FINAL SCRIPT: APPROVED FOR FILMING

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Title: Wireless Telemetry Device Implantation in a Fontan Ovine Model for Continuous and Long-Term Hemodynamic Monitoring

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Author Questionnaire

1. Microscopy: Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **No**

2. Software: Does the part of your protocol being filmed include step-by-step descriptions of software usage? **No**

3. Filming location: Will the filming need to take place in multiple locations? **No**

Current Protocol Length
Number of Steps: 19
Number of Shots: 35

Introduction

Videographer: Obtain headshots for all authors available at the filming location.

1.1. **Marissa:** Our lab conducts clinical translational research focused on congenital heart disease. We have developed several large animal models to evaluate the performance of tissue-engineered vascular grafts and study the pathophysiology associated with the Fontan circulation.

1.1.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 2.4.1*

What are the current experimental challenges?

1.2. **Marissa:** In freely moving large animals, close postoperative hemodynamic monitoring, as well as long-term data collection, pose significant challenges.

1.2.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 2.8.1*

What advantage does your protocol offer compared to other techniques?

1.3. **Marissa:** With our protocol, we are able to obtain long-term and real-time hemodynamic data, allowing us to study late-term physiological changes, as well as initiate goal-directed therapies in our animals, ultimately improving their survival.

1.3.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 3.1.2*

Videographer: Obtain headshots for all authors available at the filming location.

Ethics Title Card

This research has been approved by the Institutional Animal Care and Use Committee at the Nationwide Children's Hospital Abigail Wexner Research Institute

Protocol

2. Carotid Artery and Internal Jugular Vein Cannulation

Demonstrators: Tatsuya Watanabe, Satoshi Yuhara

2.1. To begin, shave the anesthetized sheep in a wide perimeter around the left neck and down over the chest **[1-TXT]**.

2.1.1. WIDE: Talent shaving a large area on the left side of the sheep's neck and chest. **TXT: Anesthesia: Ketamine (4 mg/kg); Diazepam (0.5 mg/kg); Injection: Through an internal jugular vein**

2.2. Position the sheep in the right lateral decubitus on the operating table **[1]** and secure the left front limb in flexion using a slipknot tie to expose the chest **[2]**.

2.2.1. Talent placing the sheep on its right side on the table.

2.2.2. Talent tying the left front limb in a flexed position to reveal the chest area.

2.3. Make a 5-centimeter longitudinal skin incision above the left carotid artery and internal jugular vein, approximately 7 centimeters cranial to the thoracic inlet **[1]**.

2.3.1. Talent making a vertical incision above the neck vessels using a scalpel.

2.4. Using electrocautery, dissect through the subcutaneous fat, connective tissue, and platysma muscle **[1]** to expose the neck vessels **[2]**.

2.4.1. Talent operating electrocautery to cut through tissues.

2.4.2. Talent pointing to the exposed neck vessels.

2.5. Using a combination of blunt and sharp dissection, clear the connective tissue circumferentially from the left carotid artery and internal jugular vein **[1]**.

2.5.1. Talent using scissors and forceps to gently remove connective tissue from around the vessels.

2.6. Now, pass a double-looped 2-0 *(2-oh)* silk tie around both vessels, proximal and distal to the cannulation site, for temporary vessel ligation **[1]**.

2.6.1. Talent looping silk ties around both the artery and vein at designated locations.

2.7. Then, make a 6-centimeter longitudinal incision at the base of the left neck between the scapula and cervical spine **[1]**.

2.7.1. Talent making a deep incision between the neck and shoulder landmarks.

2.8. Using a combination of electrocautery and blunt dissection, dissect through the subcutaneous fat and connective tissue to create a 6 by 4-centimeter pocket extending toward the spine **[1]**. Then, insert the telemetry device into the subcutaneous pocket **[2]** and secure it in place using a 2-0 silk suture **[3]**.

