Imaging Transcatheter Valve Therapies

Key Points

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Co-Chief Structural and Valvular Centre of Excellence

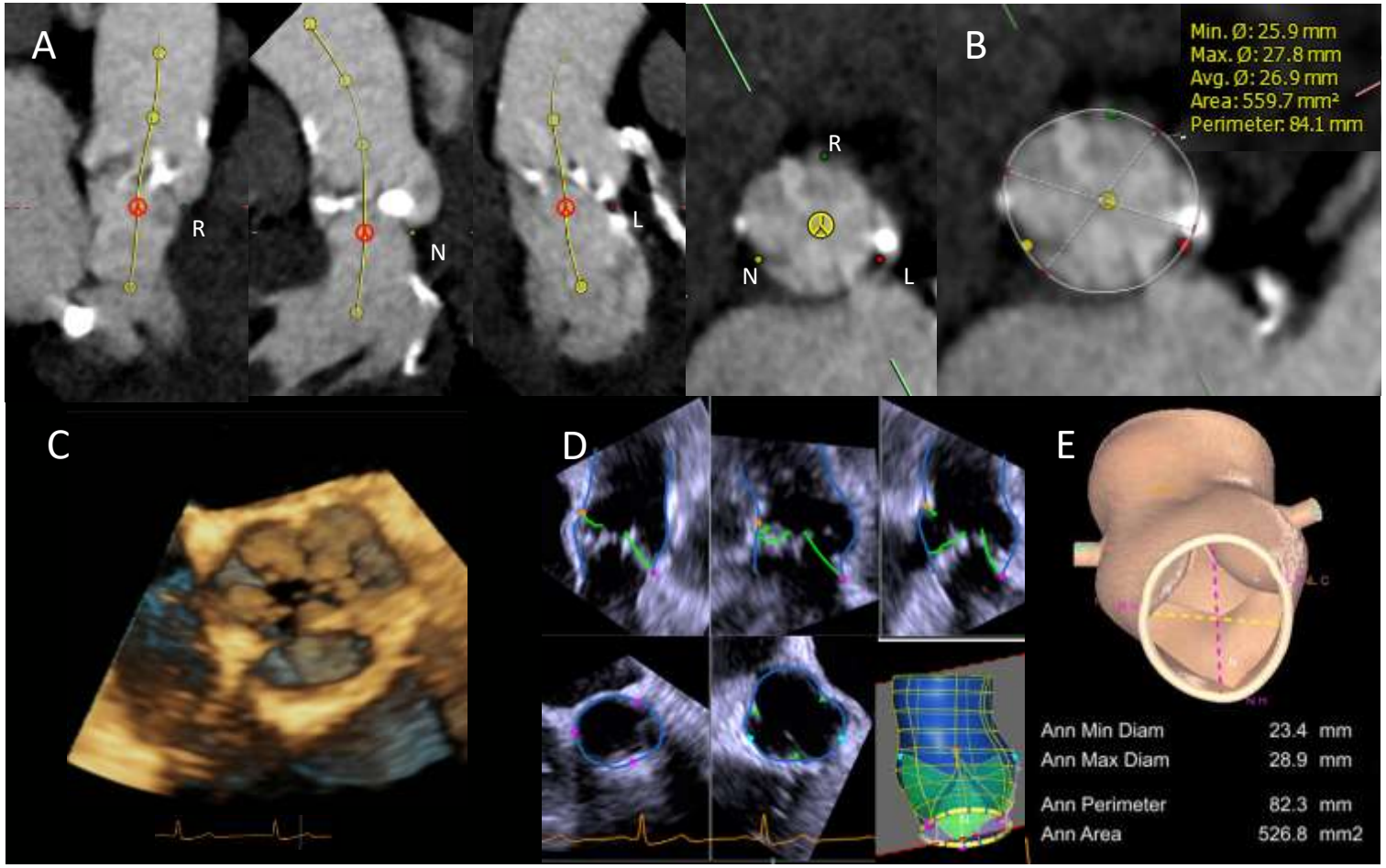
Marcus Heart Valve Center, Piedmont Heart Institute, Atlanta

Conflict of Interest:

