

Development and Validation of a Porcine *Ex Vivo* Tricuspid Valve Model

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Introduction

- *Ex vivo* models facilitate development and testing of novel procedures
- Growing interest in interventions for tricuspid valve (TV) disease
- No *ex vivo* TV model widely adopted

Objectives

To characterize and validate an *ex vivo* model of the tricuspid valve.

Materials and Methods

Model setup:

- Tissue: fresh swine hearts (n=5)
- Preparation: aorta and pulmonary artery clamped and cannulated, coronary arteries ligated, and ventricles pressurized to 40 (right) and 120 (left) mmHg
- Model assumes static conformation similar to that of end diastole/early systole (Figure 1)

Measurements:

- Circumference, tenting angles, tenting height, tenting area, and diameter (Figure 2)
- Measurements made using 3-D reconstruction of TV generated from structured light scanner (Artec) exported to processing software (Geomagic)

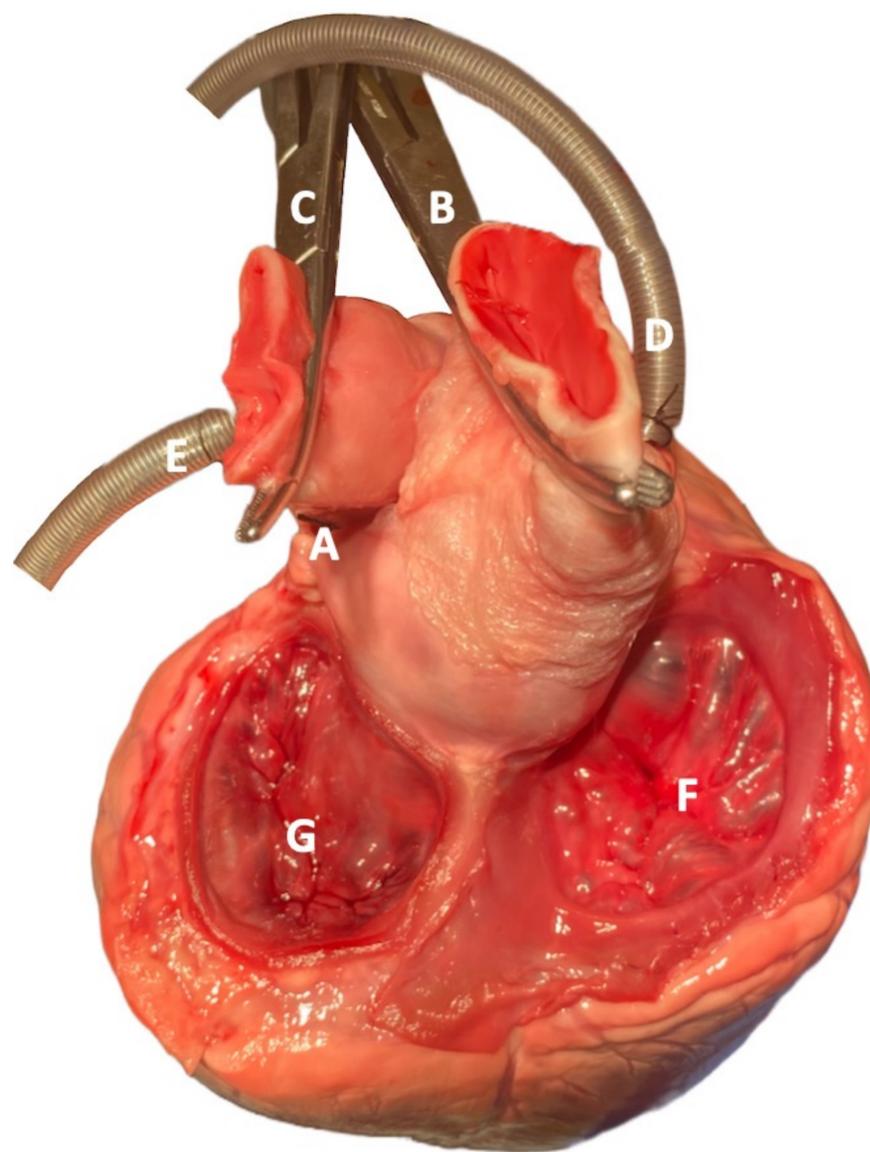
Validation:

- Measurements compared to range of published human transthoracic echocardiographic (TTE) data

Results

- Model with bi-ventricular pressurization represents TV at end diastole/early systole
- Measurements reasonably approximate human TTE
- Allows for study of novel TV transcatheter and surgical interventions
- Further modification to study TV pathophysiology

Figure 1. Experimental setup with right and left ventricles pressurized, representing tricuspid valve at end diastole/early systole.



Ligated coronary artery (A), ligated aortic cross clamp (B), pulmonary artery cross clamp (C), cannula to left ventricle (D), cannula to right ventricle (E), tricuspid valve (F), and mitral valve (G).

Figure 2. Tricuspid valve and measurements taken during analysis. Circumference (A), annulus area (B), major axis (C), minor axis (D), tenting height (E), tenting area (F), septal angle (G), and nonplanarity angle (H).

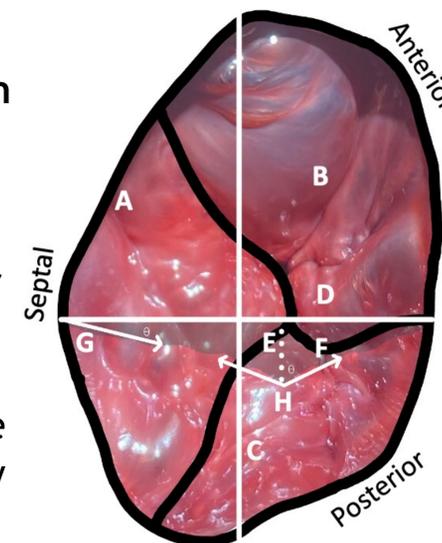


Table 1. Tricuspid valve measurements in porcine *ex vivo* model vs. human echocardiographic references.

Variable	<i>Ex Vivo</i> TV Model	Human Echocardiography
Circumference (cm)	12.7 ± 0.8	9.9-11.9
Annular area (cm ²)	8.9 ± 1.4	7.6-11.3
Tenting area (cm ²)	1.0 ± 0.4	0.5
Tenting height (cm)	0.7 ± 0.2	0.5-0.7
Minor axis diameter (cm)	2.6 ± 0.4	2.9-3.1
Major axis diameter (cm)	3.9 ± 0.4	3.4-3.8
Septal angle (degrees)	26.8 ± 10.5	11.8
Nonplanarity angle (degrees)	135.6 ± 12.6	165.0

Results as mean ± standard deviation for *ex vivo* results and range or single value for human echocardiographic measurements.

Conclusion

This study successfully characterized a porcine *ex vivo* pneumatic model of the tricuspid valve, with most measurements concordant with human transthoracic echocardiographic data.