Development of an engineered honey (Surgihoney) as a novel topical treatment

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BACKGROUND
➢ The World Health Organisation’s (WHO) 2014 report on global surveillance of antimicrobial resistance has revealed that the world has reached a critical point1 in 5 of hospital-acquired infections are now attributed to Methicillin-resistant Staphylococcus aureus (MRSA).
➢ The Department of Health’s annual report (2014 to 2015) of MRSA bacteraemia reported:
   ➢ 874 community-acquired cases
   ➢ 349 hospital-acquired cases

IMPACT ON NHS
➢ Delay of elective surgery
➢ Prolonged hospital stay
➢ Long-term antibiotic treatment

MUPIROCIN (Bactroban)
➢ Topical antibacterial treatment effective against Gram-positive bacteria, including MRSA, currently used as part of the decolonisation regime.
➢ Recent evidence indicates increasing resistance of MRSA to Mupirocin, 1-2

BACTERIAL BIOFILMS
➢ Bacteria exist in 2 states - as planktonic free-floating microbes and within biofilms
➢ Biofilms are defined as structured and antibiotic-tolerant bacterial aggregates
➢ Difficult to culture, identify, diagnose, and treat
➢ Implicated in chronically infected wounds

SURGHONEY
➢ Novel engineered organic honey product which releases controllable reactive oxygen species as key mediator
➢ Possesses potent anti-microbial properties
➢ Demonstrated to be highly effective in topical treatment of chronic wounds

PRELIMINARY WORK
➢ An in vitro study was undertaken using bacterial isolates obtained from the sinonasal cavities of patients suffering with chronic rhinosinusitis (CRS).
➢ Preliminary results have demonstrated potent bactericidal and inhibitory effects of Surgihoney on MRSA and Methicillin-sensitive Staphylococcus aureus (MSSA) in both planktonic and biofilm forms (Figures 3 & 4).

AIMS
1. To compare the efficacy of Surgihoney versus Mupirocin on MRSA isolates in an in vitro setting.
2. To conduct a small scale proof-of-principle clinical study examining the feasibility of using Surgihoney as a novel MRSA decolonisation therapy in MRSA-positive clinical subjects.

METHODOLOGY
Recruitment and phenotyping of clinical subjects
Patients identified as MRSA carriers as a result of pre-assessment screening will be recruited into the study.

Specimen acquisition, isolation of MRSA and in vitro bacterial analysis
The antimicrobial activity of Surgihoney will be assessed in vitro on both planktonic and biofilm MRSA phenotypes. The bactericidal and inhibitory function of Surgihoney will be compared to current standard therapy (Mupirocin).

Proof of principle clinical study
A small scale proof of principle clinical study will be conducted to assess the feasibility of using Surgihoney as a novel MRSA decolonisation therapy in the nasal cavity.

ENVIROMENT
The 2014 national assessment of research (Research Excellence Framework) described the University of Southampton as having the following:
➢ Over 97% of the University’s research environment has been assessed as world-leading and internationally excellent
➢ 84+ world-class research facilities
➢ Chosen by more than 150 different businesses for research and development
➢ Three Southampton Professors awarded Wolfson merit awards in 2014.

SOUTHAMPTON UPPER AIRWAY RESEARCH GROUP
➢ The Head of the Upper Airway Research Group, Mr Rami Salib, has been accredited with several Royal College of Surgeons’ of England awards including:
   ➢ Louis Alexander Fellowship (2001)
   ➢ Frances and Augustus Newman Award (2002)
   ➢ RCSEng Pump-priming award for newly-appointed Senior Lecturers (2006)
   ➢ Hunterian Professorship of Surgery (2008)
➢ Mr Stephen Hayes, Rhinology Research Fellow, was awarded the RCSEng One-Year Surgical Research Fellowship in 2011.

REFERENCES

FIGURE 1. SEM image (Mag x 10000) demonstrating surface-related biofilm (yellow arrows) on the internal maximal of a patient suffering with chronic rhinosinusitis. (Image courtesy of Dr Stephen Salib, Southampton University Hospital.

FIGURE 2. A 77 year old male with peripheral vascular disease developed leg standing ischemic ulcers chronically infected with Pseudomonas aeruginosa (A). After a 7 day treatment with Surgihoney a significant clinical improvement was seen (B). (Picture courtesy of Dr Matthew Dryden).

FIGURE 3. A dose dependent reduction of MRSA and MSSA biofilms is demonstrated following the use of Surgihoney. A minimum bactericidal concentration (MBC) was achieved as shown below.

FIGURE 4. The MIC of MRSA and MSSA biofilms were markedly greater and this trend with Surgihoney. A 94% and 99% reduction of MSSA biofilm colony forming units following Surgihoney treatment at a concentration of 500 and 1000 g/L, respectively was noted. A 72% and 90% reduction was demonstrated at similar concentrations following MSSA biofilm treatment.

FIGURE 5. A world leading centre of clinical and experimental sciences, University of Southampton, Faculty of Medicine, Southampton.

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