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Title: Implantation of Left Ventricular Assist Device (LVAD) in Juvenile Landrace Swine: A LVAD Implantation Model of Pediatric Heart Failure

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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: 14
Number of Shots: 24

Introduction

Videographer: Please obtain headshots for the authors who are present at the shoot location
Only the interview part needs to be filmed.

INTRODUCTION:

1.1. **Guangxin Yue:** Our research establishes a juvenile pig model to study pediatric LVAD support and heart reverse remodeling.

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

1.2. **Wei Wang:** A major challenge is the lack of a suitable animal model that represents a child's size and heart.

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

CONCLUSION:

1.3. **Xingchao Du:** We address the critical gap of a pediatric-specific LVAD implantation model for safety and mechanism research.

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

1.4. **Guangxin Yue:** Our model uses young, small pigs, which closely mimic the heart size and physiology of children.

1.4.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

1.5. **Wei Wang:** This model will help us develop safer, more effective ventricular assist devices for children.

1.5.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera.

Ethics Title Card

This research has been approved by the Institutional Animal Care and Use Committee (IACUC) at the Fuwai Hospital, Chinese Academy of Medical Sciences

Protocol

2. Surgical Left Ventricular Assist Device (LVAD) Implantation

Demonstrator: Jiangping Song

2.1. To begin, make a 3 to 4-centimeter longitudinal incision at the junction of the upper and middle thirds of the line connecting the mandibular angle to the manubrium sterni **[1-TXT]**. After the jugular vein, perform an anterior vena cava puncture to monitor the central venous pressure **[2-TXT]**.

2.1.1. LAB MEDIA: JOVE69151-1 00:00 – 00:20 **TXT: Anesthesia induction: Ketamine 10-20 mg/kg, IM**.

2.1.2. LAB MEDIA: JOVE69151-1 09:00 – 09:20 **TXT: Maintenance anesthesia: Isoflurane (2 - 3%); Dexmedetomidine (1 U/kg) + Propofol (1 - 2 mg/kg/h)**

2.2. Establish femoral artery access for blood pressure measurement when necessary **[1-TXT]**.

2.2.1. LAB MEDIA: JOVE69151-1 16:45 – 16:59

2.3. Now, perform a median thoracotomy in the supine position **[1]**; suspend the pericardium **[2]** and fix it to expose the heart **[3]**.

2.3.1. LAB MEDIA: JOVE69151-1 21:20 – 21:30

2.3.2. LAB MEDIA: JOVE69151-1 29:25 – 29:30

2.3.3. LAB MEDIA: JOVE69151-1 40:02 – 40:15

2.4. Next, pass the LVAD signal line through the subcutaneous tunnel from the back **[1]**, and connect it to the controller **[2]** to prevent the pig from rubbing against the signal line and causing it to fall off after waking up later **[3]**.

2.4.1. LAB MEDIA: JOVE69151-1 55:35 – 55:46

2.4.2. LAB MEDIA: JOVE69151-1 56:35 – 56:40

2.4.3. LAB MEDIA: JOVE69151-1 1:13:43 – 1:13:53

2.5. Then, determine the position and direction of the mitral valve with ultrasound **[1]**.

2.5.1. LAB MEDIA: JOVE69151-1 1:32:30 – 1:32:40

2.6. Use a sterile surgical marker to draw the fixed position of the apical ring at the apex of the heart **[1]**.

2.6.1. LAB MEDIA: JOVE69151-1 1:37:31 – 1:37:40

2.7. Now, using a 5-0 suture thread with a gasket, fix the top ring at the apex position **[1]**.

2.7.1. LAB MEDIA: JOVE69151-1 1:41:10 – 1:41:13 and 2:02:40 – 2:02:50

2.8. Then, remove the myocardium within the parietal ring using an apical punch **[1]**, and trim with tweezers and scissors to prevent fragments from falling into the cardiac cavity **[2]**.

2.8.1. LAB MEDIA: JOVE69151-1 2:08:28 – 2:08:30 and 2:09:53 – 2:09:56

2.8.2. LAB MEDIA: JOVE69151-1 2:13:15 – 2:13:25

2.9. Insert the LVAD pump head into the top ring, ensuring that the pump head enters the cardiac cavity. Fasten the lock tightly, and remove the top ring clamp **[1]**.

2.9.1. LAB MEDIA: JOVE69151-1 2:17:44 – 2:18:00

2.10. Determine the appropriate length of the artificial blood vessel from the LVAD pump head to the ascending aorta **[1]**.

2.10.1. LAB MEDIA: JOVE69151-1 2:44:22 – 2:44:27

2.11. Then, cut out an oblique opening at about a 30 degree angle **[1]** and anastomose the end to the ascending aorta to avoid distortion of the artificial blood vessel **[2]**.

2.11.1. LAB MEDIA: JOVE69151-1 2:44:42 – 2:44:52

2.11.2. LAB MEDIA: JOVE69151-2 01:30 – 01:45 and 03:30 – 03:40

2.12. Now, place the ultrasound probe on the ascending aorta to examine the blood flow. Ensure that the blood flow through the artificial vessel is smooth and that there is no significant turbulence in the aorta **[1]**.

2.12.1. LAB MEDIA: JOVE69151-1 3:47:04 – 3:47:30

2.13. Embed a drainage tube in each of the left and right spaces of the heart **[1]**, and connect

an external negative pressure suction bottle **[2]**.