Siemens, Abbott and Medtronic - Research Support

Procedure Planning

Quantitative Anatomy - TAVR



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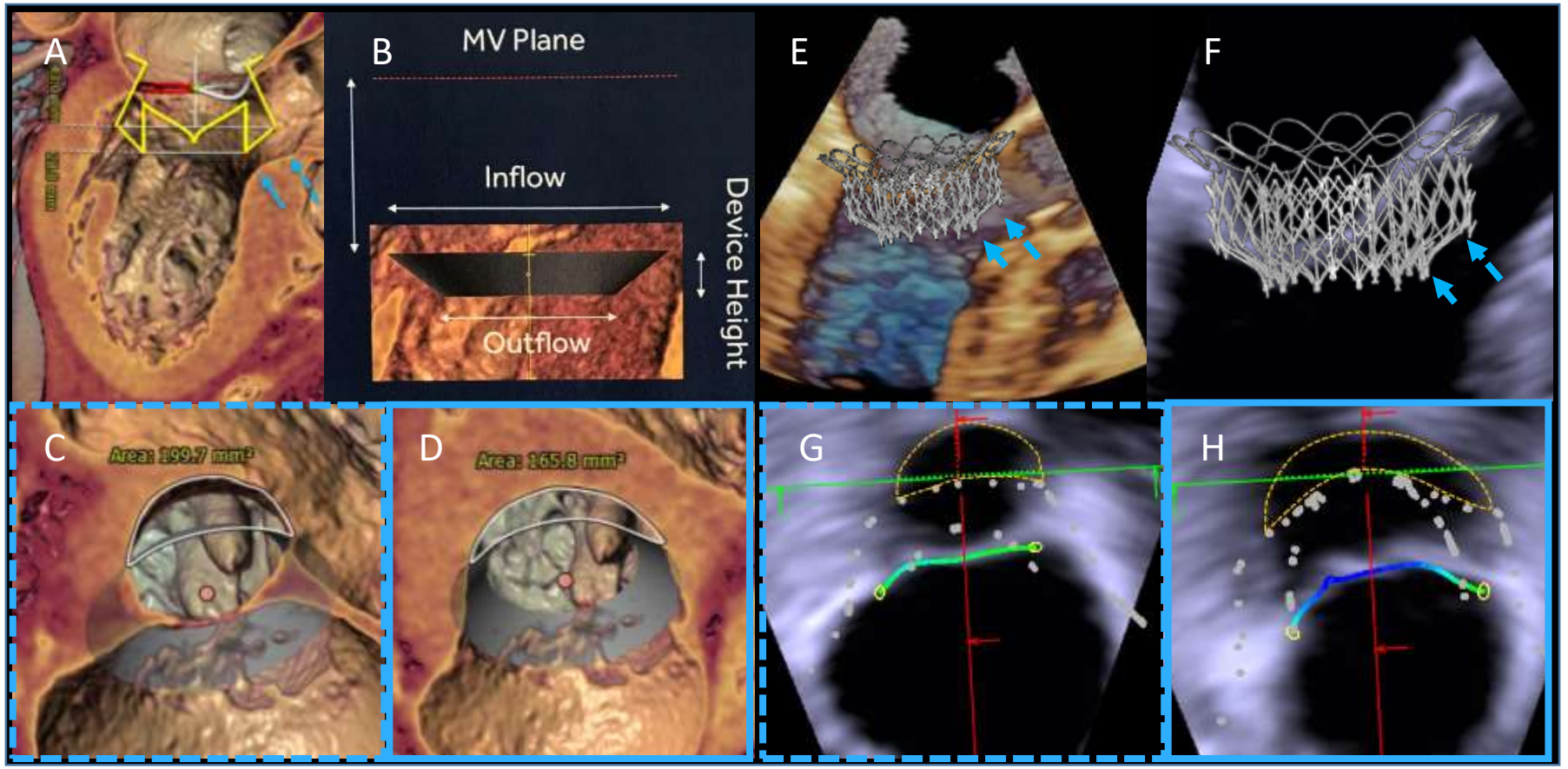
Procedure Planning

