Atrial fibrosis is recognized as the histopathological correlate of the atrial fibrillation (AF) substrate and predictive of chronicity.

**Methods:** An ad-libitum calorie-dense diet was used to promote obesity in a cohort of 30 sheep. During dynamic weight gain, 10 were sampled at baseline, 4 months and 8 months for detailed cardiac MRI, invasive arterial and LA pressure measurements. Atrial tissue fibrosis was quantified using picrosirius red stain, inflammation was graded using H&E staining and myocardial lipid content proportioned using Oil-red-O staining. Tissue analysis was quantified by automated digital methods.

**Results and Conclusion:** Weight progressively increased (48kg-125kg). There was a significant correlation between atrial fibrosis and weight, atrial volumes, myocardial mass, atrial inflammation grade, intramyocardial lipid, pericardial fat, LA pressure and mean arterial pressure. Using linear regression with stepwise entry of significantly correlated variables, weight was predictive of RA fibrosis (P<0.001) whereas LA pressure and atrial inflammation were each predictive of LA fibrosis (P<0.001 and P=0.008, respectively). Weight and total myocardial mass were each predictive of total atrial fibrosis burden (P<0.001 and P=0.018, respectively). In this model of weight gain and obesity, weight, LA hypertension, LA inflammation and ventricular mass were individually predictive of either regional or global atrial fibrosis burden, thus providing insights into mechanisms by which obesity may promote AF.

**Keywords:** fibrosis, obesity, left atrium