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NEWS

Xenon-129 MRI Pulmonary Gas Exchange in Long COVID is Associated with Cognitive Function and Brain MRI

PURPOSE

Assess associations between pulmonary MRI gas exchange, structural and functional brain MRI, and cognition in long COVID patients.

METHODS AND MATERIALS

Subjects with persistent dyspnea and/or fatigue following the resolution of acute COVID-19 infection (long COVID) were recruited from a post-COVID-19 clinic. Hyperpolarized 129Xe pulmonary MRI, structural and functional brain MRI, pulmonary function (forced expiratory volume in 1 second [FEV1]) and cognitive tests were acquired at the same study visit. Images of pulmonary gas exchange were obtained spectroscopically using a 1-point Dixon technique to estimate the xenon uptake in alveolar-capillary membrane (mem:gas) and red blood cell (RBC:gas) compartments and gas transfer ratio (RBC:mem). 3D MPRAGE anatomical and T1 weighted ASL functional brain MRI were processed using BRAINSAutoWorkup to quantify cerebral gray (GM) and white matter (WM) volumes and cerebral blood flow (CBF). Perceived cognitive difficulties were measured using Patient-Reported Outcomes Measurement Information System (PROMIS Cognitive Function) and objective cognitive performance was assessed using National Institute of Health Toolbox V3 Cognition Battery with normatively adjust t-scores grouped as follows: total cognition composite (TCC), executive function (EF), processing speed (PS), memory (Mem) and language (Lang). Univariate relationships were evaluated using Spearman correlations.

RESULTS

11 subjects (10 female, age=52±12 yrs. [min-max=28-63], BMI=30±8 kg/m3 [min-max=21-42]) approximately 31 months from acute infection (min-max=24-40 months) were evaluated. Subjects self-reported cognitive difficulties (PROMIS mean t-score=34.4); cognitive performance was within normal limits (TCC mean t-score=55.5). Pulmonary-cognition relationships were observed for EF with RBC:mem (ρ=0.76, p=0.02) and RBC:gas (ρ=0.60, p=0.05). Percent predicted FEV1 was not significantly related to cognition, but trended toward a relationship with PS (ρ=0.54, p=0.08). Pulmonary-brain MRI relationships were observed for RBC:mem with cerebral WM (ρ=0.65, p=0.04), frontal lobe GM (ρ=0.66, p=0.04), parietal lobe WM (ρ=0.77, p=0.01), parietal lobe WM (ρ=0.71, p=0.02) volumes, and CBF (ρ=-0.74, p=0.04). RBC:gas was also correlated with CBF (ρ=-0.79, p=0.02).

CONCLUSIONS

In long COVID, lower pulmonary gas exchange may be associated with cognitive dysfunction, as well as lower GM and WM volumes and higher CBF.

CLINICAL RELEVANCE/APPLICATIONS

Gas exchange abnormalities sensitively detected using 129Xe MRI may help identify long COVID patients who require additional treatment or long-term management.