Oxygenation imaging during transplant surgery

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Endogenous imaging for surgery

- Image-guided surgery
- Oxygenation: critical parameter
- Spectroscopy can measure oxygenation
- Local probes: [HbO2], [Hb]
- Clinical need for passive monitoring
- Transplant surgery
- Patient monitoring
Flap transplant surgery

- 15-25% failure rate: ischemia, fat necrosis
- 10-35% complications: re-operations

- Clinical need to improve patient care!
Absorption

Beer’s Law: \[ \mu_a(\lambda) = 2.303 \cdot \sum_{i=1}^{N} \varepsilon_i(\lambda) \cdot C_i \]
Real-time oxygenation imaging

- The key is to provide a real-time feedback
- Ideally, absorption and scattering are both measured
- Time domain: not readily adaptable
- Point scanning: slow
- Spatial Frequency Domain Imaging (SFDI)
SFDI concept

SFDI measurement

Clinical imaging system

Light source

DMD

NIR1 [670 – 780 nm]

NIR2 [800 – 1000 nm]

Color [400 – 650 nm]

Surgical field

Gioux et al. JBO. 2011. 26:086015.
Vascular occlusion on pigs

Gioux et al. JBO. 2011. 26:086015.
Arterial vs. venous occlusion

Gioux et al. JBO. 2011. 26:086015.
# First-in-human trial

<table>
<thead>
<tr>
<th>Left Abdominal Skin Flap</th>
<th>Right Abdominal Skin Flap</th>
<th>Post-Flap Elevation</th>
<th>Post-Flap Transplant</th>
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</thead>
<tbody>
<tr>
<td>Color</td>
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<tr>
<td>ctO$_2$Hb (µM)</td>
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<td>ctHHb (µM)</td>
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<td>stO$_2$ (%)</td>
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Gioux et al. JBO. 2011. 26:086015.
Intraoperative oxygenation imaging

- The clinical need exists
- The proposed solution is inexpensive
- Patient management seems to benefit

- Towards large trials, and validation
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