Real-time intestinal perfusion assessment for anastomotic site selection using laser speckle contrast imaging

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INTRODUCTION

Anastomotic leakage is a major complication following gastrointestinal surgery, influenced by various factors including tissue perfusion. Adequate perfusion is crucial for successful healing. Real-time perfusion assessment techniques like laser speckle contrast imaging (LSCI) have gained interest to guide surgical decision-making and improve outcomes. This study aimed to assess laparoscopic LSCI for real-time identification of intestinal perfusion as a red flag technique for anastomosis creation.



Figure 1 | Graphic representation of the experimental setup.

METHODOLOGY

This study was performed in compliance with Dutch legislation concerning animal research. Ischemic loops were created by experienced surgeons in a femal Dutch Landrace pig. The ischemic loops were assessed by five senior surgeons using PerfusiX-Imaging, a laparoscopic laser speckle imager (Figure 1).

1. **Intestinal perfusion (Figure 2a and 2b):**
   a. Could you identify an ischemic loop?
   b. Could you detect a perfusion difference in the other two loops?
   c. Could you identify the best perfused loop?

2. **Anastomotic perfusion (figure 2c and 2d):**
   a. Would you advise creating an anastomosis based on this additional visual feedback?
   b. Can you identify a perfusion difference?
   c. What is the worst perfused tissue?

3. **The usability of PerfusiX-Imaging was assessed using a questionnaire.**



RESULTS

1) **Intestinal perfusion**
   a. All surgeons correctly identified the ischemic loop
   b. All surgeons could identify the perfusion differences
   c. 80% of the surgeons correctly identified the best perfused loop

2) **Anastomotic perfusion**
   a. All surgeons advised against creating the loop
   b. All surgeons could identify the difference in perfusion
   c. All surgeons could identify the worst perfused loop

3) **Usability: see figure 3**

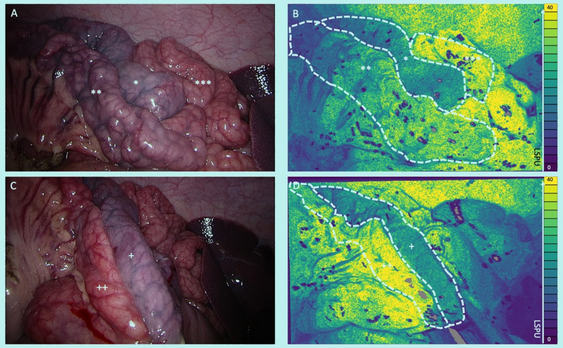


Figure 2 | The white light images (LEFT) of the three differently perfused loops. */+ Indicates the ischemic loop, ** indicates the compromised loop and ***/++ indicates the healthy loop. The PerfusiX-Imaging perfusion images (RIGHT). Blue indicates low perfusion and yellow indicates high perfusion.

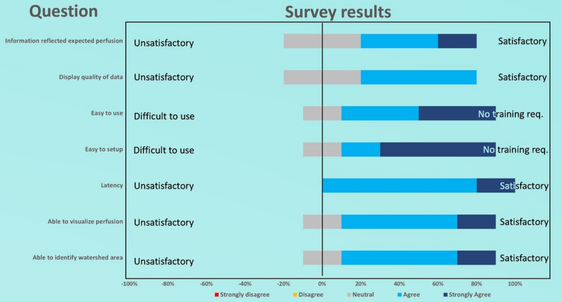


Figure 3 | The results from the survey filled in by five surgeons represented in percentages in a Likert profile graph. The answers ranged from strongly disagree/bad to strongly agree/good. The questions were **(1)** The PerfusiX-Imaging perfusion information reflected the expected pattern of blood flow? **(2)** How was the display quality of PerfusiX-Imaging on displaying the blood flow? **(3)** PerfusiX-Imaging was easy to use during surgery? **(4)** How easy was it to setup PerfusiX-Imaging? **(5)** Was there latency during the perfusion imaging? **(6)** PerfusiX-Imaging was able to visualize tissue perfusion intraoperatively? And
watershed area using PerfusiX-Imaging.

CONCLUSION

PerfusiX-Imaging provided valuable real-time feedback on intestinal tissue perfusion during surgery, enabling surgeons to select optimal tissue segments for a well-perfused anastomosis. LSCI has the potential to improve surgical decision-making and minimize complications such as AL. Further studies are needed to validate its clinical efficacy and impact on patient outcomes.