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Suggestive Case of Viral-Induced Chondrosarcoma (Chondrogenic Neoplasia) in Largescale Mullet, Planiliza macrolepis (Smith, 1846) from the Pondicherry, Southeast Coast of India

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Case Report

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Abstract

Neoplasia in wild fish populations is increasingly recognized as an important indicator of environmental stress and ecosystem health. The present study reports the first documented case of suggestive chondrosarcoma (chondrogenic neoplasia) in the largescale mullet *Planiliza macrolepis* (Smith, 1846) from the southeast coast of India. An adult female specimen exhibiting a conspicuous external mass near the caudal peduncle was collected from the Pondicherry fish landing center during a routine survey. Gross examination revealed a firm, irregular, pinkish-white tumorous growth measuring approximately 3.0 × 3.1 × 3.2 cm. Histopathological analysis demonstrated a malignant cartilaginous neoplasm characterized by abundant chondroid matrix, marked hypercellularity, nuclear pleomorphism, hyperchromasia, frequent binucleation, and chondrocyte-like cells within well-defined lacunae. Histochemical staining with Alcian Blue (pH 2.5) and Toluidine Blue confirmed the cartilaginous nature of the extracellular matrix. Ultrastructural examination using transmission electron microscopy revealed the presence of virus-like particles within the cytoplasm of neoplastic cells, suggesting a possible viral involvement in tumor development. Chondrosarcoma is exceedingly rare in teleost fishes, and this finding expands the known host range of malignant chondrogenic tumors in aquatic vertebrates. The present case highlights the need for continued surveillance of neoplastic diseases in marine fishes and underscores the potential role of infectious agents and environmental stressors in tumorigenesis within coastal ecosystems.

INTRODUCTION

The largescale mullet (*Planiliza macrolepis*) is a member of the Mugilidae family and is commonly found in coastal and estuarine waters across the Indo-Pacific region (Whitfield et al. 2012). This fish species is distinguished by its streamlined, elongated body and conspicuously large scales. Individuals can grow up to approximately 50 cm (20 inches) in length. Its silvery-gray body, which fades to a lighter tone on the underside, serves as effective camouflage within its aquatic habitat. Mature fish are predominantly herbivorous, consuming algae and organic detritus, and typically form shoals an adaptive behavior that enhances protection against predators. *P. macrolepis* is ecologically important for nutrient cycling in coastal ecosystems and economically valuable as a reliable food source. It supports both artisanal and commercial fisheries, providing sustenance and income for coastal communities across the Indo-Pacific region.

Tumor development, or neoplasia, is well-documented in fish and follows classification patterns similar to those in higher vertebrates (Knusel et al. 2007; Hochwartner et al. 2010). In India, an increasing number of neoplastic conditions have been documented in marine fishes, and these lesions are widely regarded as important biological indicators of environmental stressors, including pollution and the emergence of infectious diseases (Chavan et al. 2009; Gopalakrishnan et al. 2011; Sinduja et al. 2013; Sinduja et al. 2014; Vijayakumar et al. 2014; Singaravel et al. 2015; Vijayakumar et al. 2015; Singaravel et al. 2016a-e; Vijayapoopathi et al. 2016; Vinothkumar et al. 2017; Singaravel et al. 2017; Singaravel et al. 2018; Mariasingrayan et al. 2024; Singaravel and Gopalakrishnan 2025; Mariasingarayan et al. 2025;

Koothan et al. 2026a,b). The occurrence of tumours in wild fish populations has been linked to multiple etiological factors, such as exposure to chemical pollutants, genetic susceptibility, prolonged inflammatory processes, and infectious agents, with particular emphasis on oncogenic viruses (Zhou et al. 2010; Coffee et al. 2013; Li 2014; Vijayakumar et al. 2014; Duis and Coors 2016; Carolin et al. 2017; Singaravel et al. 2018; Hader et al. 2020; Baines et al. 2021; Singaravel and Gopalakrishnan 2025).

Chondrosarcoma is a malignant cartilage-forming neoplasm characterized by the production of chondroid matrix by neoplastic chondrocytes and represents one of the most common primary cartilaginous tumours (Lokuhetty et al. 2020; Weinschenk et al. 2021). Histologically, it is defined by increased cellularity, nuclear atypia, hyperchromasia, frequent binucleation, and an infiltrative growth pattern within hyaline or myxoid cartilage. Chondrosarcomas exhibit considerable morphological and biological heterogeneity and are commonly classified based on histological grade, which correlates with tumour aggressiveness and prognosis. While extensively studied in terrestrial vertebrates, particularly in humans and domestic animals, chondrosarcoma is infrequently reported in fishes, and its pathogenesis, biological behaviour, and etiological factors in aquatic species remain poorly understood.

