Repair of Anterior Tracheal Defects Using Bioengineered Neotrachea in a Porcine Model

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I have no disclosures

Faiz Bhora reports the following disclosures:
Royalties: Merit Endoteck
Consultant: Boston Scientific, CSA Medical
Research Materials: TEI Biosciences
Anterior Tracheal Repair Model

- There is a need for a suitable replacement for anterior tracheal defects
- Model: Bioengineered graft for repair/replacement of anterolateral defects in a porcine model, using extracellular matrix (ECM) collagen and mesenchymal stem cells
- 3.5 cm ~ 4 cm axial length (> 60% length above the right upper bronchus carina of 4 weeks old Yorkshire female pigs, 45% total tracheal length).
In Vitro Preparation of Neotracheal Graft
The Surgical Procedure
Neotracheal Graft Displays Neovascularization and Complete Luminal Healing

Bronchoscopy images were obtained 3 months post-op
Neotrachea Shows Significant Defect Regeneration Compared to ECM Alone

ECM (Control)

ECM + MSCs
HMSCs Differentiate Into Cartilage *In Vivo*
Neotrachea Lumen Has Ciliated Columnar Epithelium Contiguous With Native Trachea
Conclusions

- Total 10 animals, Control = 3, Treatment = 7
- Survival 7 days (n=3) --> 3months+ (n=7)
- Early death due to malacia, infection, sepsis
- Good patency
- Low infection rate
- Chondrogenesis, neovascularization, mucosal coverage
- Supports fast animal growth
Acknowledgments

Mount Sinai Health System
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Mount Sinai Department of Thoracic Surgery

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Animal Care Facility and Department of Comparative Medicine

This work was supported by MSSL Associate Trustees Fund to FYB and AMA, and the Hussein Family Fund to FYB
HMSCs gradually grow on the collagen matrix and form continuous multiple cell layers in vitro
## Summary of Surgeries Performed

<table>
<thead>
<tr>
<th>Pig #</th>
<th>+/- HMScs</th>
<th>Complications</th>
<th>Survival</th>
<th>Abx</th>
<th>Path</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>Tracheal collapse, respiratory distress, fever</td>
<td>7d</td>
<td>Cefazolin</td>
<td>Collapse/inflammation</td>
</tr>
<tr>
<td>2</td>
<td>+</td>
<td>None</td>
<td>5mo</td>
<td>Cefazolin</td>
<td>Chondrogenesis</td>
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<tr>
<td>3</td>
<td>+</td>
<td>Respiratory distress</td>
<td>7d</td>
<td>Cefazolin</td>
<td>Inflammation</td>
</tr>
<tr>
<td>4</td>
<td>+</td>
<td>None</td>
<td>3mo</td>
<td>Cefazolin</td>
<td>Fibrosis, chondrogenesis</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>None/fever</td>
<td>3mo</td>
<td>Cefazolin/Enrofloxacin</td>
<td>Sig narrowing, no chondrogenesis</td>
</tr>
<tr>
<td>6</td>
<td>+</td>
<td>Respiratory distress/infection/fever</td>
<td>7d</td>
<td>Cefazolin</td>
<td>Inflammation, abscess</td>
</tr>
<tr>
<td>7</td>
<td>+</td>
<td>None</td>
<td>3mo</td>
<td>Ceftiofur/Augmentin</td>
<td>Fibrosis, no chondrogenesis</td>
</tr>
<tr>
<td>8</td>
<td>+</td>
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<td>Ongoing</td>
<td>Ceftiofur/Augmentin</td>
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<tr>
<td>9</td>
<td>-</td>
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<td>Ceftiofur/Augmentin</td>
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