Introduction: Hemodialysis (HD) is designed to replace lost kidney function in patients affected by end-stage kidney disease. HD patients are typically hypervolemic and exhibit congested blood flow among abdominal organs, resulting in higher myocardial demand. During an HD session, a state of temporary hypovolemia is established, leading to a hypotensive state and decreased global blood flow. In addition, the liver becomes more vulnerable to hemodynamic stresses during HD due to circulating endotoxins (i.e., endotoxemia), increasing the liver’s vulnerability to ischemia-reperfusion injury. This study focused on using CT perfusion imaging to investigate how the hemodynamic stresses of dialysis affect hepatic blood flow, with the hypothesis that patients will have reduced global liver perfusion while undergoing standard hemodialysis treatment. This is an important finding to validate because if HD has the potential to cause hepatic ischemia, interventions before, during or after the treatment may be initiated to reduce or prevent liver injury.

Methods: 15 patients provided written informed consent as part of the pilot study. During a study visit at St. Joseph’s hospital, CT perfusion imaging and ICG clearance measurements were performed at four time points: before, 1 and 3 hours into, and after dialysis. CT imaging was performed on the GE Revolution CT scanner immediately following a bolus injection of iodinated contrast agent. ICG clearance was measured using a DDG 3300 unit for approximately 15 minutes following a single ICG bolus injection through a peripheral cannula by attaching a finger probe to the patient. Image registration for the CT scans was performed using non-rigid registration software, and parametric maps (e.g., blood flow, blood volume, mean transit time) were generated from the registered CT images. Statistical analysis was performed using non-parametric tests.

Results: The average total liver blood flow did not change over the course of HD, fluctuating by $\leq 1.5\%$ between the four timepoints (i.e., pre, 1 hr, 3 hr, post). However, hepatic arterial and portal venous blood flow demonstrated trends of increasing and decreasing, respectively, where average hepatic arterial blood flow increased to $\leq 26\%$ above baseline and average portal venous blood flow decreased to $\leq 7\%$ below baseline over the course of HD. In addition, the average ICG clearance rate showed a trend of steady decline over the course of HD, dropping to $\leq 14\%$ below baseline by the end of the dialysis session.

Conclusions: Overall, 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. However, the decline in ICG clearance (and hence liver function) suggests that HD may result in recurrent episodes of hepatic dysfunction. This is possibly due to increased endotoxin translocation from the gut due to HD-induced systemic circulatory stress and recurrent regional ischemia (e.g., heart and brain).