THE USE OF MAGGOTS IN WOUND CARE

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MAGGOTS: HISTORY

• Maggots has been mentioned in historical texts since BC, from Mayas in South America, and Aborigines in Australia
• Surgeons mentioned the healthy appearance of maggot infested wounds of war since the 1800 (Larrey, 1798 during the campaign in Egypt)
• Mostly anecdotal cases mentioned
Maggot debridement

- Noted by Ambroise Pare (1510 – 1590) and Baron Larrey (1766 – 1842)
- John Zacharias (1837 – 1901) during American civil war (1861-5) noted “During my service.....I first used maggots to remove the decayed tissue in hospital gangrene. In a single day, they would clean a wound much better than any agents we had at our command”
MAGGOTS: HISTORY

- William BAER, prof in orthopaedics at Johns Hopkins school of medicine, noticed the healthy looking wounds in WW1 that were infested by maggots, and started using it on patients with chronic osteomyelitis
- Results published in 1929 and 1931
- Father of Maggot therapy
- By 1935 more than a 1000 surgeons in 300 hospitals in USA used maggots
- 1930-1940 more than 100 papers on maggot therapy published in USA
- Commercially produced by LEDERLE, a pharmaceutical company ($5 for 1000 maggots, ~ $100 now)
MAGGOTS: HISTORY

• Maggot therapy was replaced by antibiotics, with the mass production of penicillin, and fell in disuse
• Penicillin resistant Staph aureus described in 1952 (produces penicillinase)
• Since 1970 gradual increase in the interest in maggots again, as resistance to antibiotics started to emerge
• VA study by Ron Sherman (1989) showed efficacy of maggot debridement therapy on chronic wounds
• Commercially produced in USA by MONARCH Labs Medicinal Maggots
MDT: How it starts-
Biology of *Lucilia sericata*
FLIES

• Green bottle blowfly (Phaenicia or Lucilia sericata) used as the maggots only feed on necrotic material (other maggots may feed on live tissue)
• Flies lay eggs in nutritious, warm, damp, dark places, on carrion or specific foods where they hatch in 18 – 24 hours, producing larvae of 1-2 mm
• Maggots (larvae) immediately start feeding, and live for 3 – 7 days (8-10 mm) when they develop into pupae
• Medicinal use of the larvae within their limited lifespan of 7 days
Maggot debridement

- Secrete a soup of digestive enzymes, including carboxypeptidases A and B, leucine aminopeptidase, collagenase, serine proteases, and metalloproteinase
- Extracorporeal digestion of dead tissue, on which they then feed
Phases of wound healing

5 phases described

- Hemostatic phase: control bleeding
- Inflammatory phase: mediator release
- Destructive phase: removal of dead tissue
- Proliferative phase: granulation tissue
- Maturation phase: remodelling

Overlap, takes months
Maggots at Steve Biko Academic hospital

- Private laboratory started the maggots in the 1990’s
- Dr Frans Cronje took it over in 1999, moving it to Eugene Marais hospital, as part of his wound care unit (including Hyperbaric oxygen)
- Moved to SBAH in June 2007
- Ms Johanna Legodi moved along as she is the maggot technologist
Maggot production

- Flies kept in cages, fed whey protein
- When maggots are needed, flies are stimulated to ovipost by feeding carrion (liver)
- Eggs are isolated and sterilised before hatching with sodium hypo chloride
- Larvae isolated, and put on wound
Maggot preparation

- Can be put free in wound, or contained in a gauze bag to control their movement
- Dressing to cover wound must allow oxygen through, and absorb excess fluid
- Secrete proteolytic enzymes that liquifies the tissue, and they feed on it
Septic amputation wound with maggots
Mr JH, abdominal wound infection
Maggot therapy

Necrotic wound on heel, with slough, before treatment

Wound after 4 treatments with maggots
MDT, Ms AF, 81 y

Ms AF, 81, DM. Necrotic ulcer on heel.
20 Aug 2010. 3 MDT

22 Oct 2010. Dressings after MDT, almost healed
Mr WS, 53 y, DM, HT

27 Aug 2010

17 Sep 2010

15 Oct 2010

14 Jan 2011
MM, Cape Town

Sacral pressure sore

Maggots applied

After one maggot debridement

Wet dressings

Maggots applied
Indications for MDT

• Open wound failing 2 or more conventional treatments, eg pressure ulcer, ischemic foot ulcer, venous stasis ulcer, third degree burn wound, dehisced surgical wound

• Contra-indications:

• Absolute: rapidly advancing infection (need surgery) inability to get informed consent

Relative: Osteomyelitis

Arterial insufficiency

VA Center, Long Beach, California (RA Sherman, 2002)
MDT: Indications

• Any wound with slough needing debridement
• Poor anaesthetic risk: can not be done surgically under anaesthesia
• Bed availability: MDT as outpatient (see twice a week)
MDT: Contra-indications

