Point-of-care fluorescence imaging device guides wound cleaning and patient education in obese wound care patients

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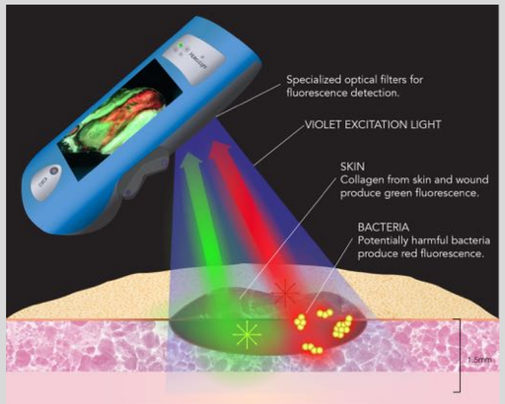
INTRODUCTION

- Obesity increases a person's susceptibility to infections due to increased bacterial colonization, skin folds which promote bacterial growth, and insufficient wound cleaning[1].
- Obesity is an independent risk factor for SSIs post abdominal surgical procedures[1]. In obese women, the odds ratio for post-cesarean surgical site infections increases by 2.0 for every five-unit increment in body mass index[2]
- Point-of-care detection of bioburden relies primarily on visual inspection of wounds and subjective and suboptimal clinical signs and symptoms.
- To address this problem, fluorescence imaging has been used to visualize red-fluorescing bacteria in real-time at the bedside using a non-contact device[3-5].
- We aimed to determine whether real-time, point-of-care fluorescence imaging of bacteria would detect bacteria in skin folds of obese patients, facilitating an improvement in care.

METHODS

Bacterial Fluorescence Imaging

- When excited by 405 nm violet light, tissues fluoresce **green** while bacteria fluoresce **red** (e.g. *Staphylococcus aureus*).
- This enables real-time, point-of-care detection and localization of bioburden (≥ 10^4 CFU/g) within and around wounds[3-5].

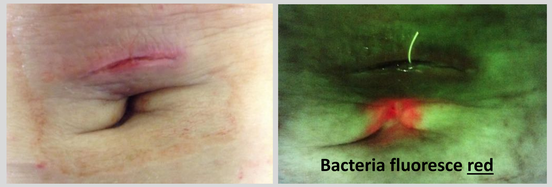


Case Series

- Seven obese wound care patients (abdominal surgeries, ulcers with lymphedema) were imaged for bacterial (red) fluorescence prior to and post-wound cleaning during routine wound assessments.
- Wounds positive for red fluorescence signal (6 of 7) were considered to be contaminated with bacteria and received additional cleaning.

RESULTS

Real-time Bacterial Detection in Abdominal SSI Enables Guided Cleaning of Red Fluorescing Regions



Standard Imaging | Fluorescence Imaging

Wound dehiscence after minor abdominal surgery in 36 year old male with no significant medical history. Red fluorescence was observed near the wound, suggesting bacterial contamination and prompting clinician cleaning of this region.

Bacterial Fluorescence Guides Cleaning and Patient Education in Obese Patient with Abdominal Drain for Abscess

Week One

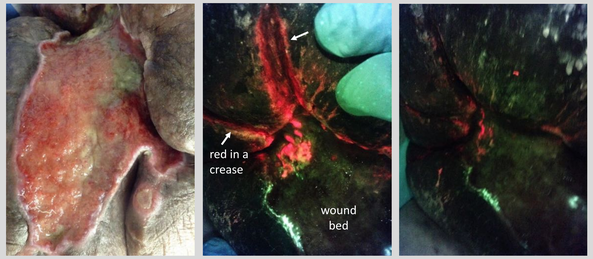
Standard Imaging | Fluorescence Image (Crease, Pre-Clean) | Fluorescence Image (Post-Clean)

26 year old moderately obese male with abdominal drain for infected tumour abscess. Bacterial (red) fluorescence was observed throughout the skin fold/crease. Fluorescence guided cleaning with water did not remove the fluorescing bacteria, thus iodine was used. Post cleaning images show the decrease in red fluorescence. Images were used to educate patient on at home cleaning practices. Images acquired three weeks later showing no bacterial (red fluorescence demonstrated effectiveness of patient education and cleaning).

