or Wright stain[16].

12. M G Body

They are basophilic intracytoplasmic inclusions in macrophages. The inclusions have a small, round laminated appearance that are formed from a mixture of calcium, iron, phosphorus, and organic matter. Certain stains including AB, PAS, von Kossa, and Prussian blue can clearly show M-G bodies. Electron microscopy indicates that the cells contain a large number of phagocytic lysosomes and layered crystals, and occasionally bacteria. MG bodies contained either lecithin or sp'hingomyelin and in three both phospholipids were present. There was no evidence of phospholipid of bacterial cell membrane derivation. Carbohydrate staining reactions suggested the presence of a neutral polysaccharide and an acidic non-suiphaied polysaccharide (such as a sialoglycan)[17].

13. Medlar Body

Also known as copper penny bodies , muriform bodies and sclerotic cells are golden brown, spherical 6-12 μ in size thick-walled cells (5–12 microns) with multiple internal transverse septa or chambers that resemble copper pennies. These are characteristic thick-walled, single, or multicellular clusters of pigmented fungal cells seen in Chromoblastomycosis[18].

14. Oval fat body

They are a common finding in the sediment of patients with higher grade proteinuria. They represent desquamated tubular epithelial cells or macrophages that are full to the brim with lipid droplets. The cellular lipid accumulation probably results from uptake of free fatty acids (FFA) complexed to albumin. These FFA are readily metabolized to triacylglycerol and cholesterol esters and stored in lipid droplets, possibly to protect the cells from harmful effects of free fatty acids. Given their pretty unique morphology, identification of oval fat bodies by phase contrast or bright field microscopy is usually straightforward. Presence can be confirmed by demonstrating the typical birefringence ("Maltese cross") of lipid droplets under polarized light**.** The histology shows tubular epithelial cells with fatty changes or foam cells of monocyte/macrophage lineage. Their presence is a sign of high grade IgA nephropathy. Sudan III can be used for staining[19].

15. Papillary mesenchymal body

They are distinct fibroblastic aggregations that represent abortive attempts to form the papillary mesenchyme responsible for hair induction. Papillary mesenchymal bodies were observed in 93% of all trichoepitheliomas, 7% of all keratotic BCC, and 0% of all routine BCC. Papillary mesenchymal body formation is an easily recognizable histologic criterion that is more reliable in differentiating these two tumors than standard criteria, including epidermal connections, keratinization, calcification, foreign body reaction, fibrosis, stromal retraction, tumor mucin, ulceration, frond like epithelial pattern, and the inflammatory response[20].

16. Pustule ovoid body of Milan

They are larger granules surrounded by a clear halo appear to represent the heterogeneity of the lysosomes, giving the appearance of large granules that have partially detached from the adjacent cytoplasm. POB are an easily recognizable component of Granular Cell Tumors[21].

17. Russel body

Russell bodies are eosinophilic spherical or globular cytoplasmic inclusions that accumulate in the rough endoplasmic reticulum of mature plasma cells. These plasma cells containing Russell bodies are also known as Mott cells. Mott cells were first described in 1890 by William Russell ; however the first case of Russell bodies in the gastrointestinal tract was in the stomach and was not described until 1998 by Tazawa and Tsutsumi. Colorectal lesions containing Russell bodies are extremely rare or are probably underreported. Russell body is characteristic of the distended endoplasmic reticulum. Russell bodies are large and globular of varying size, and become packed into the cell's cytoplasm pushing the nucleus to the edge of the cell, and are found in the peripheral areas of tumors. Russell bodies are thought to have originated as abnormal proteins that have not been secreted. The excess immunoglobulin builds up and forms intracytoplasmic globules, which is thought to be a result of insufficient protein transport within the cell. This causes the proteins to neither be degraded or secreted and stay stored in dilated. Russell bodies were found to have positive reactions to PAS stain, CD 38 and CD 138 stains. Plasma cells that contain Russell bodies and are stained with H&E stain are found to be autofluoroscence and are seen in chronic inflammation, autoimuune diseases, plasma cell dyscrasias[22].

18. Schaumann body

Also known as conchoidal bodies, are round or oval, laminated calcified structure 150 micrometre in diameter, most commonly found in sarcoidosis, tuberculosis, Crohn's disease, chronic beryllium disease and lymphogranuloma inguinale. The first documentation of the Schaumann bodies in the literature was described by Jorgen Nilsen Schaumann in 1941. They are basically the inclusion bodies that are composed of two basic elements, namely calcium carbonate crystals with a high refractive index. They are mostly found in the cytoplasm of multinucleated giant cells (MGCs) but not in epithelioid cells. These bodies are stained pink, brown, dark blue or black with routine haematoxylin and eosin. These inclusions are birefringent to polarized light[23].

19. Spironolactone body (S body)

They were first described by Janigan et al in 1963. They are solitary unique, eosinophilic, laminated, cytoplasmic inclusions found in the adrenal cortex of patients taking the medication spironolactone. They are seen as concentric whorls of smooth membranes arranged around a central core, often connected to the endoplasmic reticulum and mitochondria. Spironolactone, also known as 7α-acetylthiospirolactone is a synthetic mineralocorticoid antagonist. It is commonly used to treat heart failure, essential hypertension, cirrhosis, nephrotic syndrome, and primary and secondary hyperaldosteronism. Evidence suggests that these bodies are not merely artifacts of tissue processing, as they have been shown to react positively with antialdosterone antibodies[24].

20. Veocay body

Jose Juan Verocay (1876-1927) in 1910, first described the structure that was later named Verocay body and is considered diagnostic of a schwannoma. A typical Verocay body consists of a stacked arrangement of two rows of elongated palisading nuclei that alternates with acellular zones made up of cytoplasmic processes of the Schwann cells. The pathogenesis of the formation of this structure is explained by the overexpression of laminins in the cells that make up the Verocay body. Possibly the overexpression of laminins causes the alignment of nuclei of cells into a tight pattern of rows separated by acellular material inbetween. Conventionally the Verocay body has been associated with schwannomas. Striking formation of Verocay bodies in large areas of cutaneous neoplasms has been referred to as 'rippled pattern'[25].

II. Conclusion

Bodies in histopathology are present in different tissues of the body. The appearance, composition, and associated physiology of these bodies are specific. These structures appear within the cell nucleus or the cytoplasm or in both, and exhibit characteristic staining properties. Identification and reporting of them are important because their presence may indicate diseases or disorders.

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