Multidimensional imaging-based models for cardiovascular procedural skills training (BVP model)

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Problem Statement
Interventional cardiology is a rapidly expanding field in veterinary medicine. Pulmonary valve stenosis occurs when a dog is born with a malformed pulmonary valve, which restricts blood flow from the right heart to the lungs. Balloon valvuloplasty is a palliative procedure in which a balloon-tipped catheter is inserted into the jugular vein to the valve and is then inflated to help reduce the severity of the stenosis. Recently, the UW-Madison School of Veterinary Medicine has experienced a decrease in caseloads of canines with pulmonary valve stenosis, preventing the cardiology residents from being able to practice repairing this disorder. There is a need for a heart model to mimic pulmonary valve stenosis for residents to learn and practice repairing these valves.

This device, a model-based simulation program will be implemented to maintain the cardiologists' surgical skill set and to aid in cardiology resident training. Simulator training using multidimensional imaging-based models will augment the training already provided in the interventional lab and help protect against the ebb and flow of procedural caseload eroding skills. It also provides a more consistent experience for our residents and provides an objective method of assessing individual progress amongst our trainees.

The goal is to develop a silicone 3D model of canine pulmonary valve stenosis which can be used to learn/practice essential skills like handling of guidewires/catheters, balloon positioning and inflation, and communication between veterinary interventionists. Computed tomography angiography (CTA) of dogs with pulmonary valve stenosis will be used to create the 3D models, which will be secured in place. Lastly, a document camera will project an image of what the user is doing with their hands onto a screen. This provides a more realistic recreation of the interventional surgery, where the surgeon watches a fluoroscopy screen to monitor the movement of the interventional equipment inside the patient.

Brief Status Update

This week we continued research for the project including background research on canine heart anatomy, pulmonary valve stenosis, pulmonary valve stenosis balloon valvuloplasty, and procedures to develop 3D models from CT scans. Additionally, we wrote the Product Design Specifications to organize the requirements for this project and our clients wishes for the product.

Summary of Weekly Team Member Design Accomplishments

- Team:
    - This week we continued individual research on canine heart anatomy, pulmonary valve stenosis, and pulmonary valve stenosis balloon valvuloplasty
    - We wrote the Product Design Specifications

- Hunter Belting:
    - Researched competing designs currently being used for both humans and canine populations
    - Completed the allocated portion of the PDS
    - Prepped to meet with the client in person on Friday

- Anna Balstad:
    - Researched current human and canine heart models and their limitations.
    - Continued research on the canine heart and pulmonary stenosis.
    - Wrote sections of the PDS.

- Rebecca Poor:
    - Continued research on the canine heart anatomy and began researching cardiac heart properties for tissue.
    - Researched competing designs for cardiac heart models.
    - Wrote portions of the PDS.

- Daisy Lang:
    - Completed research regarding standards and regulations for surgical simulation models.
    - Researched competing designs for pulmonary valve models.
    - Completed designated section of the PDS.

Weekly / Ongoing Difficulties

N/A

Upcoming Team and Individual Goals

- Team:
    - Meet with client Friday afternoon to see current models in the lab and gain more understanding of the balloon valvuloplasty procedure and ideas for our model.

- Hunter Belting:
    - Attend the meeting with the client to continue to understand the project requirements and understand the surgery itself
    - Learn more about the different options for 3-D printing of silicone based products through both personal printing capabilities and outsourced capabilities to inform decision making through a design matrix

- Anna Balstad:
    - Attend client meeting.
    - Continue researching 3D printing materials and techniques.

- Rebecca Poor:
    - Attend the client meeting and ask questions regarding the material of the design and gain a greater understanding of the surgery utilized with the model.
    - Begin segmenting the CTA scans provided by the client.

- Daisy Lang:
    - Attend client meetings and take notes regarding the other models used for simulation testing of other procedures.
    - Finish preliminary research of physiology of heart and pulmonary valve stenosis based on remaining questions from client meeting.
    - Begin looking into possible materials for our design.

Project Timeline

Project Goal	**Deadline**	**Team Assigned**	**Progress**	**Completed**
PDS	9/20	All	x	x
Design Matrix	9/27	All		
Preliminary Presentations	10/4	All		
Preliminary Deliverables	10/9	All		

Show and Tell	11/1	All		
Poster Presentations	12/6	All		
Final Deliverables	12/11	All		

Expenses

Item	Description	Manufacturer	Part Number	Date	QTY	Cost Each	Total	Link
Component 1								
Component 2								
Component 3								
TOTAL:								**$0.00**