BIOSENSOR TECHNOLOGY FOR EARLY DETECTION OF ANASTOMOTIC LEAK AND INTRA-ABDOMINAL SEPSIS AFTER GASTROINTESTINAL SURGERY

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Introduction:
Anastomotic leak (AL) is a cause of considerable morbidity and mortality. Current diagnostic tests are insensitive and costly, and timely intervention is often missed. Biosensor technology has the potential to offer "point of care" detection of AL.

Methods:
An animal model of abdominal sepsis was developed using caecal ligation and puncture vs. sham at two time points (20 adult male wistar rats each arm) to assess biomarkers for AL: lactate, TNFα and E.coli. Amperometric lactate biosensors were constructed using lactate oxidase immobilised to a carbon transducer. Biosensors were evaluated in buffer, calf serum and peritoneal fluid from patients undergoing elective colorectal surgery with/without AL.

Results:
All biomarkers (lactate, TNFα, E.coli) were significantly elevated in sepsis animals compared to sham at 24 and 36 hours (p = <0.0001 all cases). Lactate at 24 hours provided the highest diagnostic accuracy (ROC analysis = 0.9229). The fabricated lactate biosensor was optimised to lactate oxidase concentration and incubation time (1.25 U, 20 min), and testing with interferents confirmed high selectivity. Lactate levels in day 1 peritoneal samples showed good correlation between the biosensor and a commercial assay (p = 0.001, Spearman’s correlation). This small patient cohort demonstrated a trend to increased lactate levels in AL vs. non-AL.

Conclusions:
Lactate, TNFα, and E. coli are early markers of abdominal sepsis in an animal model. Our amperometric biosensor provides an accurate means of measuring lactate in peritoneal fluid. It has the potential to provide “point-of-care” diagnostics, allowing early detection of AL and abdominal sepsis, improving clinical outcomes.

Take home message:
We report the successful development of a sepsis animal model identifying three suitable biomarkers correlating with abdominal sepsis. We have constructed and optimised a novel amperometric biosensor capable of accurately measuring lactate in patient peritoneal drain fluid samples for earlier detection of anastomotic leak, to improve outcomes from this catastrophic complication.