Pre-Clinical Assessment of an Amnion Covered Stent Technology for Endoluminal Applications

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Disclosures

- Medtronic
- Appletree Partners
- Peytant Solutions
- CSA Medical
- Innovital Systems
Difficulties with traditional Stenting in the non-vascular space

Chiefly – Three Issues

• Foreign body reaction – either simply because its there, sizing issues, migration, etc. Regardless this results in:
  – Inflammation
  – Granulation tissue
  – Scaring

• Infection

• Fracturing of the scaffold
All of these lead to: No good

- Embedded stents
- Infected stents
- Further luminal narrowing
“Egon – I’m unclear on the whole good, bad thing”
Causality

Therefore, like the ‘economy’: it’s mostly the ‘covering, stupid’

• Traditional covers are synthetics
  • Silicone, some variant of polyurethane, etc.
  • Uncovered stents tend to be frowned upon
• The synthetic covering tends to disrupt and alter that functional part of the mucosa: whether it be the mucociliary escalator, absorption/secretion, what-have-you
• This leads to:
  • Inflammation
  • Inspissation
  • Infection
“Desperately Seeking Suzan”
Or – a better covering

Thus, characteristics of an improved covering/coating would:

• Maintain the functional integrity of the mucosa
  – Maintain an intact muco-ciliary escalator, secretion clearance
  – Absorbtion
• Decrease inflammation/infection associated with stent placement
• To the extent possible, limit changes/alterations to the deeper tissue layers as well
A Potential Solution: Amnion

Figure 1: Layers within the Amniotic Membrane
As a Tissue, Amnion:

• Is immunologically ‘neutral’
  • Little to no HLA-A, B, C antigens and B2 Microglobulin

• Contains essential growth and healing factors: EGFR, VEGF-R3, PDGF, etc.

• Is composed of various components of Extra Cellular Matrix (ECM)
Further, amnion as a tissue is also thought to have some degree of:

- **Antimicrobial properties**

- **Anticancer properties**
As a consequence of all of the above, an amnion covered scaffold might:

• Preserve and maintain mucosal function by encouraging/stimulating normative healing

• Decrease inflammation

• Decrease infection
Hypothesis testing and experimental next steps

Implantation of an amnion-covered scaffold into a variety of different luminal environments

• Ovine trachea with survival to 30 days

• Ovine Ileofemoral Implant
A Chronic 30-Day Non-GLP Study to Assess Anti-Inflammatory and Antimicrobial Properties of Prototype Tracheobronchial Stents in Healthy Ovine.

Two sheep underwent placement of an amnion covered stent into the trachea

Summary of results:
• Gross examination in both animals revealed:
  • Widely patent tracheal lumens
  • Full incorporation of the stents into the tracheal wall
  • Mild mucosal thickening
Summary of the Histopathologic Examination Revealed

- All sections of the amnion covered stented trachea exhibited high levels of epithelialization (90% to 100%)
- Some variability was noted in the type of re-epithelialization between ciliated epithelium, non-ciliated epithelium and squamous epithelium
  - One animal with 80 to 85% of stented mucosa with ciliated epithelium
  - One animal with 30 to 80% of stented mucosa with ciliated epithelium
- Only minute areas of epithelial erosion noted and in these areas there was noted to be active neutrophilic infiltration
Pictures are usually worth thousands of words.
Caudal Aspect of Stent

H & E stain and Masson Trichrome
2x and 4x Magnification and Caudal Aspect
10x and 20x Magnification at Caudal Aspect
Cranial Aspect of Implant

H & E Stain and Masson Trichrome
10x and 10 x Magnification at Cranial Aspect
Implantation of Endovascular – Amnion Covered Stent Graft

AMNIOSTENT TRIAL

• Ovine model
• Ilio-femoral artery
• Amnion covered, SE alloy stent
• Artery pre-conditioned prior to implant

RESULTS

• Fully patent
• “Quiet”- no thrombus, No scar tissue
• Healed & Bio-integrated
• Re-endothelialized
• Barrier to transmigrating neutrophils
• No infections
• No device migration
Gross and Histopathologic Images

Low & High Magnified Cross Sections of AmnioStent

Proximal & Distal Gross Pathology AmnioStent
Take Home Messages

• Independent of the kind of lumen – amnion covered appliances appear to produce normative healing
  • Intact Endothelium
  • Intact Epithelium
• Inflammation appears to be mild and, in certain areas, altogether absent
• Integrity of the deeper tissue levels appears to be maintained
Next Steps:
“The Breakfast Club”

• Room for everyone
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