

Tumour Detection in Mouse Mammary Glands Using Small Angle X-ray Scattering

Siu KKW, Monash University, Australia;
Falzon G, University of New England, Australia;
Sidhu S, Monash University, Australia;
Restall C, Peter MacCallum Cancer Centre;
Mudie ST, CSIRO, Australia, Australia;
Cookson DJ, Australian Synchrotron Research Program, Australia;
Murison R University of New England, Australia;
Anderson R Peter MacCallum Cancer Centre, Australia;

Recent work has examined the potential of Small Angle X-ray Scattering (SAXS) as a diagnostic indicator for breast cancer. These studies have identified changes in collagen structure, the major structural component of the extra-cellular matrix (ECM), as a promising diagnostic indicator. These changes are hypothesised to arise from the degradation and remodelling of the ECM that occurs during cancer progression. More intriguingly, changes were detected in the ECM several centimetres away from tumours, considered histopathologically normal. The changes appeared to be systematic, decreasing in magnitude with distance from the tumour site.

To advance these studies we have recently begun investigations into whether the structural changes in collagen are able to predict not only tumour presence, but also metastatic potential, in a mouse model of breast cancer. The use of a murine model not only allows us to minimise the confounding inter-sample variability and biases unavoidable with our source of human breast tissue samples (surgical waste) but also to determine the magnitude of any structural changes for implanted tumours of varying metastatic capacity.

SAXS data was collected from excised mouse mammary glands from healthy mice, and involved and non-involved glands from tumour-implanted mice (5, 7, 12, 14 and 19 days after inoculation) was performed at the ChemMatCARS beamline at the Advanced Photon Source (APS). Course raster scans in 2mm steps provided SAXS patterns across different regions of the glands. Features associated with the collagen content of the tissue were extracted from the SAXS patterns and the value of the feature across the entire gland reconstructed using a mathematical model. Statistical cluster analysis of the scattering features allowed the segmentation in regions of gland with similar feature values. Good correlation between the objects detected and anatomical structures discovered following staining of the gland indicate that the SAXS technique can detect a wide range of tissue types including tumour tissue. These results provide important information on the differences in tissue structure at the molecular level and may be used to improve the detection of metastases in our SAXS studies of human breast cancer.

KEYWORDS: breast cancer, small angle X-ray scattering, diagnosis