Chondrogenic tumours have been previously reported in fishes (Mesbah et al. 2016; Sirri et al. 2009, 2010). Among these, chondrosarcoma represents a malignant and more specific chondrogenic neoplasm and was first identified in fish in species such as the paddlefish *Polyodon spathula* (Bean-Knudsen et al. 1987). However, documentation of chondrogenic -chondrosarcoma in other fish species remains extremely limited. The present study reports the first documented case of chondrogenic-chondrosarcoma in the largescale mullet *Planiliza macrolepis*, thereby expanding the known host range of this rare malignant chondrogenic tumour in teleost fishes.

MATERIALS AND METHODS

Sample Collection

During a routine biological sample survey conducted under a Ministry of Earth Sciences, Government of India-sanctioned project under Deep Ocean Mission (DOM). an adult female largescale mullet (*Planiliza macrolepis*) exhibiting signs of external tumour development was collected in August 2025. The specimen was procured from the Pondicherry fish market, located along the southeast coast of India. The fish weighed 760 g and measured 44 cm in total length, and showed conspicuous abnormal growths near the caudal peduncle. Owing to this unusual presentation, the specimen was selected for detailed laboratory analysis.

Gross Pathological Examination

A macroscopic assessment was performed to record the tumor's size, shape, surface characteristics, coloration, and consistency. The mass was carefully excised and its dimensions (length, width, and

height) were recorded. High-quality photographs were taken under controlled lighting to document external features and any notable variations in appearance, such as discoloration or texture.

Histological Analysis

The tumour tissue samples were excised and fixed for 24 h in 10% neutral buffered formalin (NBF) solution, followed by several washes in tap water prior to dehydration through a graded alcohol series, cleared in xylene, and embedded in paraffin wax. Thin sections (5 µm) were prepared using a rotary microtome (LEICA RM2125 RTS) and stained with haematoxylin and eosin (Coolidge and Howard 1979). Additional sections were stained with Alcian Blue (pH 2.5) and Toluidine Blue. The stained tissue sections were examined under a light microscope (LEICA DM 2500 LED).

Transmission Electron Microscopy (TEM)

Tumor tissue was aseptically excised and fixed in 2.5% glutaraldehyde in 0.1 M phosphate buffer (pH 7.4) for 24 hours, followed by post-fixation in 1% osmium tetroxide for 3 hours. After dehydration through an ascending ethanol series, tissues were embedded in Epon resin. Semi-thin sections were stained with toludine blue, while ultra-thin sections were stained with uranyl acetate and lead citrate. Samples were observed under a Philips Tecnai T12 Spirit TEM operating at 80 kV to analyze ultrastructural features.

RESULT

Gross Pathology

External examination of the affected *P. macrolepis* specimen revealed a prominent mass located near anterior to the caudal fin, extending across both the dorsal and ventral surfaces of the tail region. The tumor measured approximately 3.0 × 3.1 × 3.2 cm and exhibited a firm, rigid consistency. It presented as an irregularly spherical mass with a distinct pinkish-white coloration, suggestive of potential underlying tissue changes or vascular alterations (Fig. 1).

Histopathology

Histological examination of haematoxylin and eosin-stained sections revealed a neoplastic lesion composed of abundant chondroid matrix with numerous chondrocyte-like cells embedded within well-defined lacunae (Fig. 2A&B). The tumour showed increased cellularity with irregular clustering of cells. Neoplastic chondrocytes exhibited moderate to marked nuclear pleomorphism, hyperchromasia, and frequent binucleation; occasional multinucleated cells were also observed, while mitotic figures were rare. Toluidine Blue-stained sections demonstrated pronounced metachromasia of the extracellular matrix, confirming the presence of a chondroid matrix (Fig. 3A&B). Alcian Blue (pH 2.5) staining showed

strong and diffuse positivity of the tumour matrix, indicating abundant acidic mucopolysaccharides and sulfated glycosaminoglycans characteristic of cartilaginous tissue (Fig. 3C&D).

Transmission Electron Microscopy

Ultrastructural analysis of tumor tissue revealed numerous virus-like particles (VLPs) within the cytoplasm of affected cells. These particles were spherical to polyhedral in shape, ranging from 200 to 250 nm in diameter. Each VLP exhibited a distinct nucleocapsid enclosed by an electron-dense protein capsid. The viral particles were distributed throughout the cytoplasm, indicating potential viral involvement in tumor pathogenesis (Fig. 4).

