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Title: Evaluation of the peripheral airway microstructure in children with cystic fibrosis (CF) using ^3He magnetic resonance imaging

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Body: Background: Pathology and lung function studies show that small airways are affected early in CF lung disease. Due to the inaccessibility of the distal air spaces little research has been performed in this area. The lung microstructure can be studied using the relatively new technique of hyperpolarised noble gas magnetic resonance ($^3\text{HeMR}$) scanning(1). Study aims: To compare acinar airway size of children with CF with that of healthy controls. Methods: In children with relatively mild CF lung disease $^3\text{HeMR}$ was undertaken during breath-hold following inhalation of a bolus of hyperpolarised ^3He gas mixture. A signal was obtained using the q-space technique(2). We applied Yablonskiy's acinar model(3) on the raw data to obtain the values for mean acinar duct diameter, R and mean alveolar sleeve depth, h. All children had spirometry and lung clearance index (LCI) measured. Results: We studied 9 children (6-10y) with CF (FEV1: 97.6%predicted; SD \pm 14.3) and 18 age-matched controls. LCI was elevated in all CF patients (median 10.7; range 9.1-12.9). Acinar duct diameters (438.4 μm ; SD \pm 21.8) and alveolar sleeve depth (294.2 μm ; SD \pm 60.3) were both significantly (p<0.05) larger compared to controls (404.3 μm ; SD \pm 34.8 and 223.8 μm ; SD \pm 38.5 respectively). Discussion: $^3\text{HeMR}$ is well tolerated in children from school age. We found that R and h, both surrogate values for acinar size, are larger in children with mild CF lung disease compared to healthy controls. $^3\text{HeMR}$ may constitute a sensitive technique for investigating CF lung disease. References: 1.Narayanan M et al 2012 AJRCCM; 185:186 2.Shanbhag DD et al 2006 JMRI; 24:84 3.Yablonskiy DA et al 2002 PNAS; 99:3111.