Anatomy Based Simulation - TMVR



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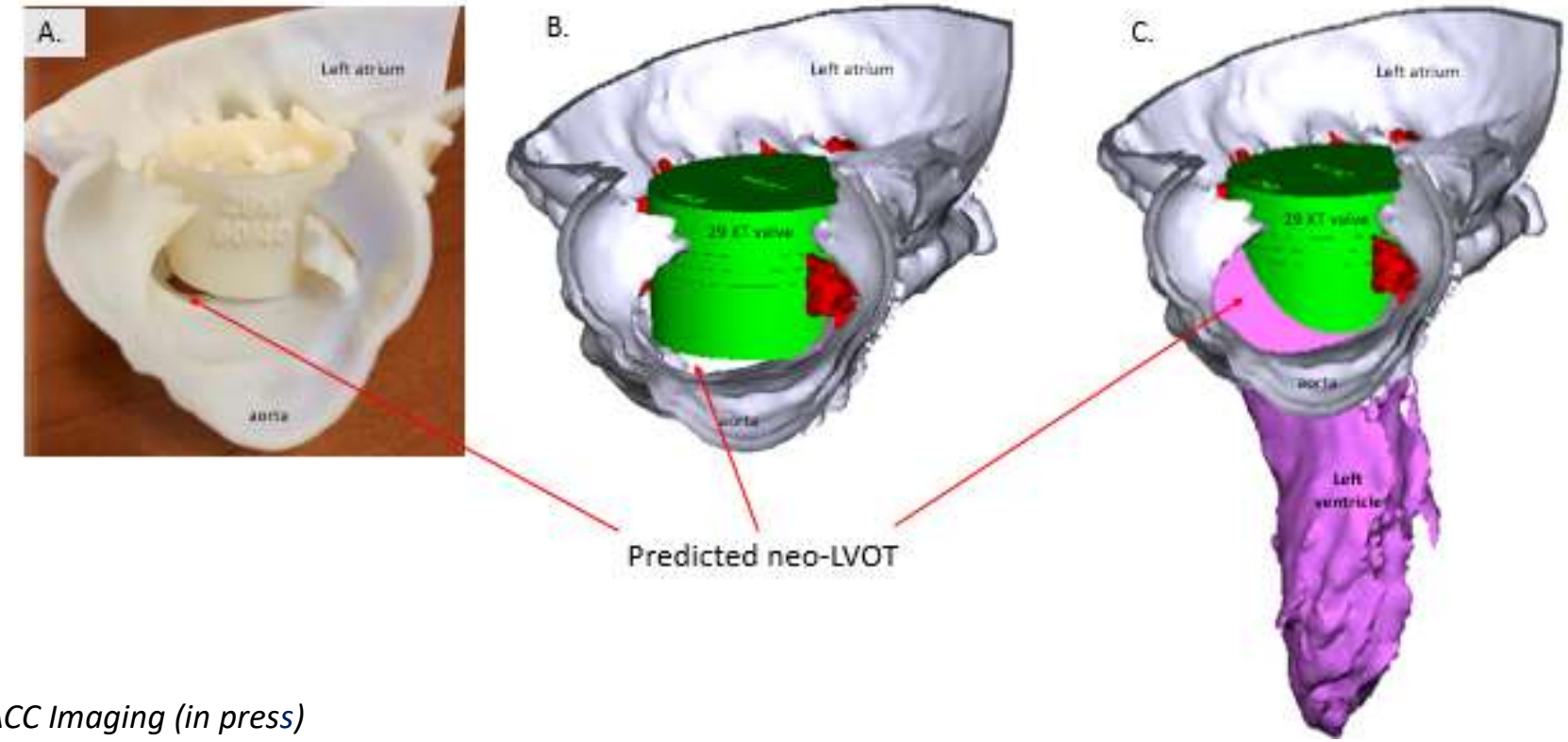
Procedure Planning

3D Printing and Simulation - TMVR



Wang DD et al., JACC Imaging (in press)

Procedure Planning

“Smart”3D Printing and Simulation

JACC: CARDIOVASCULAR IMAGING
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ORIGINAL RESEARCH

Quantitative Prediction of Paravalvular Leak in Transcatheter Aortic Valve Replacement Based on Tissue-Mimicking 3D Printing