2.8.1. Talent carefully forming the subcutaneous pocket using tools.

2.8.2. Talent placing the device into the pocket.

2.8.3. Talent suturing the device to secure it.

2.9. Tunnel the telemetry device antenna under the subcutaneous tissue **[1]** and secure it in place using a 2-0 silk suture **[2]**.

2.9.1. Talent guiding the antenna under skin.

2.9.2. Talent suturing the antenna to fix position.

2.10. Now, make 1-centimeter counter skin incisions at the base of the neck, lower left chest **[1]**, and upper right chest for placement of the electrocardiogram leads **[2]**. Tunnel subcutaneously to connect these incisions to the device body pocket **[3]** and guide the leads to their intended positions **[4]**.

2.10.1. Talent making small incisions at at the base of the neck, lower left chest.

2.10.2. Talent making small incision at the upper right chest.

2.10.3. Talent tunneling electrocardiogram leads.

2.10.4. Shot of the leads at their positions.

2.11. Next, place the electrocardiogram leads in a manner similar to the femoral implant procedure **[1]**.

2.11.1. Shot of the leads being positioned.

2.12. Prepare the pressure catheters using gel before cannulation **[1]**. Create a subcutaneous tunnel from the lateral device pocket to the medial neck incision **[2]** and thread the two pressure catheters through **[3]**.

2.12.1. Talent applying gel to catheters for preparation.

2.12.2. Talent forming the subcutaneous tunnel from the lateral device pocket to the medial neck incision.

2.12.3. Talent inserting pressure catheters.

2.13. Using a 6-0 *(6-oh)* polypropylene suture, place a purse-string stitch around the cannulation site on both vessels **[1]** and secure it with a plastic tourniquet **[2]**.

2.13.1. Talent placing a purse-string stitch around the cannulation site on both vessels.

2.13.2. Shot of attaching tourniquet on vessels.

2.14. Now, administer an intravenous dose of heparin at 100 units per kilogram 3 minutes prior to cannulation **[1]**.

2.14.1. Talent injecting heparin intravenously using a syringe.

2.15. Then, tighten the proximal and distal 2-0 silk tourniquets around the carotid artery **[1]**. Carefully incise into the vessel at the center of the purse-string stitch using a number 11 blade scalpel **[2]** and slightly dilate with the tip of a curved hemostat **[3]**.

2.15.1. Talent tightening tourniquets around artery.

2.15.2. Talent cutting into artery.

2.15.3. Shot of using hemostat to slightly dilate .

2.16. Insert the pressure catheter for the left ventricular pressure channel into the thoracic ascending aorta **[1]**. Loosen the proximal silk tourniquet to allow catheter passage **[2]**, then tighten the purse-string suture around the catheter **[3]**.

2.16.1. Talent inserting catheter into the aorta.

2.16.2. Talent adjusting tourniquet and catheter passing.

2.16.3. Shot of tying suture around catheter.

2.17. Repeat the previous steps to cannulate the left internal jugular vein using the pressure catheter for the blood pressure channel and advance it into the thoracic superior vena cava **[1]**.

2.17.1. Shot of the catheter advanced into the thoracic superior vena cava.

2.18. Confirm the position of catheter tips in the thoracic superior vena cava and ascending aorta using fluoroscopy **[1]**.

2.18.1. LAB MEDIA: Figure 2D

2.19. Finally, reapproximate the platysma muscle using a 2-0 absorbable suture **[1]**. Close the skin with deep dermal sutures using 3-0 *(3-oh)* absorbable sutures and subcuticular region with 4-0 absorbable sutures **[2]**.

2.19.1. Talent stitching the platysma muscle back together.

2.19.2. Talent completing layered closure of the incision site.

Results

3. Results

3.1. Heart rate peaked to above 150 beats per minute immediately following Fontan surgery, then gradually declined to a baseline near 100 beats per minute over 10 days **[1]**, while systolic and diastolic blood pressures remained relatively stable during the same period **[2]**. Inferior vena cava pressure exhibited a mild but sustained elevation from the time of surgery through to day 21 **[3]**.

