Chronic wounds: current and future therapy options

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Dr. Julius Ausbüttel
Wound care in history

Egyptians, Greek, Romans

- Honey
- Grease
- Lint
- Vinegar
- Wine
- Bandages
Wound care in history

Middle Ages, Renaissance

- Loss of ancient knowledge
- „laudable pus“, mainly by *Staphylococcus*
- High mortality caused by infection and insufficient treatment

Adriaen Brouwer, ca. 1633
Wound care in history

Lorenz Heister, ca. 1749
Wound care in history

19th century

• Connection of infection and bacteria
• „Sterile“ procedures in rooms and surgery

20th century

• Alexander Fleming discovers Penicillin (1928)
Wound healing phases

- Exudation
- Granulation
- Epithelization

(time)
Chronic wounds in Germany

Chronic wound → healing time > 8-12 weeks

- Ulcus cruris; 1,173,408
- Pressure sores; 320,025
- Posttraumatic Wounds; 612,229
- Diabetic Feet; 383,561
- Burns; 78,050
- Others; 404,139

Wound care treatment

Before 1970’s

„dry“

After 1970’s

„moist“

"dry"

"moist"
Wound care treatment

DRY

- Open wound
- Dry exudate and scab
- Slow epithelial cell migration under dry tissue
- Dry dermis

MOIST

- Dressing covering wound
- Moist wound environment
- Fast epithelial cell migration on moist wound bed
Benefits of modern wound care products

- Impermeable to water
- Impermeable to bacteria
- Allows gas exchange
- Absorbs exudate excess
- Maintains appropriate humidity in the wound
- Provides thermal isolation

35-37°C
What wound dressings can do
... and what not.

• Support healing
• Reduce pain
• Less dressing changes
• Exudate and odour management
• One-for-all
• Heal wound instantly
• Give information about wound status
• Help in decision making
Chronic wounds in Germany
Some of our products
Innovative and future ideas

Wound dressing 4.0

• Improve healing of the wound
• Improve monitoring of the wound
• Improve diagnosis of wound situation
Improve wound healing

Biological factors:

• Proteases ↑↓
• Growth factors
• Extracellular matrix
• Stem cells
• …

Singer et al., 1999
Improve wound healing

pH value

• Wound healing is improved by lower pH values (~ 5.5)

→ Higher value may indicate higher bacterial contamination (> 7)

• Detection of continuous pH value as indicator of bacteria and wound healing
Improve wound healing

pH value
Improve wound healing

pH value

→ Detection of pH value and correlation with wound situation
Improve wound healing

Electric fields
• TEP (transepithelial potential) of -70 mV
• Inside of cells: negatively charged, outside positively → „Biological battery“
• Wounding changes electric field
Improve wound healing

Electric fields

McCaig et al., 2005
Improve wound healing

Electric fields
- Restore electric field and give stimulus to wound healing

McCaig et al. 2009
Monitoring

Wound status

- Only to be determined during dressing change
- Insecurity about time of changing
- Fixed interval → higher costs
Monitoring

Wound status

- Temperature
- pH value
- Proteases
- Exudate
- Change dressing

bacteria

Exudate amount

Wound status
Bacteria
Temperature
pH value
Proteases
Exudate
Change dressing
Diagnosis

Infection control

• Swab test, cultivation of bacteria
• Antibiogram → time and effort
Diagnosis

Infection control

- Lab-on-a-chip

Bacteria name and amount

- S. Aureus: $1 \times 10^7 / g$ tissue
- P. aeruginosa: $1 \times 10^1 / g$ tissue
Infection control

- Lab-on-a-chip (in wound pad)

- Blood sugar: high
- Oxygen: low
- Bacteria: normal
- Infection: none
- Wound status: Check blood flow
Summary Wounds

• More wounds will have to be treated → older population, growing diseases (Diabetes,...)
• Wound care will shift to more specialized centres with higher technical infrastructure
• Treatment will be more digital and connected
• Costs and reimbursement will be major point for quality of care
• Development needs > 5-10 years (Medical Device Regulation, technical feasibility)
Summary Technology

- Biocompatible small/nano sensors needed
- Fast production in large quantities, easy to handle
- Cheap products → single use
- Wireless connected to mobile devices
Thank you

IT’S JUST A FLESH WOUND!

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