Compartmental modelling of ^{18}F-FDG to assess Pulmonary Inflammation in Obstructive Sleep Apneoa/Hypopneoa Syndrome (OSAHs) Patients.

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Introduction:
Obstructive Sleep Apnoea/Hypopneoa syndrome (OSAHs) is associated with significant systemic implications including hypertension and increased risk of cardiovascular disease. Widespread inflammation is complicit in the manifestations of OSAHs and may account for the increased cardiovascular risk [1]. Currently, the mechanism that produces the sustained inflammatory state is not well understood.^{18}F-FDG PET is a widely established non-invasive imaging technique which highlights areas of increased glucose metabolism; inflammatory cells are highly metabolically active thus, FDG-PET has been used to identify inflammatory states. Mathematical modelling of the dynamic FDG-PET signal allows the estimation of the absolute metabolic rate of glucose consumption and volume of blood in a volume of interest. A bespoke analysis pipeline was developed to enable us to extract these measures as surrogates of disease within the lung parenchyma. Our aim was to provide a novel approach to assess the inflammatory burden in the lungs of OSAHs patients and compare to the uptake to a control population of healthy subjects.

Methods:
In this work, we performed dynamic ^{18}F-FDG-PET/CT in 6 OSAHs patients and 6 healthy controls. An attenuation correction CT scan was followed by administration of 240MBq of ^{18}F-FDG; both scans were acquired under normal breathing.
Analysis was performed using an in-house pipeline (principally using MATLAB(R)) with the lung images segmented using ITK-SNAP. The outcome measures were metabolic rate of FDG (Ki) and fractional blood volume (Vb) obtained via compartmental modelling.
Mean, median, inter-quartile ranges and Mann-Whitney U tests were calculated using R.

Results:
5 male and 1 female (age range: 49-73) OSAHs patients completed the study; six healthy volunteers (5 male, 1 female) were age matched to this cohort (age range: 53 - 72). Ki was modestly decreased in the OSAHs cohort relative to healthy control group but not reach significance (mean Ki =0.0053 and 0.0061 respectively, p =0.31). Vb was markedly lower in OSAHs patients compared to the healthy group (mean Vb =0.082 and 0.14 respectively, $p < 0.05$)

Conclusion:
We present the first example (to our knowledge) of the use of dynamic FDG in OSAHs patients. Previous work has highlighted that FDG PET is a promising modality for identifying lung inflammation [2]. In this pilot study, we have shown that metabolic rate of ^{18}F-FDG determined by compartmental modelling could not distinguish a difference between the two groups. However, fractional blood volume was significantly lower in OSAHs compared with healthy subjects. The small group sizes make robust conclusions difficult to draw but we believe this preliminary result warrants further investigation into the utility of FDG PET as a marker of lung inflammation.

References:
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[2] Chen et al. Quantification of Lung PET Images: Challenges and Opportunities, J Nucl Med 2017, 58(2): 201-207