3.1.1. LAB MEDIA: Figure 3. *Video editor: Highlight the purple line for "heart rate".*

3.1.2. LAB MEDIA: Figure 3. *Video editor: Highlight the two middle lines (red and yellow) for "systolic and diastolic pressures".*

3.1.3. LAB MEDIA: Figure 3. *Video editor: Highlight the lowest dark blue line for "IVC pressure".*

3.2. Thoracic superior vena cava pressure increased immediately after Fontan circulation was established and fluctuated between minus 10 to 35 millimeters of mercury for several hours, stabilizing toward baseline within 12 hours **[1]**.

3.2.1. LAB MEDIA: Figure 4B. *Video editor: Highlight the section just after the "Anesthesia End" label*.

3.3. Abdominal inferior vena cava pressure rose significantly after Fontan circulation was initiated, reaching up to 40 millimeters of mercury, and remained elevated with oscillating peaks for the rest of the recording period **[1]**.

3.3.1. LAB MEDIA: Figure 4A. *Video editor: Focus on the right part of the graph*.

3.4. Invasive pressure measurements of the thoracic superior vena cava showed mean values fluctuating between 2 and 4 millimeters of mercury, corresponding closely with the telemetry device readings, which averaged around 1.1 millimeters of mercury **[1]**.

3.4.1. LAB MEDIA: Figure 6. *Video editor: Highlight the bottom wave-like lines*.

3.5. Abdominal inferior vena cava pressure was consistently higher during recumbency **[1]** and dropped significantly whenever the sheep transitioned to a standing position **[2]**.

3.5.1. LAB MEDIA: Figure 5. *Video editor: Highlight the point at "Recumbency"*.

3.5.2. LAB MEDIA: Figure 5. *Video editor: Highlight the point at "Standing"* .

Pronunciation Guide

1. Ketamine

- **Pronunciation link**: *Pending link verification*
- **IPA**: /ˈkɛtəˌmiːn/
- **Phonetic Spelling**: keh-tuh-meen

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2. Diazepam

- **Pronunciation link**: *Pending link verification*
- **IPA**: /daɪˈæzəˌpæm/
- **Phonetic Spelling**: dye-az-uh-pam

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3. Jugular

- **Pronunciation link**: *Pending link verification*
- **IPA**: /ˈdʒʌgjələr/
- **Phonetic Spelling**: juh-gyuh-lur

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4. Platysma

- **Pronunciation link**: *Pending link verification*
- **IPA**: /pləˈtɪzmə/
- **Phonetic Spelling**: pluh-tiz-muh

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5. Telemetry

- **Pronunciation link**: *Pending link verification*
- **IPA**: /təˈlɛmɪtri/
- **Phonetic Spelling**: tuh-leh-muh-tree

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6. Cannulation

- **Pronunciation link**: *Pending link verification*
- **IPA**: /ˌkænjəˈleɪʃən/

- **Phonetic Spelling**: kan-yuh-lay-shun

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7. Tourniquet

- **Pronunciation link**: *Pending link verification*
- **IPA**: /ˈtɜrnɪkɪt/
- **Phonetic Spelling**: tur-nuh-kit

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8. Heparin

- **Pronunciation link**: *Pending link verification*
- **IPA**: /ˈhɛpərɪn/
- **Phonetic Spelling**: heh-puh-rin

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9. Fluoroscopy

- **Pronunciation link**: *Pending link verification*
- **IPA**: /flʊˈrɑːskəpi/ or /flɔːˈrɑːskəpi/
- **Phonetic Spelling**: floo-rah-skuh-pee

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10. Recumbency

- **Pronunciation link**: *Pending link verification*
- **IPA**: /rɪˈkʌmbənsi/
- **Phonetic Spelling**: rih-kum-buhn-see
