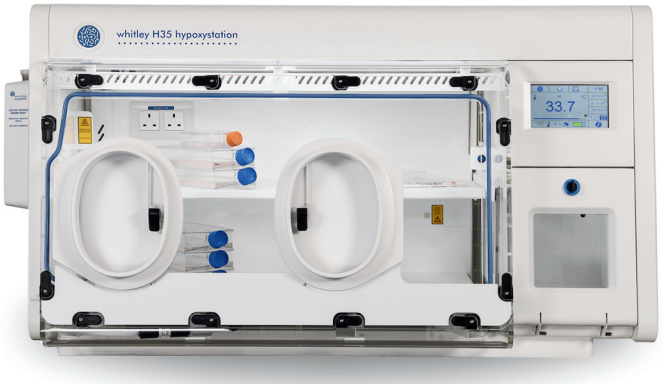
Unveiling the Significance of Hypoxia in Cellular Adaptation

Abstract:

Understanding cellular responses to hypoxia, or low oxygen environments, is crucial to unravel the intricacies of various diseases, such as cancer metastasis. Dr Violaine See, Lecturer at the Institute of Integrative Biology at the University of Liverpool, is investigating how cells adapt to hypoxic conditions including the implications for cancer treatment such as chemotherapeutic resistance via tumour hypoxia adaptation. Dr See uncovers the correlation between hypoxia and cellular behaviour, shedding light on the aggressive nature of cancer cells under low oxygen levels using the H35 Hypoxystation.

Introduction:

Cells exhibit remarkable adaptability to their environment, particularly in response to hypoxia where oxygen availability is scarce. Hypoxia exerts profound effects on cellular physiology, influencing gene expression, metabolism, and cellular signalling pathways. In pathological contexts, such as cancer, hypoxia plays a pivotal role in disease progression and treatment resistance.



A major adaptive response is seen through the expression of hypoxia-inducible factors (HIFs), orchestrating a cascade of cellular responses to low oxygen. Under normoxic conditions (21% O2), HIFs are targeted for degradation by prolyl hydroxylase enzymes. This is not a true reflection of in vivo conditions found in either the tumour microenvironment or healthy tissues.

Dr See's research focuses on deciphering the cellular mechanisms underlying this adaptation, with a particular emphasis on hypoxia-induced changes in cancer cell behaviour. By comprehensively investigating how cells sense and respond to hypoxia using the strict low O2 control of the H35 Hypoxystation, Dr See aims to identify critical pathways involved in disease progression, offering valuable insights for therapeutic interventions in adult and paediatric brain tumours.

Experimental:

Dr See's research employs neuroblastoma cells as a model system to study the effects of hypoxia on cancer cell behaviour. The experimental design involves preculturing neuroblastoma cells in either hypoxia (3 days at 1.0% O2) or non-hypoxic conditions. Cells are labelled with fluorescent markers and implanted into a chick embryo model. The cells are transplanted into the chorioallantoic membrane (CAM) - the outermost extra-embryonic membrane that is highly vascularised.

Dr See's findings have showcased that precultured neuroblastoma cells in 1% O2 developed into tumours as well as invaded surrounding tissues throughout the chick embryo. These findings were only observed for cells precultured under hypoxia.
Through extensive research, Dr See's team has demonstrated the development of chemotherapeutic resistance in brain tumours, highlighting the clinical relevance of hypoxia in cancer treatment. Further highlighting the effects of hypoxia on aggressive cell growth and metastasis.

The H35 Hypoxystation has been instrumental in Dr See's research, enabling precise control over oxygen levels during cell culture experiments. By mimicking hypoxic conditions found in vivo, Dr See has uncovered invaluable insights into the aggressive behaviour of cancer cells and their metastatic potential. Her findings hold profound implications for cancer therapy, underscoring the importance of considering physiological oxygen levels in understanding disease progression and developing targeted treatment strategies.