DISPROPORTIONATE ABDOMINAL VISCERAL FAT MASS REDUCTION AND COMPLETE REVERSAL OF CARDIOVASCULAR REMODELING ACCOMPANY ROUX-EN-Y GASTRIC BYPASS BUT NOT GASTRIC BANDING - BENEFITS BEYOND WEIGHT LOSS

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Word Count: 800

Brief title: Bariatric Surgery and Cardiovascular Remodeling

Funding: The study was supported by a grants from the Wellcome Trust and British Heart Foundation (BHF). SN and OR acknowledge support from the Oxford BHF Centre of Research Excellence and the Oxford National Institute for Health Research Biomedical Research Centre.

Disclosures: No relationships with industry relevant to this study

Although bariatric surgery is highly effective in reducing total body fat, Roux-en-Y gastric bypass (RYGB) proportionally reduces abdominal visceral fat more than laparoscopic adjustable gastric banding (LAGB)(1). Given that visceral fat depots are more strongly linked to increased cardio-metabolic risk, left ventricular (LV) remodelling and vascular stiffness, (2) this suggests that RYGB should result in greater cardiovascular benefits than LAGB. We sought to: 1) compare improvements in cardiovascular structure and function following RYGB and LAGB and 2) determine if visceral fat is reduced towards normal levels, a return to normal body mass index (BMI) is necessary to completely reverse the cardiovascular remodelling in obesity.

One-hundred and thirty-five participants (26 pre bariatric surgery, 36 obese controls, 73 normal weight) underwent body composition analysis with DEXA and MRI assessment of abdominal visceral fat and cardiovascular magnetic resonance assessment of LV mass, LV concentric remodelling (LV mass-to-volume ratio, LVMVR) and regional aortic distensibility (AD), as previously described (3). All 26 bariatric patients were re-studied after surgery (14 RYGB, 12 LAGB, mean 854±383 days, no difference in follow up time, $p>0.20$). Exclusion criteria included; hypertension (>140/90 mmHg), diabetes (glucose ≥6·7mmol/l), hypercholesterolaemia (total ≥ 6·5 mmol/l), smoking, and previous weight reduction surgery.

All statistics were analysed using SPSS 20. All data was normally distributed. Independent, paired T-tests, and one-way ANOVA with Bonferroni correction were performed to compare groups. A $p<0.05$ was considered significant.

Before surgery, although BMI was higher in the RYGB group compared to the LAGB group (46.8±5.6 vs 41.1±4.8kg/m^2; $p=0.01$), body fat percentage (52.3±24.7 vs 48.9±22.2%, $p=0.19$), total fat (66.3±14.2 vs 56.3±12.6kg; $p=0.07$), visceral fat (173.8±63.5 vs 140.0±70.0cm^2;

p=0.21), glucose (5.3±0.7 vs 5.3±0.7mmol/l; p>0.99), cholesterol (5.1±0.8vs 5.1±0.6mmol/l; p=0.7) and systolic blood pressure (129±12 vs 119±144.mmHg; p=0.05) were similar. LV mass (134.4±25.1g vs 127.5±24.4g; p=0.48), LVMVR, (0.89±0.18 vs 0.84±0.14; p=0.45) and regional AD (ascending aorta; 4.2±2.0 vs 5.8±3.5mmHg^{-1}, p=0.18, proximal descending aorta (PDA) 3.7±1.5 vs 4.6±2.2mmHg-1, p=0.21, abdominal aorta (DDA) 4.7±1.4 vs 6.2±3.1mmHg^{-1}, p=0.13) were also similar between surgical groups.

Although BMI change was greater with RYBG (14.0±4.6 vs 8.5±3.2kg/m^2, p0.02), post-operative BMI (RYGB 32.7±4.7 vs LAGB 32.6±5.6kg/m^2; p=0.94) and total fat loss (RYGB 41.0±11.1 vs LAGB 33.4±18.2%; p=0.92) were similar. Visceral fat loss expressed as a percentage (RYGB 61.6±11.8 vs LAGB 31.1±18.1%; p<0.001) and relative to the total fat loss (RYGB 1.6±0.5 vs LAGB 1.0±0.6; p=0.02) were greater following RYGB. RYGB also resulted in greater improvements in cholesterol (4.4±0.8 vs 5.3±0.9mmol/l; p=0.04), and systolic blood pressure (-11.6±9.4 vs 1.1±10.7 mmHg; p<0.01).

Although both RYGB and LAGB reduced LV mass (by 23% and 15%, p<0.01 for both) and LVMVR (by 12% and 17% respectively, p<0.01), RYGB was associated with a greater LV mass reduction (by 8%, p=0.049) and greater improvement in abdominal AD (59%, p=0.05).