DISCUSSION

Neoplasia has been documented across a broad phylogenetic spectrum of fishes and virtually all organ systems, reflecting both the evolutionary antiquity of tumorigenesis and the susceptibility of aquatic vertebrates to diverse carcinogenic influences (Wellings 1969; Roberts 2012). The etiology of fish tumors is widely regarded as multifactorial, involving complex interactions between environmental contaminants, genetic predisposition, age, sex, chronic tissue irritation, and infectious agents, particularly oncogenic viruses (Vielkind & Vielkind 1982; Anders & Yoshimizu 1994; Okihiro et al. 1993). In recent decades, the increasing frequency of tumor reports in wild marine fishes from Indian coastal waters has highlighted neoplasia as a valuable biological indicator of ecosystem health and environmental stress (Chavan et al. 2009; Gopalakrishnan et al. 2011; Singaravel et al. 2016a–e; Vinothkumar et al. 2017; Mariasingrayan et al. 2024).

The present study documents a rare chondrogenic malignancy in the largescale mullet *Planiliza macrolepis*, a widely distributed and ecologically important mugilid species (Whitfield et al. 2012). Grossly, the tumor presented as a firm, irregular, pinkish-white mass located near the caudal peduncle, a morphology comparable to previously described chondrogenic neoplasms in fishes, including cranial chondrosarcoma in paddlefish (*Polyodon spathula*) (Bean-Knudsen et al. 1987) and chondromas in grass carp and neon tetra (Sirri et al. 2009, 2010; Mesbah et al. 2016). The size, rigidity, and invasive appearance of the lesion in the present case are consistent with malignant behavior rather than a benign cartilaginous proliferation.

Histopathological evaluation provided definitive evidence supporting a diagnosis of chondrosarcoma. The tumor was characterized by abundant chondroid matrix containing densely packed neoplastic chondrocytes within lacunae, marked hypercellularity, nuclear pleomorphism, hyperchromasia, and frequent binucleation. These features are in agreement with the diagnostic criteria for chondrosarcoma described in the WHO Classification of Tumours of Soft Tissue and Bone (Lokuhetty et al. 2020) and with clinicopathological descriptions in higher vertebrates (Weinschenk et al. 2021; Lam et al. 2019). Although mitotic figures were infrequent, this finding does not preclude malignancy, as low mitotic

activity has also been reported in conventional chondrosarcomas with infiltrative growth and aggressive potential (Depboylu et al. 2023).

Chondrogenic tumors are exceedingly uncommon in teleost fishes, and most reported cases are benign chondromas rather than malignant chondrosarcomas (Sirri et al. 2009, 2010; Mesbah et al. 2016). To date, chondrosarcoma has been documented only sporadically in fishes, notably in paddlefish (Bean-Knudsen et al. 1987). Therefore, the present report represents the first confirmed case of chondrosarcoma in *Planiliza macrolepis* and expands both the taxonomic and anatomical spectrum of malignant cartilaginous tumors in teleosts.

Mugilid fishes are known to develop a variety of neoplasms, including squamous cell carcinoma (Jithendran et al. 2011), myxoinflammatory fibroblastic sarcoma, leiomyoma (Singaravel et al. 2016b), and cutaneous fibroma (Mariasingrayan et al. 2024). However, cartilaginous malignancies have not previously been reported in this group. The present finding therefore underscores the neoplastic diversity observed in mullets and suggests that mugilids may be more susceptible to mesenchymal tumors than previously recognized.

A particularly noteworthy aspect of this study is the ultrastructural detection of virus-like particles (VLPs) within the cytoplasm of neoplastic cells. Viral involvement in fish tumorigenesis has been well documented, especially in epidermal papillomas, lymphocystis, and chromatophoromas (Anders & Yoshimizu 1994; Okihiro et al. 1993; Vijayapoopathi et al. 2016). The presence of VLPs in the present case raises the possibility of a viral role in the initiation or progression of chondrosarcoma in *P. macrolepis*. While causality cannot be established based solely on ultrastructural observations, similar associations between viral particles and neoplastic tissues have been reported in other fish tumors, supporting a viral oncogenesis hypothesis (Anders & Yoshimizu 1994; Roberts 2012).

The increasing number of tumor reports from Indian coastal waters, including melanophoromas, chromatophoromas, fibrosarcomas, odontomas, and various epithelial and mesenchymal neoplasms (Singaravel et al. 2015, 2016d, 2017; Vijayakumar et al. 2014, 2015; Koothan et al. 2026a,b), suggests that environmental stressors such as pollution, habitat degradation, and pathogen emergence may play an important role in tumor development. Given the ecological and commercial significance of *P. macrolepis*, the occurrence of a malignant tumor in a wild individual is of concern and warrants further epidemiological and molecular investigations.

