Tissue Fragment Injection System

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Points of Interest

- Client Information
- Problem Statement
- Background: Vx-2
- Current Methods: Surgical & Percutaneous
- Design Criteria
- Design Alternatives
- Design Matrix
- Final Design
- Future Work
- Conclusions
- Questions
Client Information

- Dr. Chris Brace
- UW-Madison, Department of Radiology and Biomedical Engineering
Problem Statement

- Injection of Vx-2 carcinoma tumor cells in rabbit livers
- Percutaneous less invasive than surgical

Limitations
- Suturing
- Unwanted seeding
- Backflow

Eliminate limitations and lower technical skill required
Vx-2 Carcinoma Tumor Model

- Liver is most common site for metastases
- Used in rabbits to study liver cancer growth and develop treatments
- Similar characteristics to human liver tumors

Luo et al
Surgical Method

- Most common implantation method

- Advantages
  - Easy access to implantation site
  - Accurate cell placement
  - Minimal unwanted seeding in abdominal cavity

- Limitations include
  - Long recovery time
  - Anesthetic complications
  - Length of procedure

- Dr. Brace’s current protocol is surgical
Existing Percutaneous Method

- 16-gauge needle with a 14-gauge sheath
- Wire used to push out tumor cells
- Guided by ultrasound imaging
Design Criteria

- Seed tumor cells to the liver
- Prevent unwanted tumor cell seeding
- Decrease procedure time
- Decrease technical skill
- Biocompatible materials
- 18-gauge needle
- 5 cm insertion depth
- Ergonomics
Design Alternatives: Cellular Delivery Mechanism (CDM)

- Mechanical release
- Uses two coaxial needles
  - 20-gauge and 18-gauge
- The 20-gauge has a specialized end
- Cells directly loaded into compartment
Design Alternatives: PLGA Capsule

- Polylactic-co-glycolic acid
- Biodegradable
- Biocompatible
- Mechanical flexibility
- Dye-casting

Diagram:
- PLGA
- Tissue Fragment

Dimensions:
- 12 mm
- 1.0 mm
- 10.1 mm
PLGA Capsule Cont.

- Biopsy needle
- Tissue fragment notch
- Retractable sheath

20mm

18-gauge
Design Alternatives: PLGA Covering with N-IPAAm Plug

- 3 Needles
  - 18-gauge guide needle
  - Two 20-gauge needles
    - 1st: PLGA needle tip & cells
    - 2nd: N-IPAAm

- Uses cell suspension
# Design Matrix

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<th>Criteria</th>
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<th>PLGA covering and N-IPAAm Plug</th>
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Final Design: PLGA Capsule
Future Work

- Testing with PLGA
- Testing with biopsy needle
- Method of PLGA encapsulation
  - “Sandwich” between two sheets
  - Encapsulate in pellet form
- RARC Certification
Conclusions

- Decreased technical skill required
- Procedure time reduced
- Minimal unwanted seeding
- Minimal backflow of cells
Acknowledgements

- Dr. Chris Brace - Client
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