- Not suitable for wounds with exposed blood vessels
- Dry hard necrosis
- Osteomielitis
RESULTS

Patients

Treatments

success
Results

• Older patients with co-morbidities
• Diabetes: 66%
• Hypertension 30%
• Previous amputation of a toe: 35%, of which half were treated successfully and half ended with a more proximal amputation
Results

- **Success** with MDT: 80%
  - After cleaning wound with maggots, change to other dressings till healing is complete
  - Single application, and up to 5 times

- **Failures**: 20%
  - Reasons:
    - Poor blood supply
    - Underlying vascular insufficiency
    - Continued smoking
    - Bone infection
Availability

- US: registered with FDA as device
- MONARCH LABS, Irvine, CA
- MDT: maggot debridement therapy)
- UK: registered as a medical treatment
- LarvE from Zoobiotic, Biosurgical Research unit
- MLT (Maggot larval therapy)
Availability

- RSA: InqabaBiotec
- Surgimaggs
MDT: Indications

- Necrosis
- Bacterial biofilm
- Infection/multi resistant bacterial present (MRSA)
- Hard to heal wounds
- Diabetic foot ulcers
- Pressure ulcers
- Venous ulcers
- Complicated surgical wounds
MAGGOT DEBRIDEMENT THERAPY

- We have a unique asset at SBAH to have access to maggots
- Utilized to the benefit of our patients
- Other clients have access to our maggots, with consent from patient (and a small donation)
- This is now available to all patients in RSA, from InqabaBiotec
THE USE OF MAGGOTS IN WOUND CARE

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QUESTIONS
1. Hemostatic phase

- Constriction of injured vessel
- Temporary platelet plug (exposed collagen)
- Clotting cascade initiated
- Tissue thromboplastin activates factor Vll, then F X
- Fibrin clot formed, and stabilized by F Xlll
2. Inflammatory phase

- Inflammatory mediators released from injured tissue and blood vessels
- Leucocytes migrate to injured area to prevent proliferation of micro-organisms
- Vasodilatation
- Rubor, calor, dolor, tumor, functio lesia
3. Destructive phase

- Macrophages migrate to help with phagocytosis of necrotic tissue
- Other cell lines also migrate to help with this process: neutrophils, fibroblasts, epithelial and endothelial cells
- Release of proteases to degrade damaged matrix, and cells
- Release of growth factors to initiate repair
4. Proliferative phase

- Formation of new capillary loops and granulation tissue (angiogenesis)
- Fibroplasia, formation of new collagen and matrix for cells to migrate and repair the damage
- Still disorganised picture
5. Maturation phase

- Remodelling of the collagen, contracture of the wound, and eventual epithelialisation of the surface, to complete the healing process
- The whole process takes months, up to a year
- Can be arrested at any point by intervention from colonisation, biofilm formation, critical colonisation, infection, treatment, poor blood supply, etc
EFFECT ON WOUND

- Maggots have their effect on three levels:
  - Debridement
  - Disinfection
  - Enhance wound healing
DEBRIDEMENT

The removal of dead, necrotic tissue, organisms, and odour

- Other types: Surgical
- (sharp, knife and scissors)
- Mechanical
- Dressings (wet to dry)
- Irrigation (syringe, tap water, shower)
- Versajet
- Enzymatic (Iruxol)
- Maggot therapy
DISINFECTION

• Secretions are also antimicrobial, especially against MRSA (most common organism in wounds)
• Allantoin, urea, phenylacetic acid, phenylacetaldehyde, calcium carbonate, and other enzymes, can kill micro-organisms
• Ammonium bicarbonate makes wound more alkaline, which promotes wound healing
ENHANCE WOUND HEALING

• Stimulation of the effects of host epidermal growth factor and IL 6, growth of fibroblasts, chondrocytes, type 2 collagen, etc
• Stimulates granulation tissue formation
Maggots at SBAH

- 2 types of fly colonies:
  - Lucilia cuprina (sheep blowfly)
  - Lucilia sericata (green bottle blowfly)
- 2 separate colonies, known as Welkom 1 and 2, and kept apart
MAGENT PREPARATION IN LAB

- Flies are kept in cages, and ovipost on liver
- Eggs are isolated and sterilised with hypochloride before hatching, to ensure maggots are clean when put on wound
MAGGOTS: HISTORY

- Maggot therapy is registered in USA and UK
- FDA allows maggot therapy on prescription since Jan 2004, for “debriding non-healing necrotic skin and soft tissue wounds....”
- Followed in Feb 2004 by UK NHS
- No formal allowance in RSA, therefore one must get informed consent from patient for this unregistered treatment
Maggot therapy