In conclusion, this study provides the first evidence of chondrosarcoma in the largescale mullet *Planiliza macrolepis* and adds to the limited global literature on malignant chondrogenic tumors in fishes. The combined gross, histopathological, histochemical, and ultrastructural findings strongly support the diagnosis and suggest a possible viral contribution to tumor pathogenesis. Continued surveillance of neoplastic diseases in wild fish populations, coupled with advanced molecular diagnostics, is essential for understanding tumor etiology, assessing environmental health, and safeguarding fishery resources.

Declarations

Conflict of Interest

The authors declare that there is no conflict of interest related to the publication of this

Ethics Statement

The manuscript does not require ethical approval. According to the guidelines framed by the Government of India for experiments on fish (CPCSEA), ethical approval is required only for experimental studies and wild fishes, not for research involving dead food fish obtained from such landing sites.

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Author Contribution

Vasanthan Koothan sample collection, sample processing, conceptualization, methodology development, investigation, data recording, and formal analysis. Ayyaru Gopalakrishnan revised the manuscript with comprehensive guidance and provided support throughout the work. The authors have thoroughly reviewed the manuscript.

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References

1. Whitfield AK, Panfili J, Durand JD (2012) A global review of the cosmopolitan flathead mullet *Mugil cephalus* Linnaeus 1758 (Teleostei: Mugilidae), with emphasis on the biology, genetics, ecology and fisheries aspects of this apparent species complex. Rev Fish Biol Fish 22:641–681. https://doi.org/10.1007/s11160-012-9263-9
2. Knüsel R, Brandes K, Lechleiter S, Schmidt-Posthaus H (2007) Two independent cases of spontaneously occurring branchioblastomas in koi carp (*Cyprinus carpio*). Vet Pathol 44:237–239.

https://doi.org/10.1354/vp.44-2-237

3. Hochwartner O, Loupal G, Wildgoose WH, Schmidt-Posthaus H (2010) Occurrence of spontaneous tumours of the renal proximal tubules in oscars *Astronotus ocellatus*. Dis Aquat Organ 89:185–189. https://doi.org/10.3354/dao02149
4. Gopalakrishnan A, Maran BAV, Puvanendran V, Rajkumar M, Balasubramanian T, Ferguson HW (2011) Neoplasia in the Indian oil sardine Sardinella longiceps and the great barracuda Sphyraena barracuda from the south-east coast of India. J Fish Dis. https://doi.org/10.1111/j.1365-2761.2011.01299.x. 34:—
5. Lokuhetty D, White VA, Cree IA (2020) WHO classification of tumours of soft tissue and bone, 5th edn. International Agency for Research on Cancer, Lyon. https://doi.org/10.32074/1591-951X-213
6. Weinschenk RC, Wang WL, Lewis VO (2021) Chondrosarcoma. J Am Acad Orthop Surg 29:553–562. https://doi.org/10.5435/JAAOS-D-20-01188
7. Bean-Knudsen DE, Uhazy LS, Wagner JE (1987) Cranial chondrosarcoma in a paddlefish Polyodon spathula. J Fish Dis 10:363–369. https://doi.org/10.1111/j.1365-2761.1987.tb01083.x
8. Wellings SR (1969) Neoplasia and primitive vertebrate phylogeny: echinoderms, prevertebrates, and fishes—A review. Natl Cancer Inst Monogr 31:59–128
9. Okihiro MS, Whipple JA, Groff JM, Hinton DE (1993) Chromatophoromas and chromatophore hyperplasia in Pacific rockfish (Sebastes spp). Cancer Res 53:1761–1769
10. Roberts RJ (2012) Neoplasia of teleosts. In: Fish Pathology, 4th edn, pp 167–185. https://doi.org/10.1002/9781118222942
11. Vielkind J, Vielkind U (1982) Melanoma formation in fish of the genus Xiphophorus: a genetically based disorder in the determination and differentiation of a specific pigment cell. Can J Genet Cytol 24:133–149. https://doi.org/10.1139/g82-013
12. Anders K, Yoshimizu M (1994) Role of viruses in the induction of skin tumours and tumour-like proliferations of fish. Dis Aquat Org 19:215–232
13. Jithendran KP, Maruthamuthu N, Sahoo PK, Govindarajan T (2011) Squamous cell carcinoma in grey mullet, Mugil cephalus L. (Perciformes: Mugilidae). Comp Clin Pathol 20:673–675. https://doi.org/10.1007/s00580-010-0995-9
14. Singaravel V, Gopalakrishnan A, Raja K, Vijayakumar R, Asrafuzzaman S (2016) Neoplasia in flat head grey mullet, Mugil cephalus Linnaeus, 1758 (Perciformes: Mugilidae): two case reports of myxoinflammatory fibroblastic sarcoma and leiomyoma. Comp Clin Pathol 25:1081–1085. https://doi.org/10.1007/s00580-016-2295-0
15. Mariasingrayan Y, Danaraj J, Dinh-Hung N, Vijayapoopathi S, Kaliyamoorthy K, Ayyaru G (2024) Cutaneous fibroma in largescale mullet, Planiliza macrolepis (Smith, 1846) from Rameswaram Island, Southeast India. Natl Acad Sci Lett 1–4. https://doi.org/10.1007/s40009-024-01415-2
16. Mesbah M, Rezaie A, Dezfuly ZT (2016) Case report of chondroma in a grass carp (Ctenopharyngodon idella). Vet Res Forum 7:173

