

Adipokine secretions correlate with MRI measurements of adiposity

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Target Audience: Physicians working in obesity and metabolic syndrome; image processing scientists with an interest in abdominal MRI.

Introduction: Colonic diverticulosis affects up to 66% of those > 65 years in the UK¹, and a recent study reported a 26% rise in admissions for acute diverticulitis in the USA². This may relate to increasing obesity which is a risk factor for developing complications of diverticular disease (DD) including abscess formation and perforation. These inflammatory complications may relate to the known pro-inflammatory effect of visceral adipose tissue (VAT). Adipokines and cytokines secreted by VAT may promote inflammation in the gut wall. This study aimed to use MRI to determine the impact of VAT on adipokines and the symptoms of DD. We also assessed small bowel water content (SBWC), an MRI parameter we have previously linked to functional diarrhoeal symptoms. **Methods:** 55 patients (24 male) recruited from secondary care with BMI 20.5 – 39.5 kg m⁻² were scanned after giving written informed consent (Ethics 10/H0405/80). The study was carried out on a 1.5T Philips Achieva Scanner using a 16 Element SENSE torso coil. A 3D T1w DIXON protocol³ was used to measure abdominal fat as previously described⁴. SBWC was measured using a single shot TSE sequence as previously described and validated⁵. All MRI data was acquired after an overnight fast. Blood and stool samples were also collected on the scan day.

Data Analysis: Volumes of VAT, subcutaneous (SAT) and total (TAT) adipose tissue and abdominal volume, across a 30 slice region centred on the L4/L5 invertebral disc (Figure 1,) were determined by a single operator using a previously validated, semi-automatic segmentation algorithm written in IDL® 6.4 (Research Systems, Boulder Co, USA)⁴. Small bowel liquid volumes were measured by manual segmentation as previously described⁵. Concentrations of the anti-inflammatory adipokine, adiponectin, leptin and faecal calprotectin were determined and correlations between these, BMI and fat volumes were calculated. **Results:** The study procedures were well tolerated. Adiponectin was found to correlate negatively with VAT ($r = -0.344$, $p = 0.01$), abdominal volume ($r = -0.510$, $p = 0.0002$), and BMI ($r = -0.425$, $p = 0.002$), confirming that obesity is associated with low adiponectin. Leptin in contrast correlated strongly with SAT ($r = 0.762$, $p < 0.0001$) and TAT ($r = 0.698$, $p < 0.0001$), while the correlation with VAT was weaker ($r = 0.384$, $p = 0.004$). BMI correlated strongly with VAT ($r = 0.727$, $p < 0.00001$), SAT ($r = 0.742$, $p < 0.00001$) and TAT ($r = 0.87$, $p < 0.00001$). Calprotectin correlated weakly but positively with abdominal volume ($r = 0.315$, $p = 0.029$) and BMI ($r = 0.302$, $p = 0.03$). Patients having BMI > 25 showed a weak but positive correlation between calprotectin and VAT ($r = 0.304$, $p = 0.048$), demonstrating that obesity influences intestinal inflammation (Figure 2). There were also weak but significant correlations between small bowel water volumes and SAT ($r = -0.284$, $p = 0.04$), TAT ($r = -0.291$, $p = 0.035$) and leptin ($r = -0.343$, $p = 0.011$).

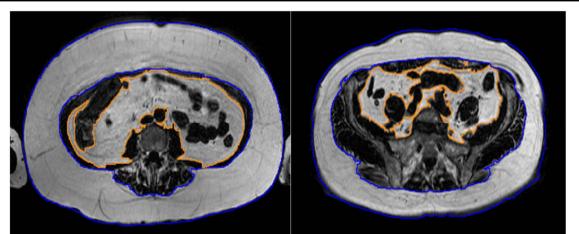


Figure 1: SAT (defined blue) and VAT (defined orange) regions obtained from the semi-automatic segmentation algorithm

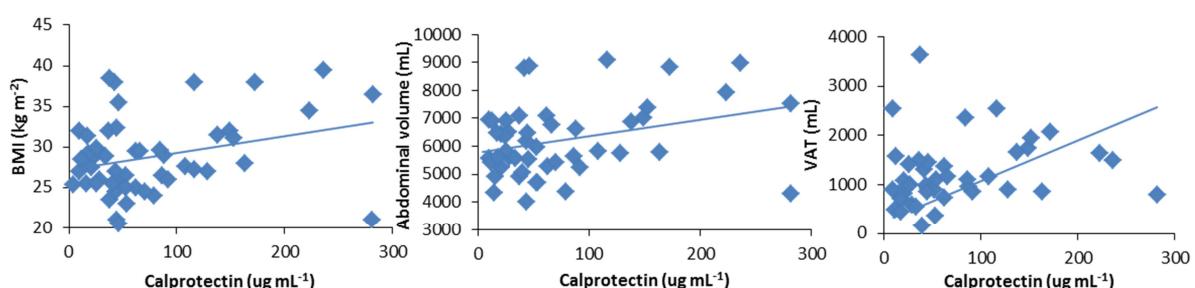


Figure 2: Correlation of Calprotectin with BMI (left) abdominal volume (middle) and VAT (right) demonstrating the link between VAT, obesity and intestinal inflammation

Conclusions: DIXON imaging of the bowel combined with a semi-automated segmentation algorithm has been used to determine the relative amounts of VAT, SAT and TAT in patients with DD. These values correlated well with adipokine concentrations and faecal calprotectin. The study confirms the known link between leptin, adiponectin and obesity, and demonstrates for the first time that abdominal visceral fat is related to intestinal inflammation possibly by the release of adipokines.

References: [1] NHS. Hospital episode statistics online. [2] Etzioni, D.A., et al., Ann Surg, 2009. **249**(2): p. 210-7. [3] Eggers et al. MRM 2011:65:96-107. [4] Hoad et al., Poster # 4310 presented at ISMRM-ESMRMB 2014. [5] Hoad et al. Phys. Med. Biol., 2007: 52:6909-6922. **Acknowledgements:** NIHR Nottingham Digestive Diseases Biomedical Research Unit