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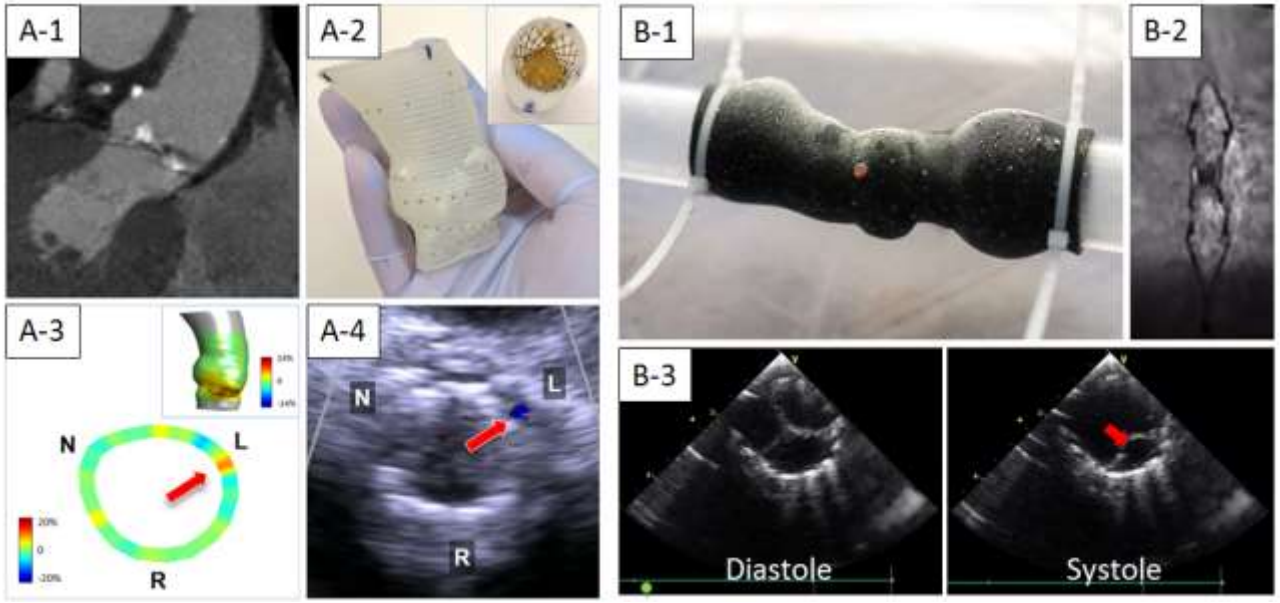
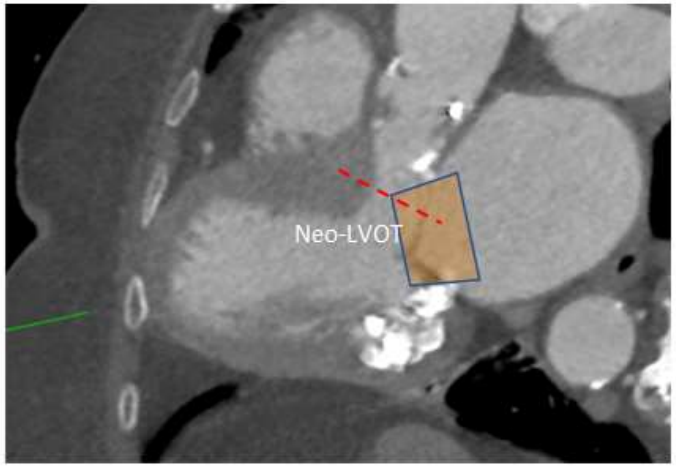
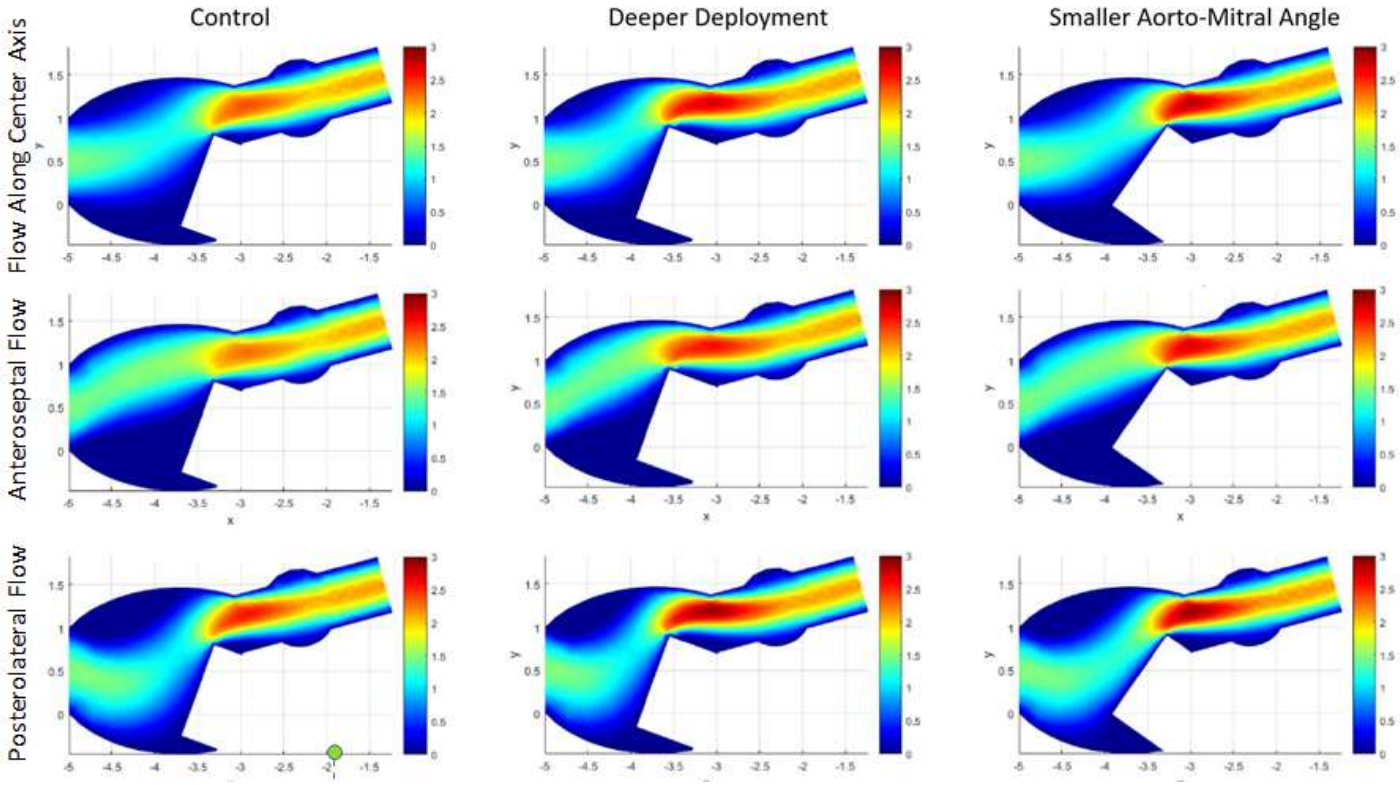