17. Sirri R, Mandrioli L, Bacci B, Morini M, Bettini G (2010) Snout chondroma in a neon tetra Paracheirodon innesi. Fish Pathol 45:84–87
18. Sirri R, Mandrioli L, Panarese S, Bacci B, Morini M, Bettini G (2009) Facial myxomatous chondroma in a neon tetra (Paracheirodon innesi). 14th EAFP Int Conf Dis Fish Shellfish:437.
19. Chavan BB, Sundaram S, Josekutty CJ, Katkar BN (2009) Some interesting cases of tumour in marine fishes. Fish Chimes 29:37
20. Gopalakrishnan A, Maran BAV, Puvanendran V, Rajkumar M, Balasubramanian T, Ferguson HW (2011) Neoplasia in the Indian oil sardine Sardinella longiceps and the great barracuda Sphyraena barracuda from the southeast coast of India. J Fish Dis 34:937–942. https://doi.org/10.1111/j.1365-2761.2011.01299.x
21. Koothan V, Dinh-Hung N, Singaravel V, Gopalakrishnan A (2026a) Presumptive case of melanoma or melanophoroma in Terapon jarbua from Indian coastal water. Dis Aquat Org
22. Koothan V, Jha S, Luricson L, Ganesan K, Gopalakrishnan A (2026b) Characterization of hypermelanosis in the commercially important flatfish Synaptura albomaculata (Kaup, 1858) from Indian coastal water. Thalassas Int J Mar Sci 42:2. https://doi.org/10.1007/s41208-025-00679-9
23. Mariasingarayan Y, Danaraj J, Vijayapoopathi S, Dinh-Hung N (2025) First report of cutaneous leiomyoma in Plotosus canius (Hamilton, 1822) from the coastal waters of Parangipettai, India. J Fish Dis e14164. https://doi.org/10.1111/jfd.14164
24. Mariasingrayan Y, Danaraj J, Dinh-Hung N, Vijayapoopathi S, Kaliyamoorthy K, Ayyaru G (2024) Cutaneous fibroma in largescale mullet, Planiliza macrolepis (Smith, 1846) from Rameswaram Island, Southeast India. Natl Acad Sci Lett 1–4. https://doi.org/10.1007/s40009-024-01415-2
25. Sinduja K, Gopalakrishnan A, Sakthivel A (2013) Comparative studies on nutritional value of normal and tumour tissue of Sardinella longiceps from Nagapattinam southeast coast of India. Int J Sci Innov Technol 2:432–443
26. Sinduja K, Vijayakumar R, Gopalakrishnan A (2014) Prevalence and histopathology of branchioblastoma in Sardinella longiceps of southeast coast of India. Indian J Geo-Mar Sci 43:2327–2332
27. Singaravel V, Gopalakrishnan A, Raja K (2016a) Iridophoroma in Indian mackerel Rastrelliger kanagurta. J Appl Ichthyol 33:116–118
28. Singaravel V, Gopalakrishnan A, Raja K, Rajkumar M, Ferguson HW (2018) Neoplasia in goldlined seabream Rhabdosargus sarba. J Fish Dis 41:405–411. https://doi.org/10.1111/jfd.12757
29. Singaravel V, Gopalakrishnan A, Raja K, Vijayakumar R, Asrafuzzaman S (2016b) Neoplasia in flat head grey mullet Mugil cephalus: two case reports of cutaneous myxoinflammatory fibroblastic sarcoma and leiomyoma. Comp Clin Pathol 25:1081–1085. https://doi.org/10.1007/s00580-016-2295-0
30. Singaravel V, Gopalakrishnan A, Raja K, Vijayakumar R, Asrafuzzaman S (2017) Oral neoplasms in pickhandle barracuda Sphyraena jello from India. Dis Aquat Org 125:115–124. https://doi.org/10.3354/dao03138