When compared to an age and sex-matched cohort with similar BMI (32.7±4.7 vs 33.7±3.1kg/m2; p=0.77) and total fat (38.1±7.7 kg vs 38.5±7.2kg; p>0.99) patients following RYGB had 47% lower visceral fat (p<0.001). Despite remaining obese, visceral fat following RYGB was reduced to the same level as age and sex-matched normal weight controls (Figure 1). LV mass (102.5±21.9g vs 122.4±29.5g; p=0.03) and LVMVR (post RYGB 0.73±0.03 vs 0.84±0.02; p=0.004) were also both lower than BMI and fat mass matched obese controls, and regional AD better (PDA 5.9±1.8mmHg^{-1} vs 4.6±1.6mmHg-1; DDA 8.5±2.8 mmHg-1 vs 6.4±2.4 mmHg-1; both p<0.05). Again, although still obese, LV mass (102.6±18.7 vs

103±29.4g; p>0.99), LVMVR (0.73±0.12 vs 0.75±0.13; p>0.99) and regional AD (PDA and DDA; p>0.43) were all similar to normal weight controls (Figure 1).

The medium term effects of two common forms of bariatric surgery on cardiovascular remodelling are assessed in this pilot study. We have shown that RYGB results in greater reduction in abdominal visceral fat, and greater reversal of LV remodelling and aortic stiffness than LAGB. Furthermore we have shown that although remaining obese following RYGB, LV mass, concentric remodelling and aortic elastic function are returned to normal. Overall this suggests that, as long as visceral fat is reduced, a return to normal BMI is not necessary for complete resolution of the cardiovascular structural and functional changes in obesity. Larger studies are need to confirm these findings and establish how the reduction in abdominal visceral fat mediates these improvements independently from other fat depots.

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Figure

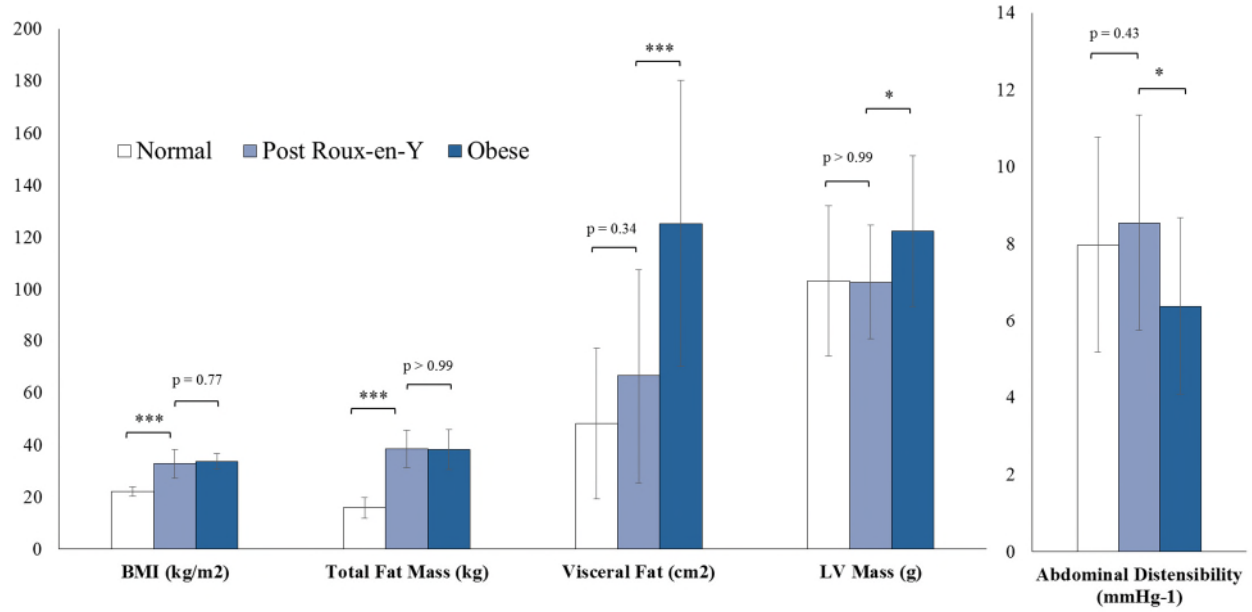

Figure 1. The Effect of Roux-en-Y Gastric Bypass on Cardiovascular Remodelling (Standard Deviationbars; *** p<0.001, * p<0.05)