REAL-TIME INTRAOPERATIVE COMPARISON OF MUCOSAL AND SEROSAL PERFUSION OF RECTOSIGMOID ANASTOMOSIS USING LASER SPECKLE CONTRAST IMAGING (LSCI) AND INDOCYANINE GREEN FLUORESCENCE ANGIOGRAPHY (ICG-FA) IN A PORCINE MODEL

Saloni Mehrotra, MD[1]; Yao Z Liu, MD[2]; Vasiliy Buharin, PhD[3]; Christopher McCulloh[3]; Garrett Skinner, MD[1] ; Chibueze Nwaiwu, MD[2]; Steven Schwaitzberg, MD[1]; Matthew Kalady, MD[4];Peter Kim, MD, PhD[2]
[1]SUNY at Buffalo; [2]Brown University; [3]Activ Surgical, [4] The Ohio State University Wexner Medical Center

Introduction

We report a novel application of Laser Speckle Contrast Imaging (LSCI) to detect and quantify mucosal and serosal tissue perfusion in a clinically relevant porcine rectosigmoid anastomosis model.

Accurate intraoperative assessment of both mucosal/serosal tissue perfusion may influence technical decisions and lead to reduced complications including strictures and anastomotic leaks.

Methods

ActivSight™ is an FDA-cleared device in laparoscopic form factor that can be used to visualize both LSCI and indocyanine fluorescence angiography (ICG-FA) intraoperatively.

Using LSCI and ICG-FA, mucosal (trans-anal) and serosal (transperitoneal) perfusion of a stapled end-to-end porcine rectosigmoid anastomosis was assessed under the following conditions: (1) control, e.g. physiologic blood flow; and (2) induced ischemia via superior rectal artery occlusion ***(Figure 1, 2, 3).***

Microvascular perfusion was quantified using LSCI derived Relative Perfusion Units (RPU) percentages. ICG-FA was assessed by visual inspection.

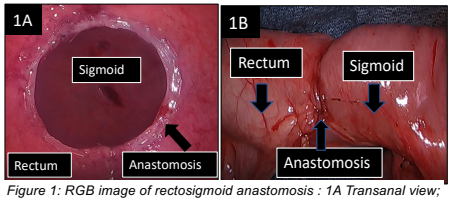


Figure 1: RGB image of rectosigmoid anastomosis : 1A Transanal view; 1B Transperitoneal view

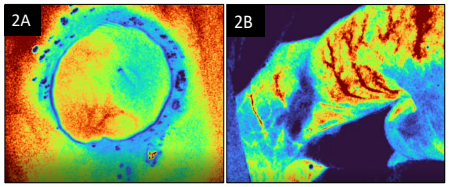


Figure 2: Laser Speckle Perfusion Colormap of rectosigmoid anastomosis (control) : 1A Transanal view; 1B Transperitoneal view

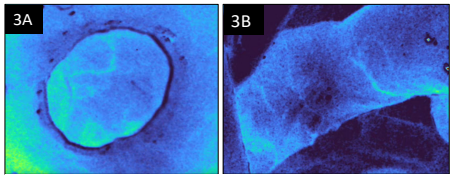


Figure 3: Laser Speckle Perfusion Colormap of rectosigmoid anastomosis (occlusion) : 1A Transanal view; 1B Transperitoneal view

Results

Higher perfusion was measured on the mucosal surface of the anastomosis (52% ±26) as compared to the serosal surface (41% ±10, p=0.09) (Figure 4A) using LSCI RPU.

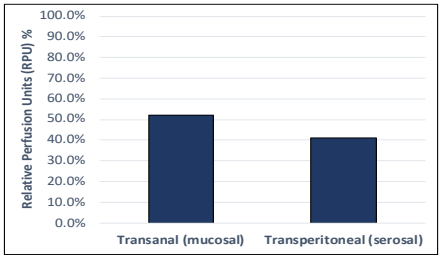


Figure 4A. Comparison of Transanal and Transperitoneal anastomotic perfusion . Transanal perfusion > Transperitoneal perfusion (p=0.09).

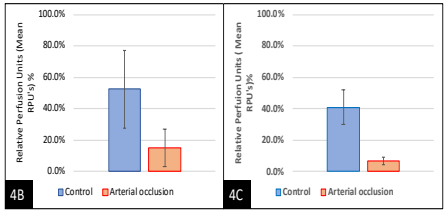


Figure 4: Distribution of RPU in transperitoneal (4A) and transanal image (4B). control perfusion> arterial occlusion perfusion (p<0.05).

Arterial occlusion induced a significant decrease in anastomotic perfusion on both the mucosal (15% ±12) and the serosal surfaces (6% ±2) (p<0.00001) (Figure 4B/4C).

Visual inspection of ICG-FA did not detect any apparent differences in mucosal and serosal anastomotic perfusion under these two conditions (Figure 5A/5B).

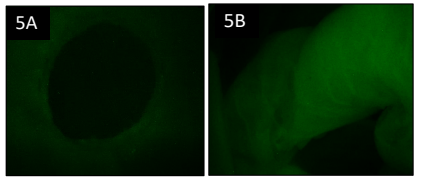


Figure 5: ICG-FA image of rectosigmoid anastomosis under both control and arterial occlusion conditions : 5A Transanal view; 5B Transperitoneal view

Conclusion

LSCI can detect and display real time variation in tissue perfusion mucosal and serosal surfaces of a porcine rectosigmoid anastomosis.

Real time assessment of mucosal and serosal perfusion using LSCI may provide a potential tool for more accurate intraoperative clinical decision making and reduced complication rates.

University at Buffalo The State University of New York
Department of Surgery
salonime@buffalo.edu