31. Singaravel V, Gopalakrishnan A, Vijayakumar R, Raja K (2015) Prevalence and pathology of gastric tumours in Indian oil sardine Sardinella longiceps from Parangipettai coastal waters, southeast coast of India. J Coastal Life Med 3:592–595
32. Singaravel V, Gopalakrishnan A, Vijayakumar R, Raja K, Asrafuzzaman S (2016c) A case report on cutaneous myxoma or invasive myxomatosis in Blackfin sea catfish Arius jella. Comp Clin Pathol 25:491–495. https://doi.org/10.1007/s00580-015-2192-6
33. Singaravel V, Gopalakrishnan A, Vijayakumar R, Raja K, Asrafuzzaman S (2016d) Occurrence of chromatophoroma or chromatophoromatosis in Sardinella longiceps from Tamil Nadu southeast coast of India. J Appl Ichthyol 32:712–717. https://doi.org/10.1111/jai.13100
34. Singaravel V, Gopalakrishnan A, Vijayakumar R, Raja K, Asrafuzzaman S (2016e) Scleral fibrosarcoma and conjunctival squamous papilloma in Indian oil sardine, Sardinella longiceps (Valenciennes, 1847). J Appl Ichthyol 32:1221–1223. https://doi.org/10.1111/jai.13165
35. Singaravel V, Gopalakrishnan A (2025) Iridophoroma in deep-bodied mojarra, Gerres erythrourus (Bloch, 1791). Natl Acad Sci Lett 1–6. https://doi.org/10.1007/s40009-025-01467-0
36. Vijayakumar R, Gopalakrishnan A, Raja K, Sinduja K (2014) Occurrence of tumour odontoma in marine fish Sphyraena jello from the southeast coast of India. Dis Aquat Org 108:53–60. https://doi.org/10.3354/dao02700
37. Vijayakumar R, Raja K, Singaravel V, Gopalakrishnan A (2015) Four types of neoplasms in Asian sea bass Lates calcarifer. J Coastal Life Med 3:438–440
38. Vijayapoopathi S, Ayyaru G, Kuzhanthaivel R, Syed A (2016) Lymphocystis in Indian oil sardine, Sardinella longiceps (Valenciennes, 1847). Asian Pac J Trop Dis 6:611–614. https://doi.org/10.1016/S2222-1808(16)61100-1
39. Vinothkumar R, Rameshkumar P, Saravanan R, Surya S, Nazar A, Rohit P (2017) Neoplasia in oil sardine from Palk Bay. Mar Fish Inf Serv Tech Ext Ser 231:29–30
40. Lam SW, van Langevelde K, Suurmeijer AJ, Cleven AH, Bovée JV (2019) Conventional chondrosarcoma with focal clear cell change: a clinicopathological and molecular analysis. Histopathology 75:843–852. https://doi.org/10.1111/his.13921
41. Depboylu B, Tasan SC, Tataroglu C (2023) Chondrosarcoma: an analysis of clinical characteristics, treatment outcomes, and prognostic factors in a decade-long single center experience. Atl J Med Sci Res 3:116–124. https://doi.org/10.5455/tjmed.2023.06.041

Figures



Figure 1

The affected specimen Largescale Mullet (*Planiliza macrolepis)*; The close-up view affected portion shows the prominent tumorous outgrowth.