Week Three

Standard Imaging | Fluorescence Imaging (no red observed)

Cleaning of Skin Folds Under Bacterial Fluorescence Guidance Increases Wound Healing Rates and Patient Compliance in a Non-Healing, Lymphedema Complicated VLU

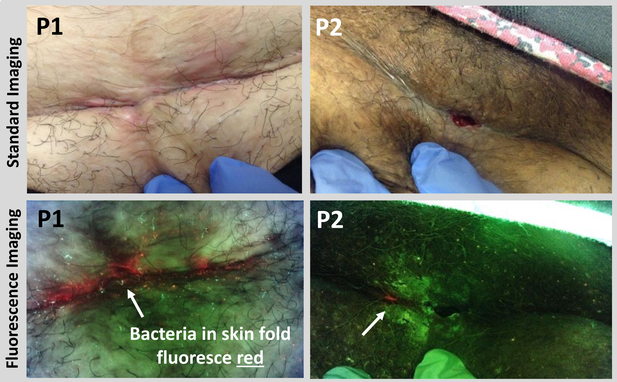


Standard Imaging | Fluorescence Imaging (Pre-Clean, Red in Creases) | Fluorescence Imaging (Post-Clean)

Morbid obesity-associated lymphedema in this 56 year old female patient resulted in extreme leg swelling and a non-healing venous leg ulcer. Deep skin creases surrounding the wound provide an environment in which bacteria can thrive, but the patient would not tolerate crease cleaning due to extreme pain.

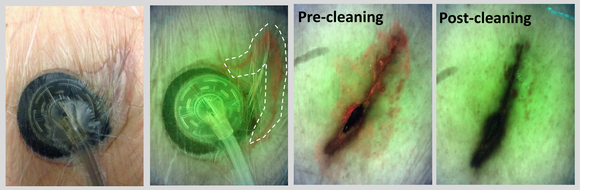
Images demonstrating widespread bacterial (red) fluorescence in the creases were used to educate the patient, resulting in increased tolerance for crease cleaning, both at wound care visits and at home. With regular crease cleaning the wound began to decrease in size and was reclassified as "healable".

Bacterial Fluorescence Guided Cleaning in SSIs Post C-section



Fluorescence imaging of two patients with SSIs after C-section revealed bacteria (red) in skin folds and guided additional cleaning and patient education.
(P1) Morbidly obese (BMI > 40) 35 year old patient 3 weeks post C-section.
(P2) Moderately obese (BMI 32) 32 year old second C-section patient.

Bacterial Fluorescence Images Guide Extent and Location of Wound Cleaning at Scheduled NPWT Dressing Change in Obese Patient with Abdominal Wound



Standard Imaging | Fluorescence Imaging Before and During Dressing Change

58-year-old moderately obese male with appendectomy abscess undergoing negative pressure wound therapy. Red (bacterial) fluorescence observed under adhesive (circled) and on wound. Red fluorescence guided the extent and location of wound cleaning at this dressing change.

SUMMARY AND CONCLUSIONS

- Images guided the extent and localization of clinician cleaning.
- Visualizing bacteria, which the patient otherwise could not have seen, provided enhanced awareness of their bacterial burden and infection risk. Bright and simple colours on fluorescence images (green = tissue, red = bacteria) made it easy for patients to understand when and where bacteria was present.
- Patients were counseled on at home cleaning practices that should regularly be performed (eg. cleaning at and around their wound, lifting of skin folds, regular cleaning of skin creases). An improvement in patient adherence was observed.
- Results highlight the potential of this imaging tool to enhance patient education and to improve patient understanding and adherence with home cleaning protocols in the obese patient population.

REFERENCES

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5. Rennie MY et al. Point-of-care fluorescence imaging positively predicts the presence of pathogenic bacteria in wounds at loads ≥ 10^4 CFU/g: a clinical study. J Wound Care (submitted)

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