Procedure Planning

Computational Modeling





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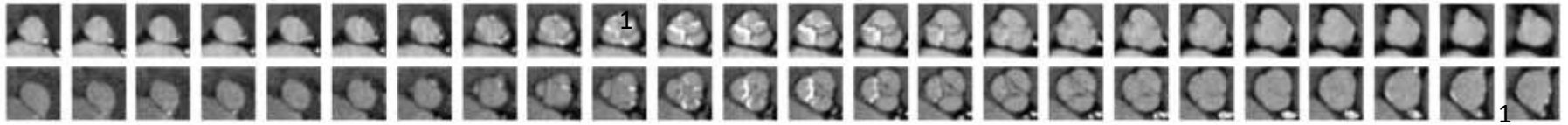
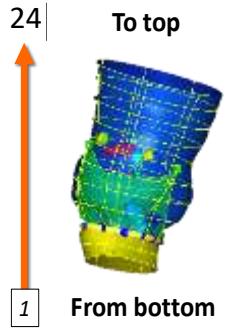
Procedure Planning

Artificial Intelligence

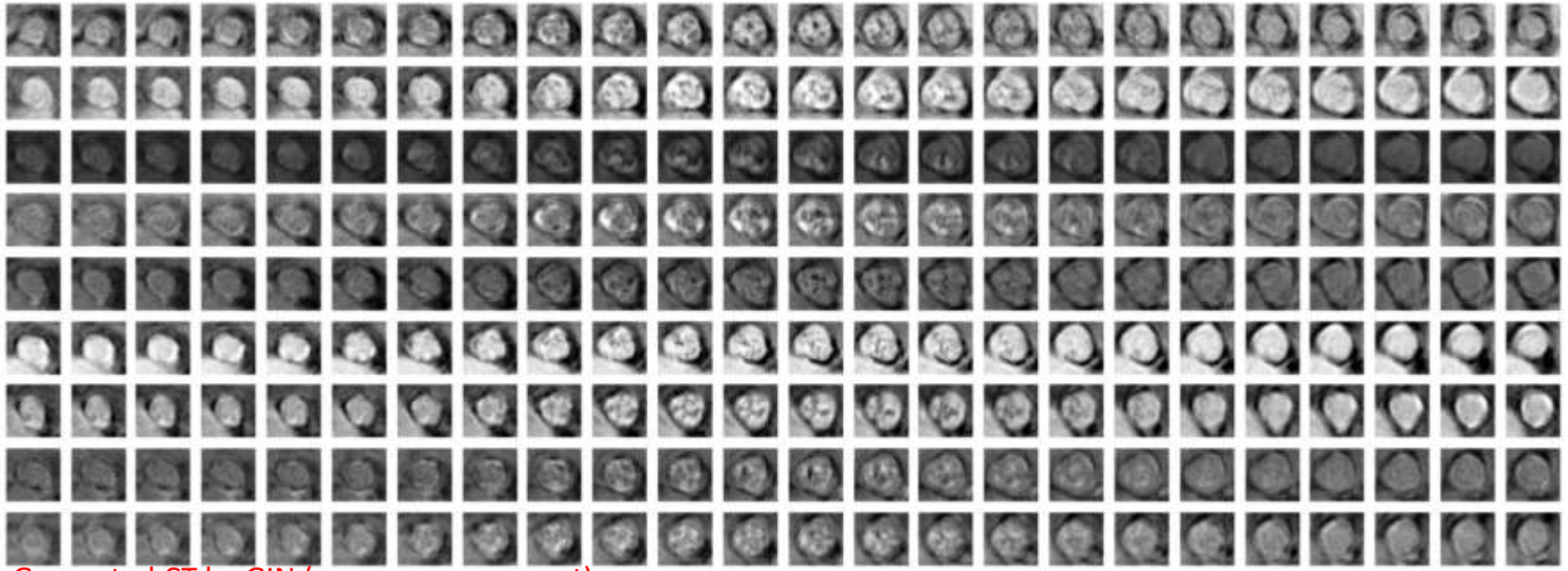
- Using 24 CT slides/cuts (every row)
- Using Python + Tensorflow (on TITAN Xp)
- Generated CT sections seems real