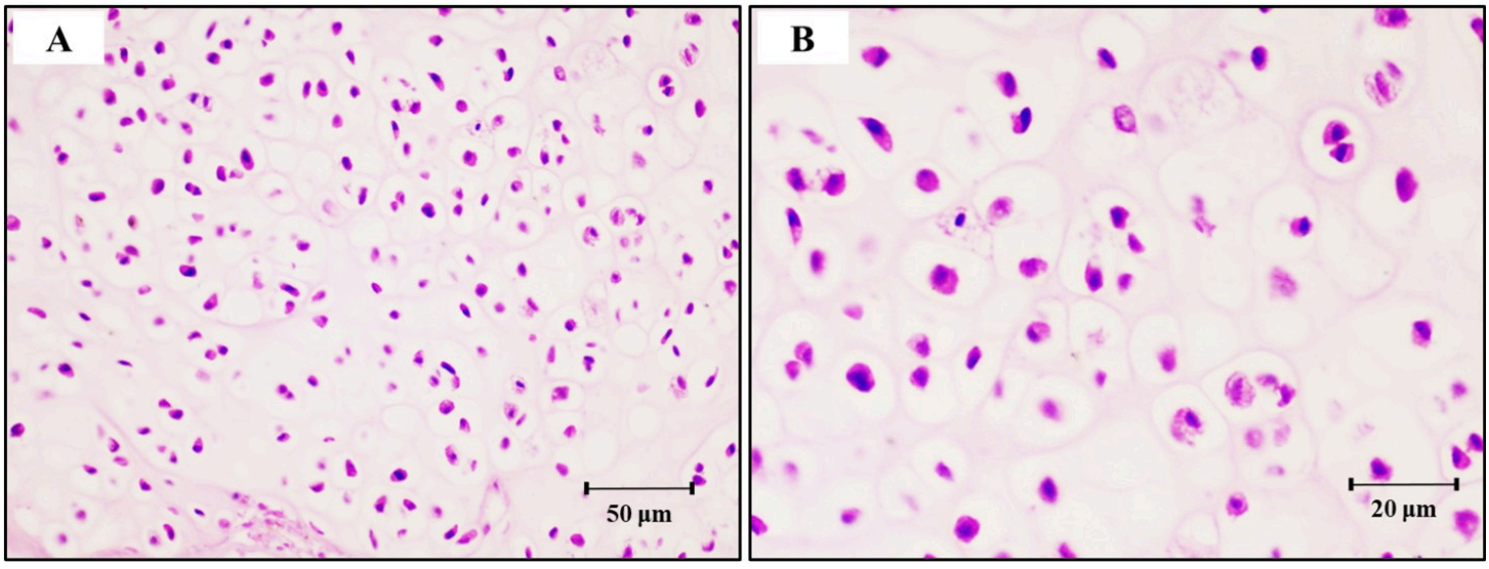


Figure 2

Histological features of chondrosarcoma in the largescale mullet *Planiliza macrolepis*. (A-B) Haematoxylin and eosin-stained sections showing increased cellularity of neoplastic chondrocytes embedded within a chondroid matrix, with nuclear pleomorphism, hyperchromasia, and frequent binucleation.

