The rat ischemic epigastric skin flap model revisited: Optimization of flap dimension and ischemic duration

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Affiliations and Disclosures

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• Nothing to disclose
Introduction

- The superficial inferior epigastric artery (SIEA) originates from the femoral artery, and gives into medial and lateral branches to supply the epigastric skin flap model.
- The non-standardization of many parameters, such as flap dimension, borders, vascular supply, and ischemia duration, makes the model sub-optimal.
## The non-standardization of the model

<table>
<thead>
<tr>
<th>Study Name</th>
<th>Rat Species &amp; Weight (g)</th>
<th>Borders</th>
<th>Flap Dimension (cm)</th>
<th>Clamped vessel</th>
<th>Duration (hr)</th>
<th>Control Necrosis Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Küntscher MV et al. PRS(2002)</td>
<td>Wistar; 230-335</td>
<td>Undefined</td>
<td>6*10</td>
<td>Artery &amp; Vein</td>
<td>3</td>
<td>68.2</td>
</tr>
<tr>
<td>Gideroglu K et al. J Surg Res (2009)</td>
<td>SD;200-235</td>
<td>Undefined</td>
<td>4*5</td>
<td>Artery &amp; Vein</td>
<td>12</td>
<td>41.4</td>
</tr>
<tr>
<td>Cetinkale O et al. PRS(1998)</td>
<td>Wistar Albino; 200 in average</td>
<td>Undefined</td>
<td>3*5</td>
<td>Artery &amp; Vein</td>
<td>11</td>
<td>85.5</td>
</tr>
</tbody>
</table>
Objective

• To build a modified and standardized model, specifically designed to evaluate the effects of many different therapeutic modalities towards prolonged ischemia injury, which is frequently encountered in free tissue transfer.
Materials and methods

• A novel imaging agent was used pre-operatively in 5 Lewis rats to determine the optimized borders of the flap, in order to include the two branches of SIEA.

• Different arterial ischemia durations (0, 12, 14, 16, 18 hours) were subsequently induced in five groups (n=5 in each group) after elevation of the flap.
Results

The image study helped to standardize the lateral border of flap, so both branches of SIEA were included.

Lateral axillary line was chosen!
Image study in five Lewis rats:

The lateral axillary line was proved to be the optimized lateral border of the flap.
Superior border: xyphoid process
Inferior border: suprapubic line
Lateral border: lateral-axillary line
Medial border: Median line of the abdomen
• Two vessel clamps were placed on the femoral artery only, to specifically simulate the ischemia scenario. Venous occlusion was not intentionally generated.

• In group 5 (18 hours), complete loss of the flap, due to venous thrombosis, was observed in three rats, rendering it unfit for the model.
Sham 1.1% necrosis
12 hours 26.2% necrosis
14 hours 34.6% necrosis
16 hours; 44.8% necrosis (highly variable pattern)

Complete loss of flap

18 hours
The flap necrosis area

<table>
<thead>
<tr>
<th>Ischemia duration</th>
<th>Sham ±</th>
<th>12 hours ±</th>
<th>14 hours ±</th>
<th>16 hours ±</th>
<th>18 hours ±</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flap necrosis (%)</td>
<td>1.1±1.31</td>
<td>26.2±16.9</td>
<td>34.6±10.13</td>
<td>44.8±22.99</td>
<td>Unfit for model</td>
</tr>
</tbody>
</table>
Conclusion

• **14-hours ischemia** was determined to be the most suitable duration for the modified flap model, for it provides the largest and most consistent necrosis area to test the effects of different therapeutic modalities.
Significance of the findings

• A modified rat epigastric skin flap model with standardized borders and optimized ischemia duration was established.

• The detailed incremental change of necrotic area was delineated.

• New therapeutic choices of flap loss can be developed by proper use of the model.