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EVALUATION OF INTESTINAL VIABILITY USING 3-CCD (CHARGE COUPLED DEVICE) IN CHILDREN UNDERGOING APPENDECTOMY

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Introduction

The surgeon's ability to determine intestinal viability is limited to subjective measures of visual clues of perfusion. This inability to accurately determine viability presents a conundrum for the surgeon. In our laboratory, we use 3-CCD technology to separate visible light into its three primary wavelengths; by using an easily implemented mathematical algorithm, the amount of light detected by the CCDs can be directly correlated with tissue oxygenation. In this study, we report the use of 3-CCD technology to determine intestinal perfusion by using an appendectomy model for ischemia.

Methods

In this study, we sequentially recorded 10 laparoscopic appendectomies for appendicitis. In brief, the recorded images are analyzed by selecting three regions of interest (ROIs) and evaluating the intensity levels (a.u.) at various locations along the appendix. Figure 1A demonstrates the enhanced image of an ischemic appendix during an appendectomy. The black box indicates the fat ROI, the white boxes indicate the appendix ROIs, and the dashed black boxes indicate the colon ROIs. The colon was used as a control for normal perfusion and a ratio to fat was performed to normalize the data.

Results

As an indication of decreased perfusion, the appendix demonstrated a significant reduction in mean ROI values over time. Figure 1B represents fat normalized ROI intensity values calculated for the colon ($R^2 = 0.02$), appendix ($R^2 = 0.92$), and distal appendix ($R^2 = 0.89$).

Conclusions

In this primary study, we have demonstrated proof of principle for 3-CCD technology to determine bowel ischemia. We have conclusively demonstrated reduced intensity levels in areas of known ischemia. Given the ability of this technology to identify areas of ischemia, this technique has the potential to significantly change the management of malrotation with volvulus, necrotizing enterocolitis and intestinal reconstruction in the future.