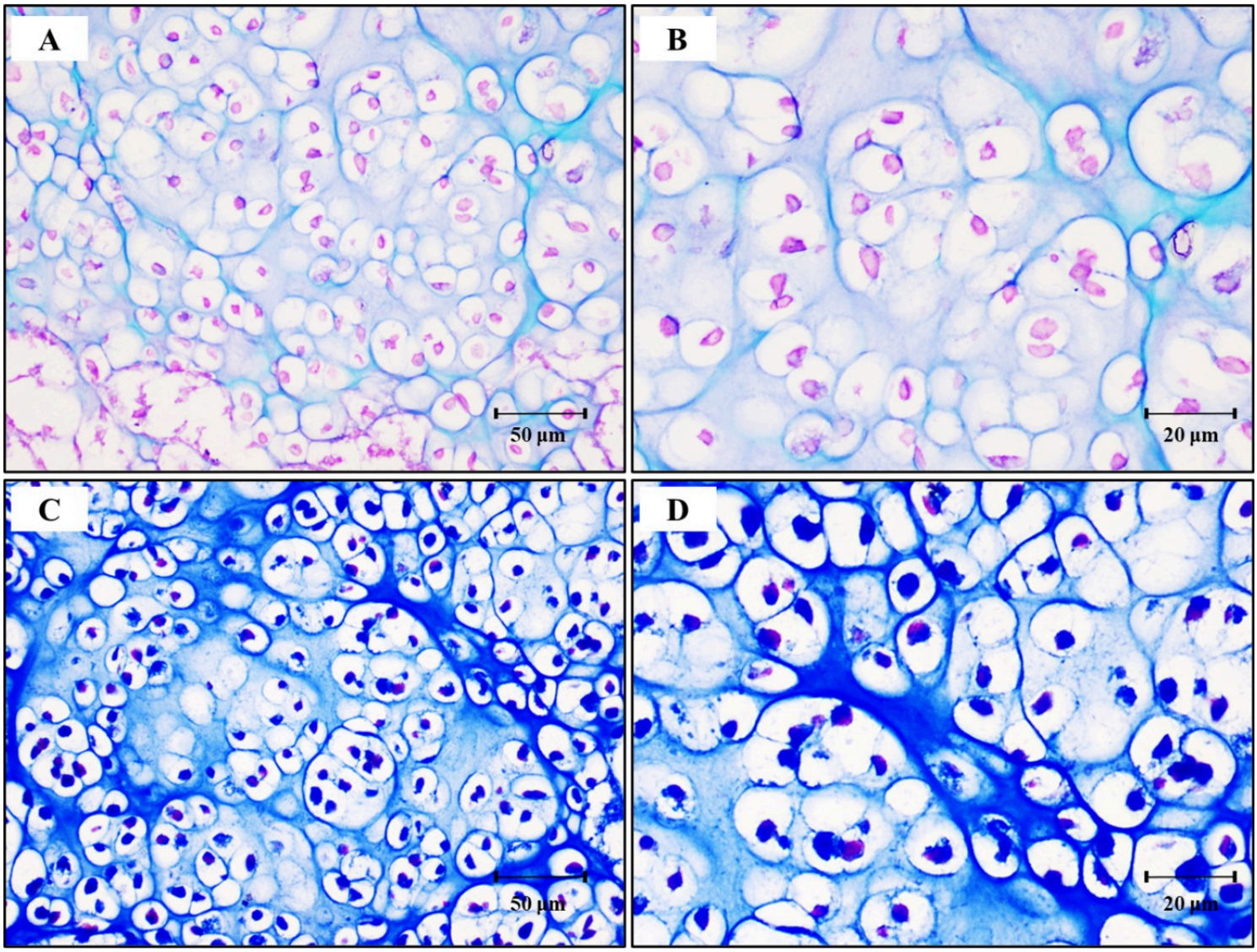


Figure 3

Histological features of chondrosarcoma tissue with special stain (C-D) Toluidine Blue-stained sections demonstrating metachromasia of the extracellular matrix, confirming chondroid differentiation. (E-F) Alcian Blue (pH 2.5) stained sections showing strong positivity of the tumour matrix, indicating abundant acidic mucopolysaccharides and sulfated glycosaminoglycans. Scale bars: A, C = 50 µm; B, D = 20 µm.

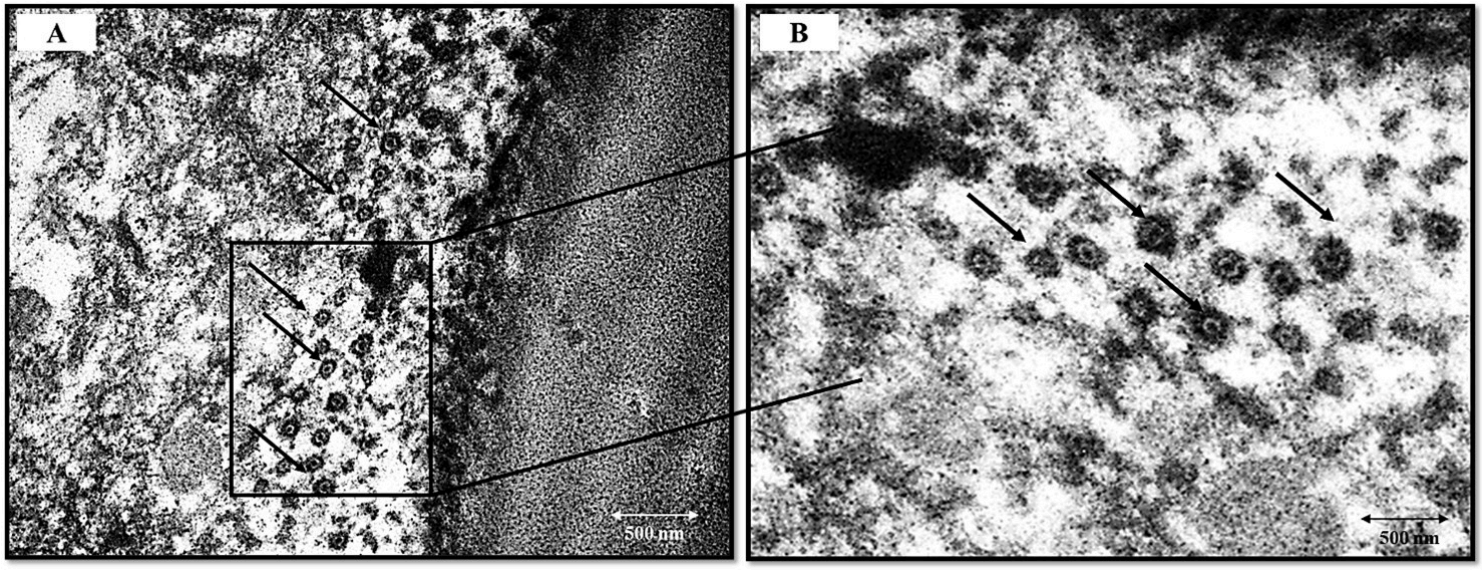


Figure 4

Transmission electron microscopy shows the viral particles (arrow) present in tumour affected tissue of *Planiliza macrolepis* (A). The close-up view of “A” shows the virus-like particles were enveloped with protein capsid (arrows) and nucleocapsid, protein envelope and electron dense nucleocapsid (B). Scale bars = 500nm