MAS $^1$H NMR assessment of donor livers prior to transplantation


(1) Liver Transplant Surgical Service, King's College Hospital, Denmark Hill, London, SE5 9RS

(2) Department of Biological Sciences, Imperial College, South Kensington, London, SW7 2AZ

The expanding need of grafts for liver transplantation has led to the increased use of sub-optimal or "marginal" grafts and there is a current need to find reliable ways of assessing donor livers before using them. In previous studies we've concentrated on just one liver function, bile secretion. However, although the secretion of bile is an all-important liver function and bile acids are quantitatively the major component of human bile, biliary bile acid secretion tells us little of metabolic status of the liver. The recent advent of metabolomics and in particular the technique of Magic Angle Spinning (MAS) Proton Nuclear Magnetic Resonance ($^1$H NMR) combined with computer-based pattern recognition techniques (PR) offers a unique holistic approach to the assessment of donor liver function before transplantation. We report here the results of the first application of this technique to human livers. With ethical permission and family consent Tru-cut biopsies were taken from the left hepatic lobe of three heart-beating donors before liver mobilisation and analysed by MAS $^1$H NMR spectroscopy at 600 MHz. Results: Each spectrum was dominated by broad signals from high molecular triglycerides with clear resonances of glucose in the region 3.4 - 4.0 ppm CPMG spin-echo made low molecular weight components such as alanine, lactate, valine, isoleucine, leucine, glutamate, glutamine more obvious. Resonances between 3.3 - 4.0 ppm clearly visible in the parent liver spectrum were absent from that of the corresponding hepatic bile and whilst no resonances above 5.5 ppm were detected in the tissue spectra both phenylalanine and tryptophan were present in the corresponding hepatic biles. Bile acid proton shifts prominent in bile spectra were absent from liver spectra consistent with the view that transporters of hepatic bile acid secretion are sufficiently abundant to ensure that bile acids do not accumulate. Glucose resonances were present in liver spectra but not in bile spectra consistent with the absence of hepatic glycogen peaks and suggestive of reduced caloric intake. Thus the use of MAS $^1$H NMR provides information both on hepatic metabolic status and the potential of the donor liver to supply sufficient fuel to compensate for the presumably malnourished state of the recipient.