

BIOMEDICAL ENGINEERING
COLLEGE OF ENGINEERING AND APPLIED SCIENCES

SUMMER RESEARCH OPPORTUNITIES FOR UNDERGRADUATE students

FOR APPLICATION YEAR: 2025

PROJECT TITLE: Abdominal Wall Tension as a Novel Indirect Measure of Intra-Abdominal Pressure in Neonates

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Project Description

Intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS) are comorbid conditions that could result in low perfusion to the abdominal area and lower extremities, consequently negatively affecting oxygen delivery to organs, ultimately leading to organ failure, and death. Incidence rates of ACS in the literature vary, but some reports show rates as high as 20%. IAH and ACS are indicated primarily by intra-abdominal pressure (IAP) with IAH defined as IAP greater than 12 mmHg and ACS defined as IAP greater than 20 mmHg. This is often, but not exclusively, seen in neonates with necrotizing enterocolitis (NEC) (inflammation or perforation of the intestines). In neonates, even slightly elevated IAP of 5 mmHg, well before the threat of ACS, can lead to extreme discomfort and difficulty feeding as additional fluid introduced to the abdominal area from feeding further elevates IAP, dangerously progressing the neonate to ACS. Disrupting an infant's nutritional intake is especially detrimental at this stage in life where regular feeding schedules must be maintained to help babies grow and develop. The gold standard of quantitative IAP measurements is a peritoneal catheter; however, catheterization is invasive and very risky and may require sedation or paralysis. As a result, physicians rely on palpation to monitor IAP.

However, studies have shown that palpation is unreliable with up to 60% of patients being misdiagnosed. Given the need for monitoring IAP to prevent ACS, support regular nutrition, and detect NEC, the difficulty in monitoring IAP using a catheter, and the unreliability of palpation, there remains a need for a simple, noninvasive method of measuring IAP in neonatal populations.

Abdominal wall tension (AWT) has shown potential as a non-invasive, indirect measure of IAP, being previously validated in adults. AWT can be measured with a force sensor as the sensor lightly presses into the abdomen (~5 mm depth) and is similar in principle to the palpation method but provides objective measures of force instead of the “sensation of force” as with palpation. Previous studies have correlated AWT to IAP in adults, but not in neonates. Given the differences in skin and soft tissue elasticity of neonates compared to adults, which could impact the relationship between AWT and IAP, it is necessary to explicitly characterize the relationship between AWT and IAP in the neonates to assess whether AWT is a proper indirect measure of IAP in this population. This research aims to demonstrate that AWT is a safe, non-invasive, indirect measure of IAP in neonates and can be leveraged to decrease the incidence of IAH, ACS, and NEC, as well as support clinical decision-making regarding nutrition.