2.13.1. LAB MEDIA: JOVE69151-1 4:18:00 – 4:18:13

2.13.2. LAB MEDIA: JOVE69151-1 4:20:17 – 4:20:28

2.14. Finally, align the sternum **[1]** and close the chest layer by layer **[2]**.

2.14.1. LAB MEDIA: JOVE69151-1 4:29:10 – 4:29:20

2.14.2. LAB MEDIA: JOVE69151-1 4:50:20 – 4:50:30

Results

3. Results

3.1. The left ventricular assist device implantation in a 3-month-old landrace pig was successfully completed following the established protocol. The preoperative electrocardiogram showed a normal cardiac rhythm before surgery **[1]**.

3.1.1. LAB MEDIA: Figure 1B. *Video editor: Highlight the ECG trace in the left panel*

3.2. Postoperative electrocardiogram results on the 3rd and 14th days showed no abnormalities compared with the preoperative result **[1]**.

3.2.1. LAB MEDIA: Figure 1B. *Video editor: Highlight the middle and right ECG panels*.

3.3. The preoperative echocardiography revealed a left ventricular ejection fraction of 62% and a fractional shortening of 26% **[1]**.

3.3.1. LAB MEDIA: Figure 1C. *Video editor: Highlight the first image on the left in the first row*.

3.4. The LVAD pump head was confirmed intraoperatively to face directly toward the mitral valve **[1]**.

3.4.1. LAB MEDIA: Figure 1C. *Video editor: Highlight the extreme right image in the first row*.

3.5. Postoperative echocardiography on the 14th day confirmed the LVAD pump head remained in place with normal ventricular wall motion and heart function **[1]**.

3.5.1. LAB MEDIA: Figure 1C. *Video editor: Show the 2 images in the bottom row*.

3.6. The left ventricle ejection fraction and fractional shortening remained within normal ranges throughout the 28-day postoperative period **[1]**.

3.6.1. LAB MEDIA: Figure 2A and B. *Video editor: Highlight the graph lines*.

3.7. Red blood cell count and hemoglobin decreased after surgery but stabilized following transfusion **[1]**.

3.7.1. LAB MEDIA: Figure 2D and E. *Video editor: Highlight the line graphs*.

3.8. Platelet count and neutrophil percentage fluctuated within the first 3 postoperative days, likely due to surgical trauma **[1]**.

3.8.1. LAB MEDIA: Figure 2F AND G. *Video editor: Highlight the line graph from day 0 to day 3*.

3.9. Liver and kidney function markers temporarily increased after surgery but returned to normal within 3 days **[1]**.

3.9.1. LAB MEDIA: Figure 2H, I, J, K. *Video editor: Highlight the graphs sequentially*.

3.10. The LVAD maintained stable function with an average rotational speed of 3600 revolutions per minute and flow around 2 liters per minute post-implantation **[1]**.

3.10.1. LAB MEDIA: Figure 3B. *Video editor: Highlight the graph line for "Flow"*

3.11. Postoperative heart rate **[1]**, systolic pressure **[2]**, and diastolic pressure **[3]** remained stable during continuous monitoring **[4]**.

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

3.11.2. LAB MEDIA: Figure 3A. *Video editor: Highlight the line for "systolic pressure"*

3.11.3. LAB MEDIA: Figure 3A. *Video editor: Highlight the line for "diastolic pressure"*

3.11.4. LAB MEDIA: Figure 3A. *Video editor: Highlight all 3 lines*

- Mandibular (as in "mandibular angle")

Pronunciation link: https://www.howtopronounce.com/mandibular (howtopronounce.com)
IPA: /mænˈdɪbjələr/
Phonetic Spelling: man-DIH-buh-lur

- Manubrium sterni

Pronunciation link: https://www.howtopronounce.com/manubrium-sterni (howtopronounce.com) How To Pronounce+1
IPA: /məˈnuːbriəm ˈstɜːrni/
Phonetic Spelling: muh-NOO-bree-um STUR-nee

- Jugular

Pronunciation link: https://www.merriam-webster.com/dictionary/jugular
IPA: /ˈdʒʌgjələr/
Phonetic Spelling: JUG-yuh-lur

- Vena cava

Pronunciation link: https://www.merriam-webster.com/dictionary/vena%20cava
IPA: /ˌviːnə ˈkɑːvə/
Phonetic Spelling: VEE-nuh KAH-vuh

- Thoracotomy

Pronunciation link: https://www.howtopronounce.com/thoracotomy (howtopronounce.com)
IPA: /ˌθɔːrəˈkɒtəmi/ (US: /ˌθɔːrəˈkɑtəmi/)
Phonetic Spelling: thuh-ruh-KOT-uh-mee

- Pericardium

Pronunciation link: https://www.merriam-webster.com/dictionary/pericardium
IPA: /ˌpɛrəˈkɑːrdiəm/
Phonetic Spelling: per-uh-KAR-dee-um

- Anastomose (as in "anastomose the end to the ascending aorta")

Pronunciation link: https://www.merriam-webster.com/dictionary/anastomose
IPA: /əˈnæs·təˌmoʊs/
Phonetic Spelling: uh-NAS-tuh-mose

- Apical (as in "apical ring at the apex of the heart")

Pronunciation link: https://www.merriam-webster.com/dictionary/apical
IPA: /ˈeɪpɪkəl/
Phonetic Spelling: AY-pih-kul

- Tachycardia (even though not explicitly in text, often relevant in cardiac surgery)

Pronunciation link: https://www.merriam-webster.com/dictionary/tachycardia
IPA: /ˌtækɪˈkɑːrdiə/
Phonetic Spelling: tak-ih-KAR-dee-uh

- Ejection (as in "ejection fraction")

Pronunciation link: https://www.merriam-webster.com/dictionary/ejection
IPA: /ɪˈdʒɛkʃən/
Phonetic Spelling: ih-JEK-shun