Fibropapillomatosis in Marine Turtles: An Emerging Viral Threat to Conservation

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OPEN ACCESS

Keywords

Fibropapillomatosis, Chelonid herpesvirus 5, Marine turtles, Pathology, Neoplasia

How to cite this article:

Patel, S. and Mendake. A. 2026. Fibropapillomatosis in Marine Turtles: An Emerging Viral Threat to Conservation. *Vigyan Varta* 7 (05): 255-257.

ABSTRACT

Fibropapillomatosis (FP) is a globally emerging neoplastic disease of marine turtles characterized by the formation of cutaneous and visceral tumours. The condition is strongly associated with chelonid herpesvirus 5 (ChHV5), a double-stranded DNA virus belonging to the family *Herpesviridae*. FP predominantly affects juvenile green turtles (*Chelonia mydas*) and has reached panzootic proportions worldwide. Environmental stressors such as pollution, habitat degradation and immunosuppression are believed to influence disease expression. Pathologically, FP is characterized by epithelial hyperplasia, dermal fibroblast proliferation and intranuclear inclusion bodies. Although natural tumour regression has been reported, severe cases lead to functional impairment and mortality. This article summarizes the pathology and pathogenesis of FP and highlights its significance in marine turtle conservation.

INTRODUCTION

Marine turtles are ecologically important reptiles inhabiting tropical and subtropical marine ecosystem, yet their populations are increasingly threatened by anthropogenic activities and emerging diseases. Among these, FP has become a major concern due to its expanding global spread and impact on turtle health. First reported in the early 20th century, the disease has shown a dramatic

increase in prevalence since the 1980s and is now considered a panzootic condition affecting all seven species of marine turtles, particularly the green turtle (*Chelonia mydas*) (Jones *et al*., 2016).

FP is characterized by the development of benign fibroepithelial tumours affecting the skin, eyes, shell and internal organs. These proliferative lesions can compromise essential physiological functions such as feeding, vision and locomotion, thereby reducing survival chances in severely affected individuals (Kelley *et al*., 2022). The disease has been strongly linked to ChHV5, although its pathogenesis is complex and influenced by environmental and host-related factors (Herbst *et al*., 1999; Dupont *et al*., 2024).

Clinical and Epidemiological Correlation

FP predominantly affects juvenile turtles inhabiting coastal environments, with prevalence varying geographically and temporally, sometimes exceeding 50% in affected populations (Kelley *et al*., 2022). Clinically, affected turtles may show impaired vision due to ocular tumours, reduced feeding efficiency, locomotor difficulty and progressive weight loss. Although FP is not always directly fatal, severe tumour burden and secondary complications may lead to mortality.

Pathogenesis

The pathogenesis of FP is multifactorial, involving viral infection, environmental influences and host immune status. ChHV5, an alpha herpesvirus, is considered the primary etiological agent and is capable of establishing latent infections with potential reactivation under stress conditions (Rao *et al*., 2020). Lesion development is believed to progress through distinct stages: an early papilloma stage characterized by predominant epidermal proliferation, an intermediate fibropapilloma stage showing combined epidermal and dermal proliferation and a chronic fibroma stage marked by extensive dermal fibroplasia (Herbst *et al*., 1999; Rao *et al*., 2020). Environmental factors such as pollution, heavy metals and poor water quality are strongly associated with increased disease prevalence and may contribute by inducing immunosuppression, thereby facilitating viral replication and tumour development. Notably, not all ChHV5-infected turtles develop tumours, indicating that additional cofactors are required for disease expression (Dupont *et al*., 2024). Furthermore, spontaneous regression of lesions has been reported, suggesting a possible role of host immune responses in disease resolution (Kelley *et al*., 2022; Dupont *et al*., 2024).

Pathology

Gross Pathology

FP is characterized by single or multiple tumours that vary in size from small nodules to large masses measuring several centimetres in diameter. These lesions may be sessile or pedunculated and show diverse morphologies, including smooth, verrucous, or polypoid growth patterns, with coloration ranging from pale to dark depending on anatomical location and pigmentation (Jones *et al*., 2016). Tumours are commonly observed on external soft tissues such as the skin, eyelids, neck and flippers, but may also involve the carapace and plastron. In advanced cases, visceral tumours can develop in internal organs including the lungs, liver, kidneys, heart and gastrointestinal tract, often remaining undetected until necropsy but significantly impairing organ function (Herbst *et al*., 1999). Severe tumour burden may lead to obstruction of vision, restricted movement, interference with feeding, emaciation and increased susceptibility to predation and secondary infections (Kelley *et al*., 2022).

Histopathology

FP tumours are characterized by proliferative changes involving both epithelial and connective tissue components, with marked epidermal hyperplasia (acanthosis) accompanied by hyperkeratosis and prominent dermal fibroblast proliferation forming a dense fibrous stroma (Herbst *et al*., 1999). Degenerative alterations such as ballooning degeneration of epidermal cells and basal cell degeneration are commonly observed, often resulting in dermal-epidermal cleft formation, while in advanced or chronic cases, ulceration and necrosis may also be evident, collectively indicating a fibroepithelial neoplasm involving both epidermal and dermal components. A key diagnostic feature is the presence of eosinophilic intranuclear inclusion bodies, representing viral replication within host cells and immunohistochemical studies have demonstrated herpesvirus-associated antigens within tumor tissues, supporting a viral role in disease pathogenesis (Rao *et al*., 2020). In addition, inflammatory changes may include lymphocytic infiltration, granulocyte accumulation and formation of foreign body granulomas, while secondary infections with bacteria, fungi and parasites are frequently encountered and may further contribute to lesion progression (Herbst *et al*., 1999).

CONCLUSION

FP is a significant emerging disease impacting marine turtle populations globally. The disease is characterized by tumour formation associated with ChHV5 and influenced by environmental and host-related factors. Pathologically, it involves both epithelial and mesenchymal proliferation with characteristic viral inclusion bodies. Although spontaneous recovery occurs in many cases, severe disease can impair survival and contribute to population decline. Continued research into the pathogenesis and environmental determinants of FP is essential for developing effective conservation and management strategies.

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