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Cellular- and histopathological effects of a pollutant gradient – introduction

M. N. Moore

Plymouth Marine Laboratory (West Hoe), Prospect Place, The Hoe, Plymouth PL1 3DH, United Kingdom

Numerous cytological, histochemical and histological approaches have been used to detect pathological disturbances in aquatic organisms. Many of these have been based directly on techniques used in mammalian pathology, while others have been developed from studies on various cellular processes in invertebrates, particularly in mussels. Some of these approaches have proved useful in the assessment of pollutant effects including (1) lysosomal membrane stability, (2) lysosomal enlargement, (3) lipofuscin accumulation, (4) stimulation of NADPH-ferrihemoprotein reductase, (5) digestive tubule dilation and degeneration, (6) degeneration of ovarian eggs, (7) degeneration of gills, (8) incidence of granulocytomas. Most of these effects are probably generalized responses to toxic chemicals, although stimulation of NADPH-ferrihemoprotein reductase (cytochrome P-450 reductase) appears to be specifically induced by certain organic xenobiotics such as polycyclic aromatic hydrocarbons.

Some effects such as destabilization of lysosomal membranes can be mechanistically linked to lysosomal enlargement and lipofuscin accumulation, both of which are indicative of autophagy. Autophagy in turn can be linked directly to degeneration of digestive tubules. There is also a considerable body of evidence on lysosomal involvement in cell injury in mammals to support the occurrence of these types of relationships in marine invertebrates.

In mussels, digestive cells of the digestive tubules appear to be a particular target for the injurious action of many pollutants, and the extensive lysosomal-vacuolar system in these cells is a site of metal accumulation. Lysosomes are also known to accumulate polycyclic aromatic hydrocarbons and nitrogenous heterocyclic compounds.

Standard histopathological approaches are useful in providing an overall picture of the degree of disturbance within the organ systems concerned. Studies on cellular pathobiology and histopathology conducted at the GEEP Workshop used all of the approaches mentioned above and emphasized, where possible, the mechanistic linking of effects at the different levels of cell and tissue organisation. Many of the effects observed support the utility of some of the above techniques in the assessment of pollutant impact, and provide further evidence for the claim that digestive cells of mussels are a sensitive target for environmental xenobiotics.

Some clarification is needed for the experimental treatments in the following papers. The high treatment condition (H) for mussels lasted for only 23 d due to mortality of the original mussel stocks in the H dose basin. At the time of restocking of the H basin, a second batch of mussels was placed in the control basin; samples of these controls (also taken after 23 d) were designated CH. High-treatment mussels were compared with CH controls, but not the controls for low and medium treatments, in the papers by Moore and by Lowe in this MEPS SPECIAL; Auffret has used both control conditions in the histopathological investigation.

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