Non Invasive Quantification of Ectopic Fat Content: flexibility with bariatric surgery induced weight loss

Inès ABDESSELAM[1,2], Bénédicte GABORIT[2,3], Frank KOBER[1], Alexis JACQUIER[4], Olivier EMUNGANIA[5], Marie-Christine ALESSI[2], Monique BERNARD[1], and Anne DUTOUR[2,3]

[1]Faculté de médecine, Aix-Marseille University, CRMBM, CNRS7339, Marseille, France, [2]Faculté de médecine, Aix-Marseille University, NORT, Inserm1062/Inra1260, Marseille, France, [3]Endocrinology, Metabolic diseases and nutrition, CHU Nord, Marseille, France, [4]Radiology, CHU TImone, Marseille, France, [5]Gastroenterology, CHU Nord, Marseille, France

Target Audience : Cardiac MRS in clinical research

Purpose: Ectopic fat deposition in heart, liver and pancreas is linked to obesity. Recent literature suggests that these excessive fat accumulations may contribute to organ dysfunction, leading to insulin-resistance, increased heart risk, and type 2 diabetes (T2D) development.

Furthermore, bariatric surgery (BS) could significantly reduce visceral and epicardial fat. However, there was no significant change in myocardial triglyceride content 6 months after surgery. (Fig. 1) Whether this weight loss could modulate pancreatic fat is totally unknown.

The aim of this study was first to investigate the impact of BS on ectopic fat deposition in heart, liver and pancreas level using Proton magnetic resonance spectroscopy (^{1}H-MRS).

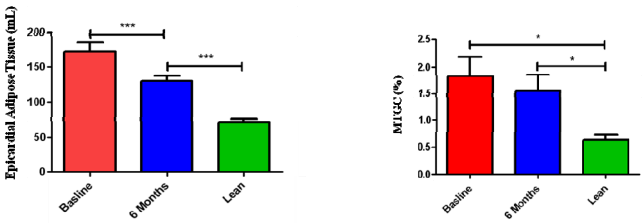
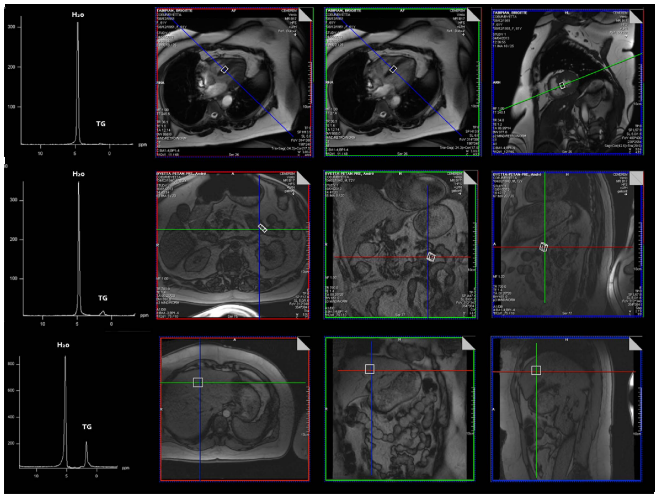


Fig 1: Effect of BS on EAT and MTGC

We assessed ectopic fat accumulations 6 months after bariatric surgery and two years later to determine whether decreased levels of triglyceride content are maintained over time and whether myocardial triglyceride content could be decreased afterward.

Subjects and Methods: 45 subjects 13 healthy volunteers, 13 obese non diabetics and 19 T2D matched for age and gender. Participants underwent the following: ^{1}H-SRM point-resolved single-voxel proton spectroscopy sequence (PRESS) to determine myocardial (MTGC), pancreatic (PTGC) and hepatic (HTGC) triglyceride content on a 3-T wide-bore magnet (Verio, Siemens Medical Solutions, Erlangen, Germany) equipped with a 32-element phased array coil (Fig. 2); abdominal CT scan to quantify visceral and subcutaneous adipose tissue, and also metabolic analysis including HOMA-R, HOMA-B, and lipidomic plasma fatty acids composition. In the population of obese subjects, 16 underwent BS (sleeve gastrectomy or gastric by-pass) and were reassessed 6 months, then 2 years later with MRI examination.



Fi g. 2: Proton Magnetic Resonance Spectroscopy

Results: PTGC assessment has been validate in obese subjects. The mean intra-subject coefficient of variation of pancreatic fat measurements was 1.65%, with Pearson correlation coefficients (r) of 0.99, and coefficient of variation inter-subject was 4.55% with r=0.99. PTGC was significantly increased in diabetic patients (23.8 ± 3.2%) compared to obese (14.0±3.3; p=0.03) and lean subjects (7.5±0.9%; 0.0002).

We showed, for the first time, that BS induced a significant reduction of PTGC (-46.8±6.3%) reaching lean levels, which was significantly higher than BMI decrease (-25.4±1.3%). An improvement of beta cell function was observed. BS induced also a huge decrease of HTGC (49,8±9,6%). The PTGC and HTGC losses were not correlated, suggesting tissue specific mobilization of these ectopic fat stores.

Two years after bariatric surgery, decreased levels of PTGC and HTGC are still low (10,75% ± 2,53 and 5,08% ± 0,56) compared to 6 months after BS (p=NS). We observed no decrease of MTGC level either at this late time (Fig. 3).

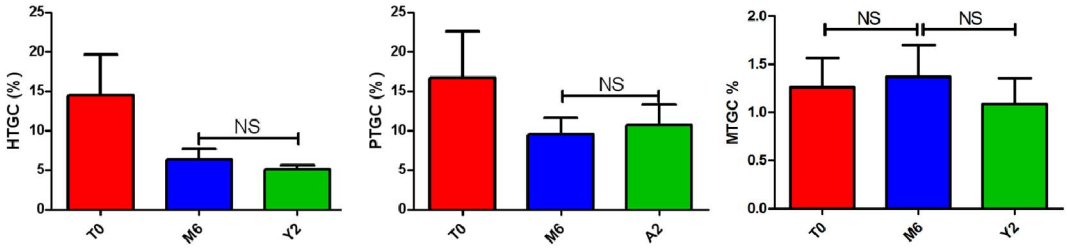


Fig.3 : Effect of BS on ectopic fat

Discussion/Conclusion: MR method is a precise and reliable tool for fat distribution assessment. PTGC increased in T2D and drastically decreased after BS. We identified in this study, new predictors of pancreatic fat accumulation. This decrease seems to be maintained over time. However, BS had no impact on MTGC, even two years later.