Negative Pressure Wound Therapy

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Case - Taxi

• ‘Taxi’ Rainbow
  – 5 yo FE boxer
  – Recently whelped – presented with septic mastitis
  – Mastectomy of the affected glands performed
  – Recovery uneventful
Case - Taxi
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NPWT Principles

• What is it?
  – Application of a vacuum evenly distributed across the surface of a wound, typically through an open cell foam dressing
    • Open cell foam (typically polyurethane)
    • Occlusive drapes
    • Vacuum tubing and pump
Case - Taxi
Case - Taxi
NPWT Principles cont...

• Vacuum
  – Can program different pressures
    • -125 mmHg most common
    • -75 mmHg used for skin grafts

– Modes
  • Continuous
  • Intermittent
NPWT Principles cont...


  – Established -125 mmHg as the standard level of subatmospheric pressure
    • Based on local blood perfusion studies at variable pressures
  – Suggested intermittent vacuum may be more effective than continuous
    • Controversial
NPWT Principles cont...

• Continuous vs intermittent
  – Literature inconclusive
  – Intermittent may be more effective in stimulating fibroplasia and neovascularisation
  – However, more painful, not tolerated in cats
  – For now, continuous dominates veterinary literature
NPWT Principles cont...

  - Evaluated split thickness graft incorporation at varying subatmospheric pressures
  - Demonstrated equivalent clinical outcomes at -75 mmHg as compared to -125 mmHg
  - Benefits of reduced subatmospheric pressure
    - ↓ pain
    - ↓ secondary skin reaction
    - ↓ risk of venous occlusion
    - ↓ risk of nerve compression
NPWT Mechanisms

- Macrodeformation and microdeformation theory

NPWT Mechanisms cont...


<table>
<thead>
<tr>
<th>Cytokine</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>TNF, IL-1β, MMP-1, -2, -9, -13</td>
<td>↓</td>
</tr>
<tr>
<td>VEGF, FBGF-2, TGFβ, PDGF, IL-8, IL-10</td>
<td>↑</td>
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</tbody>
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NPWT Mechanisms cont...

• Glass et al.
  – Mechano- and chemoreceptor mediated cell signalling
    • Results in angiogenesis, ECM remodelling and deposition of granulation tissue
  – Modulation of cytokines to an anti-inflammatory and pro-repair profile
NPWT Benefits

• Modulate inflammatory and proliferative response to injury
  – Decrease interstitial edema
  – Earlier appearance of granulation tissue
  – Promote blood flow to affected area
  – Improves flap survival

• Remove wound exudate

• Draw wound edges together
NPWT Benefits cont...

- Reduced frequency of bandage changes
- Shorten time to definitive reconstruction
- Decrease total labour
- Earlier discharge from hospital
- Cost benefit
- **Bacterial clearance??**
Practical Applications

• Extensive...
  – Acute and chronic wounds
    • Degloving injuries, shearing wounds, decubital ulcers, bite wounds...
  – Abscesses
  – Burns – *silver impregnated foams*
  – Surgical dehiscence
  – Skin flaps and grafts
  – Extravasation
  – And more...
Novel Applications and Recent Literature

• Or et al. *Negative pressure wound therapy using polyvinyl alcohol foam to bolster full-thickness mesh skin grafts in dogs* – *Vet Surg* 2017; **46**: 389-395

– NPWT and free skin grafting
  • Optimal contact between skin graft and recipient bed
  • Immobilisation
  • Rapid development of granulation tissue in mesh holes
  • Drain fluid under graft
  • Reduce risk of graft necrosis
  • Isolate wound from external environment
Novel Applications and Recent Literature

- Or et al. cont...

<table>
<thead>
<tr>
<th>Polyurethane foam</th>
<th>Polyvinyl alcohol foam</th>
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</thead>
<tbody>
<tr>
<td>Hydrophobic</td>
<td>Hydrophilic</td>
</tr>
<tr>
<td>Dry</td>
<td>Pre-moistened</td>
</tr>
<tr>
<td>Pore size 400-600 um</td>
<td>Pore size 60-270 um</td>
</tr>
</tbody>
</table>
• Or et al. cont...
  – Outcomes
    • n=8; 7 successful with ‘excellent’ graft take
    • One failed – had 85% circumferential skin loss on antebrachium prior to grafting
  – Recommendations
    • Change bandage q5-7 d
    • -125 mmHg 3 days, then -75 mmHg thereafter
Novel Applications and Recent Literature

• Coutin et al. *Cefazolin concentration in surgically created wounds treated with negative pressure wound therapy compared to surgically created wounds treated with nonadherent wound dressings* – *Vet Surg* 2015; 44: 9-16

  – Most controversial reported benefit – *antibacterial effect*
Novel Applications and Recent Literature

- Coutin et al. cont...
  - Prospective, controlled experimental study
  - 12 beagles
  - Full thickness cutaneous wounds
  - NPWT or non-adherent bandages
  - Cefazolin 22 mg/kg IV q 8 hours
  - Tissue cefazolin concentrations measured
Novel Applications and Recent Literature

- Coutin et al. cont...

Conclusion: No statistical difference in cefazolin tissue concentration when comparing wounds treated with NPWT vs nonadherent dressings
Novel Applications and Recent Literature

• Spillebeen et al. *Negative pressure therapy versus passive open abdominal drainage for the treatment of septic peritonitis in dogs: A randomized, prospective study* – *Vet Surg* 2017; **46**: 1086-1097

  – Continued open drainage post-operatively for management of septic peritonitis
  • Passive open abdominal drainage
  • Negative pressure wound therapy
Novel Applications and Recent Literature

- Spillebeen et al. cont...
Novel Applications and Recent Literature

• Spillebeen et al. cont...
  – No statistical differences in measured variables between POAD and NPAD groups
    • Operating time for initial surgery
    • Anaesthesia time for initial surgery
    • Postoperative drainage time
    • Operating time for surgical closure
    • Anaesthesia time for surgical closure
    • Overall bandage costs
    • Survival
    • Diarrhoea
    • Oedema
    • Vomiting/regurgitation
Novel Applications and Recent Literature

- Spillebeen et al. cont...  
  – Benefits? Subjectively...

<table>
<thead>
<tr>
<th>Negative pressure abdominal drainage</th>
<th>Passive open abdominal drainage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced work load</td>
<td>High work load</td>
</tr>
<tr>
<td>Need for bandage changes obviated</td>
<td>Complicated bandage changes</td>
</tr>
<tr>
<td>Reduced patient discomfort</td>
<td>High patient discomfort</td>
</tr>
<tr>
<td>More accurate fluid monitoring</td>
<td>Inaccurate abdominal fluid monitoring</td>
</tr>
<tr>
<td>Reduced risk of nosocomial infections by converting to a closed wound</td>
<td>Increased risk nosocomial infections during bandage changes</td>
</tr>
</tbody>
</table>
Novel Applications and Recent Literature

• Nolff et al. *Negative pressure wound therapy with instillation for body wall reconstruction using an artificial mesh in a Dachshund* – *Aust Vet J* 2015; **93** (10): 367-372

  – First description of instillation therapy (NPWTi) in veterinary literature
Conclusion

- Emerging technique in veterinary medicine with the potential for a plethora of applications
- Some research needs to be done to finesse how the technique is applied
  - Which pressures?
  - For how long?
  - Which material to use?
  - Continuous vs intermittent therapy?
  - Instillation therapy applications?
- Ongoing research to support different applications
- Mechanism of action yet to be fully elucidated
Conclusion
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