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Quantitative analysis of fluorescence intensity during NIR guided surgery in ventral hernia repairs: Standardizing subjectivity

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INTRODUCTION

Complex ventral hernia repair (VHR) are becoming more frequently performed by general surgeons in the US. Adequate perfusion of the abdominal wall is essential for wound healing after surgery, especially in the setting of complex abdominal wall reconstructions with large myocutaneous flaps. This study aims to standardize a normal range of fluorescence intensity, based on tissue type (skin and subcutaneous tissue) during VHRs.

METHODS

During open VHRs 3 still images were taken following the administration of indocyanine green (ICG) while illuminated with a near-infrared (NIR) imaging system. The NIR system utilized, the timing of ICG administration to visualization, the phase of the operation, and the distance from the device to the tissue were the same for all cases. The images were extracted and analyzed using ImageJ software. Three aleatory areas of the skin were selected to evaluate skin light intensity ratios (IR) (Group A) for each image in all cases. The same was done to evaluate subcutaneous tissue light intensity (Group B). A one-sample *t-test* was performed to observe and compare means between all IRs, and the continuous data was used to determine standard deviations and range of IRs for both groups.

Table 1.1
Common demographics

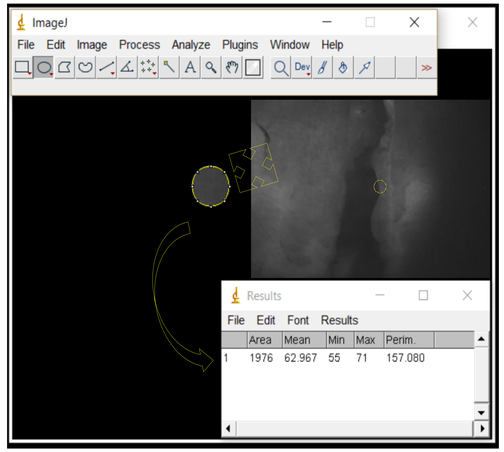
	Total population N=6
Age (years)	50.5±11.5
BMI (kg/m^2)	24.7±4.9
Gender (Male)	83.3% (N=5)
Race (Caucasian)	66.7% (N=4)
CST	100% (N=6)
OSA	33.3% (N=2)
T2DM	50% (N=3)

BMI: Body mass. CST: Component separation technique. OSA: Obstructive sleep apnea. T2DM: Type 2 diabetes mellitus.

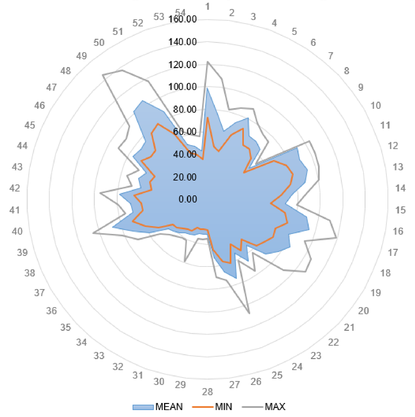
Table 1.2
Operative details & postoperative outcomes

	Total population N=6
Operative details	
OR time (mins)	200±54
Mean defect area (cm^2)	271±183
Postoperative outcomes	
SSO at 30-days postop	0%
Mortality at 30-days postop	0%
Recurrence at 1-year follow-up	0%

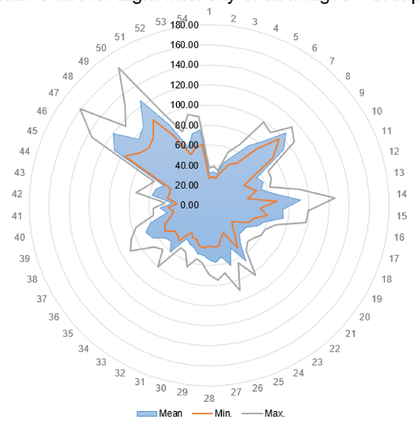
OR: Operative room. SSO: Surgical site occurrence defined as any surgical site complication including infection, seroma, wound dehiscence, and the formation of an enterocutaneous fistulae. Means±Standard deviation or Percentage (%), (N=number).



Radar Chart for Light Intensity of all images - Group A



Radar Chart for Light Intensity of all images - Group B



RESULTS

A total of 6 cases were included for image assessment. A total of 18 images and 54 areas of interest were assessed to determine light IRs emitted by fluorescence. This was performed for both Group A and B. The mean IRs for Group A was 66.6±19.6, while the mean IRs for Group B was 62.8±21.8. When comparing areas of interest in each image, and compared collectively, the IRs were found to be significantly different (p<0.0001) in both groups.

CONCLUSIONS

NIR imaging systems provide visual feedback for operating surgeons. These results are the first attempt to renounce subjectivity when assessing fluorescence while performing surgery and attempt quantitative range of fluorescence emitting tissues for better surgical outcomes. Further larger studies are necessary to determine absolute range values during fluorescent guided surgery.