Bacterial imaging with the Moleculight camera - my journey so far

Mr David Russell
Consultant Vascular Surgeon, Leeds Teaching Hospitals
Honorary Clinical Associate Professor, University of Leeds
Background

• Patients with diabetes are at greater risk of infection: Neuropathy, PAD & impaired response to infection

• Delayed treatment = limb threatening infections and amputations

• Diabetic foot infections cannot be reliably identified using clinical assessment alone
Background

• Current imaging modalities

  **X-ray** = radiation, delayed changes, additional patient waiting time

  **MRI** = patient contraindications, costly, repeated hospital visits

• Prescription of inappropriate antimicrobials

  Costly

  Patient side-effects

  Increased bacterial resistance
Moleculight i:X™

- Bacterial wall porphyrins demonstrate autofluorescence under appropriate stimulus

- Strength of signal proportional to concentration of active bacteria

- Moleculight emits 405nm (violet blue) wavelength with dual band filter (500-550 and 590-690nm)
  - Distance from wound and surrounding light controlled
  - $\geq 10^4$ colonising units identified
Current Evidence

• CE mark Sept 2016.

• 1 first in man study
  – Part 1 validation of technology in 28 patients
  – Part 2 feasibility of autofluorescence to “guide treatment” 12 patients

DaCosta et al. PLoS ONE 2015; 10(2) e0116623
## Current Evidence

### Summary of Sampling Data

<table>
<thead>
<tr>
<th></th>
<th>USA</th>
<th>Canada</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PPV</strong></td>
<td>100 %</td>
<td>100 %</td>
</tr>
<tr>
<td><strong>n</strong></td>
<td>16</td>
<td>27</td>
</tr>
<tr>
<td><strong>Sampling Method</strong></td>
<td>Biopsy</td>
<td>Curettage</td>
</tr>
<tr>
<td><strong>Microbiological Analysis</strong></td>
<td>qPCR</td>
<td>Culture</td>
</tr>
<tr>
<td><strong>Bacterial loads detected</strong></td>
<td>$10^4$ to $10^8$ CFU/g</td>
<td>Light to heavy (96% moderate or heavy)</td>
</tr>
<tr>
<td><strong>Prevalent Pathogens</strong></td>
<td><em>Staph. aureus</em> – 44 %</td>
<td><em>Staph. aureus</em> – 48 %</td>
</tr>
<tr>
<td></td>
<td><em>Streptococcus</em> – 25 %</td>
<td><em>Mixed Bacteria</em> – 70 %</td>
</tr>
<tr>
<td><strong>Polymicrobial Colonies</strong></td>
<td>38 %</td>
<td>44 %</td>
</tr>
</tbody>
</table>

### Pathogens Detected* from Red Fluorescence Guided Sampling

- **qPCR**
  - *Staph. aureus*
  - *Enterococcus faecalis*
  - *Klebsiella pneumoniae*
  - *Streptococcus agalactiae*

- **Culture and Sensitivity Testing**
  - *Proteus mirabilis*
  - *Staphylococcus spp*
  - *Streptococcus spp*
  - *Citrobacter freundii*
  - *Escherichia coli*

* Pathogens sum to >100% due to polymicrobial colonies

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Rennie MY et al, Presented at AMSUS 2016
Imaging Examples
Case Study
Case Study
Summary of Current Knowledge

• We know Moleculight i:X™ can:
  – Identify bacteria at ≥10⁴ CFU
  – Be useful in targeting wound sampling
  – Help to manage “hard-to-heal” chronic wounds

• We don’t know how it changes management:
  – Further debridement
  – Antimicrobial dressings / topical antibiotics
  – Systemic antibiotics
  – More frequent clinic review
Pilot RCT

• 60 patient prospective, pilot, randomised trial
  – 30 managed with information from Moleculight i:X™
  – 30 wound area assessment from device only
  – Stratified by site and ulcer depth

• Aims:
  – To determine difference in healing rates at 12 weeks
  – Secondary aims:
    • To determine differences in other clinical outcomes
    • To assess influence on wound management decision making of Moleculight i:X information
    • To assess differences in microbiological yield with use of Moleculight i:X™
Pilot RCT

• Primary outcome
  – Healing rate at 12 weeks (blinded assessment of healing/12 week review)

• Secondary outcomes
  – Decision making processes
  – Infection rate, antibiotic prescribing
  – DFU related hospital admission
  – Amputation rate
  – Pain scores, DFS-SF, EQ-5D-DL
# Inclusion/Exclusion Criteria

## Inclusion
- Aged >18 years
- Diagnosis of Diabetes Mellitus
- Has ulceration of foot below malleoli
- ABPI >0.5 or toe pressure >30mmHg
- Consent to participate (written / witnessed verbal informed consent)
- Expected to comply with follow-up schedule

## Exclusion
- Has any current clinically infected DFU
- eGFR < 20mL/min/1.73m²
- Recent immunosuppressive therapy
- Connective tissue disorders or dermatological disorders as a cause of ulcer
Leeds multidisciplinary team diabetic foot ulcer clinic
Screening and eligibility

Information Provision

Consent

Baseline assessments and Randomisation
1:1 (60 participants)

Treatment as usual + Moleculight N=30

Treatment as usual N=30

Follow up
Assessments at week 2, 4, 8, 12 post randomisation

END OF TRIAL
Summary

• Moleculight i:X™ is a novel technology for identifying bacteria in wounds
  – Point of care test
  – Identifies $\geq 10^4$ CFU
  – Use is associated with improved wound healing

• Decision making associated Moleculight i:X™ is unclear