Big picture: Lipid ordering visualized in a living vertebrate organism

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Scientists have obtained the first visualization of the inherent arrangement of lipid molecules in different tissues of a whole, living vertebrate organism. The research, published by Cell Press in *Biophysical Journal* on July 6th, validates earlier studies done with primary cells and may lead to a new understanding of the physiological significance of plasma membrane organization.

All cells are surrounded by a dynamic semi-permeable structure called the plasma membrane. Plasma membranes are made of a thin double layer of lipids interspersed with a diverse complement of proteins. Research has shown that the lipids are not randomly distributed throughout the plasma membrane, but are instead arranged in specific groups that may serve distinct functional roles. The degree of lipid packing, called "membrane lipid order", is commonly used to characterize the physical organization of the membrane.

"Previous work has suggested that the organization of cell membranes and their biophysical structure may play an important role in a wide range of cellular processes," explains study author, Dr. Arindam Majumdar from Uppsala University in Sweden. "For example, some cells posses a higher membrane lipid order at the top of the cell than the bottom, which may have important implications for cellular trafficking.

These earlier studies were restricted to model membranes or cells cultured in the laboratory. But no one has been able to visually image this directly before in tissues, organs or whole embryos, making it

difficult to address the physiological relevancy of membrane lipid order. In the current study, Dr. Majumdar, along with co-author Dr. Katharina Gaus from the University of New South Wales in Sydney, Australia, performed the first imaging of membrane order in intact, living vertebrate embryos.

Using sophisticated microscopy combined with a membrane dye, laurdan, that changes color depending on the membrane lipid properties, the researchers imaged the membrane lipid order in a wide variety of tissues in live zebrafish embryos.

"We found that the differences in membrane order that have been observed previously do exist in the tissues of living organisms and that these distributions can be quantitatively analyzed," concludes Dr. Gaus. "In the future, imaging data obtained from living organisms may play an important role in assessing the physiological significance of membrane order."

"This work represents a cross-disciplinary and international collaboration combining and synergizing our respective experimental systems in a novel way," says Dr. Majumdar. "Since the zebrafish is an animal model system for studying human diseases, we hope to apply the laurdan method to understand the role of membrane order in human pathologies."

More information: Majumdar, Gaus et al.: "Imaging membrane lipid order in whole, living vertebrate organisms." The Biophysical Journal, July, 2010. www.biophysics.org/

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