Dynamics of NMR-visible Mobile Lipids (ML) in cultured cells

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NMR-visible mobile lipids (ML) detectable from cultured cells are accepted to originate mostly from neutral lipids. To be more precise from their fatty acyl chains, mostly from triacylglycerol, with some contribution of diacylglycerol and cholesterol esters [1]. These neutral lipids are contained in cytosolic micelles, the so called lipid droplets (LD), or, lately lipid bodies (LB), because of their highly dynamic behaviour inside cells [2] and the variety of their associated proteome [3-4]. Their biological function, apart from being a neutral lipid store for energy production, is still somewhat uncertain, although a carbon shuttle role between plasma membrane and endoplasmic reticulum has been proposed for them in tumour cells [5]. ML detected by high resolution NMR of cell pellets originates from lipid bodies of sizes in the range of 0.5-2 μm as shown by restriction to diffusion measurements in intact cells [6]. These bodies may also be visualized by epifluorescence using for example Nile Red [7] and the dimensions observed for them do agree well with NMR determined measurements [6].

ML content in cells may change due to various causes. Leaving aside pathology (apoptosis, cytotoxicity) which will be discussed by others in this course, proliferation rate seems to be an accepted cause of ML intensity changes [7-9], although according to [5] the ML intensity change would not originate from net content changes but from NMR visibility changes, being the suggested epifluorescence and NMR visibility diameter threshold for LB contents about 200 nm. In this respect, the fact that LB are actively transported in cells, bound to the cytoskeleton [10-11] and may merge changing their size [10] or split apart [12], has been thoroughly demonstrated in different cellular systems.

In summary, ML seems to originate in living cells from the neutral lipid content of LB of average diameters in the range of 0.5-2 μm. These ML resonances may change in apparent intensity due to growth rate changes and these intensity changes may be caused by changes in the size of the LB produced by regulated active merging or fission processes inside cells.

References

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