Introduction: Hemodialysis (HD) replaces lost kidney function in end-stage kidney disease patients. HD exerts significant circulatory stress on the body due to rapid removal of fluid and sudden relief of edema leading to hypovolemia and a hypotensive state, resulting in lower global blood flow. Using CT perfusion imaging, we previously determined that HD does not have a significant effect on total liver perfusion, although the changes in hepatic arterial and portal venous blood flow during HD are indicative of hemodynamic shifts in delivery of blood to the liver. In addition, a companion study which measured water content in the liver and leg (i.e., centrally and peripherally) before and after HD using water MRI found that peripherally measured water content tended to decrease while liver water content tended to increase. The current study focused on using CT perfusion to independently investigate how liver fluid content changes during HD, with the hypothesis that patients will have increased liver water while undergoing standard HD treatment. This is an important finding to validate because understanding how central fluid status is affected by HD can help guide clinical decisions regarding optimal fluid volume removal.

Methods: 15 patients provided written informed consent as part of the study. During a study visit at St. Joseph’s hospital, CT perfusion imaging was performed at four times: before, 1 and 3 hours into, and after HD. CT imaging was performed on the GE Revolution CT scanner immediately following a bolus injection of iodinated contrast agent. Liver fluid content was represented as hepatic extravascular, extracellular contrast distribution volume (Vd) and quantified as Vd=(F-E)k2 , where F is blood flow, E is extraction efficiency and k2 is efflux rate constant. Deconvolution-based ROI analysis was used to obtain Vd values from the CT images (registered using non-rigid registration software) and statistical analysis was performed using non-parametric tests.

Results: Preliminary analysis of 10 patients was completed. Vd decreased below baseline in 5 patients (#1-5) and increased above baseline in 3 patients (#6-8). For patient #9, Vd increased above baseline during HD but then dropped below baseline by the end of HD while for patient #10, the trend was the reverse. The average Vd for all patients increased to ≤39% above baseline 1 hr into HD and then decreased to and remained at just under (≤3-4% below) baseline from 3 hrs until the end of HD.

Discussion: The changes in hepatic Vd were heterogeneous among patients. However, the transient increase in average Vd early into HD may represent increased liver congestion (due to water), leading to increased vascular resistance and hence a reduction in low-pressure circuit (i.e., portal venous) perfusion. To compensate, hepatic arterial perfusion would increase, potentially causing increased oxidative stress and a drop in hepatic function, which supports the findings of our previous study.