

Background: Activation of the renin–angiotensin–aldosterone system (RAAS) is a hallmark of congestive heart failure (CHF), where persistent stimulation drives sodium and water retention, vasoconstriction, and both myocardial and renal fibrosis. These maladaptive pathways contribute to congestion, diuretic resistance, and worsening renal function. Although loop diuretics are widely used in the management of CHF, the degree to which intravenous (IV) diuretics further stimulate the RAAS, beyond activation driven by CHF itself, has not been evaluated in dogs. Similarly, it is unknown whether different clinical manifestations of CHF, such as left-sided CHF (LHF; pulmonary edema) versus right-sided CHF (RHF; cavity effusions), are associated with distinct RAAS profiles. Identifying whether RAAS activation is homogeneous or variable across CHF phenotypes and treatment states will support accurate sample-size estimates for future interventional trials. Furthermore, it could propel exploration of novel approaches and identify opportunities to refine CHF therapies to avoid exacerbating RAAS activity.

Statement of Purpose: To determine if a commonly used diuretic (furosemide) given IV to dogs in CHF incrementally activates RAAS beyond that associated with active CHF itself and to evaluate whether RAAS activation differs between dogs presenting with LHF compared to dogs with RHF.

Hypotheses:

1. Dogs with active CHF (prior to IV furosemide or not requiring IV diuretics) will exhibit greater RAAS activation than dogs with stable CHF, but less activation than dogs that have already received IV furosemide.
2. RAAS activation will not differ between dogs with LHF and those with RHF.

Specific Aims (Objectives):

Aim #1: To compare RAAS metabolites and enzymes among three diuretic-treated CHF groups:

- a) stable CHF with no evidence of congestion
- b) active CHF (evidence of congestion) either before receiving or not requiring IV furosemide
- c) active CHF (evidence of congestion) after receiving IV furosemide

Aim #2: To compare background loop diuretic dosages and biochemical variables among these 3 groups

Aim #3: To compare RAAS metabolites and enzymes between dogs with LHF and RHF

Student role: Most samples have been biobanked and analyzed; remaining analyses will be completed in spring 2026, and an additional five dogs meeting criteria for group (b) will be prospectively enrolled. Under direct mentorship (Dr. Adin on-site; Dr. Harris remotely), the student will:

1. The student will peruse the Emergency white board and the Cardiology appointment board daily to identify dogs with active CHF who are stable enough to allow for blood sampling before IV furosemide administration or if IV is not needed. The student will coordinate client consent with the clinician of record, obtain the blood samples, and process the blood samples prior to analysis.
2. The student will record clinical patient data, including signalment, medications and dosages, presence/absence of active CHF, biochemical values from the renal panel and RAAS variables.
3. The student will collate data in an excel spreadsheet and participate in statistical analysis with the guidance of the faculty mentors. Manuscript preparation and presentation of study findings are expected as per program requirements.