Real valves for training (168X10)





GIN



Generated CT by GIN (as many as we want)

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Procedure Planning

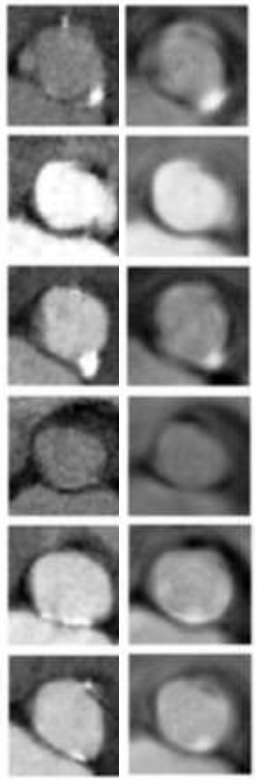
Artificial Intelligence

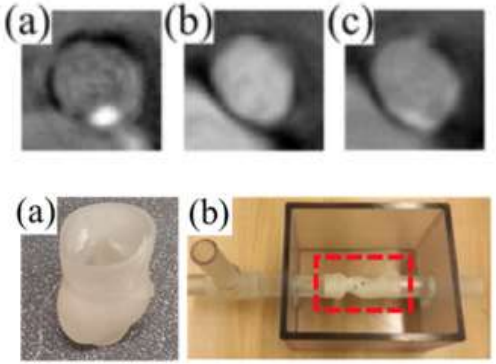
Generative Invertible Networks (GIN): Pathophysiology-Interpretable Feature Mapping and Virtual Patient Generation

Paper ID: 442

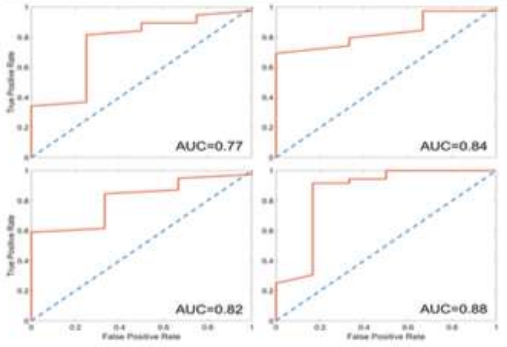
Abstract. Machine learning methods play increasingly important roles in pre-procedural planning for complex surgeries and interventions. Very often, however, researchers find the historical records of emerging surgical techniques, such as the transcatheter aortic valve replacement (TAVR), are highly scarce in quantity. In this paper, we address this challenge by proposing novel generative invertible networks (GIN) to select features and generate high-quality *virtual patients* that may potentially serve as an additional data source for machine learning. Combining a convolutional neural network (CNN) and generative adversarial networks (GAN), GIN discovers the pathophysiologic meaning of the feature space. Moreover, a test of predicting the surgical outcome directly using the selected features results in a high accuracy of 81.55%, which suggests little pathophysiologic information has been lost while conducting the feature selection. This demonstrates GIN can generate virtual patients not only visually authentic but also pathophysiologic interpretable.

Keywords: Virtual patients, Generative neural networks



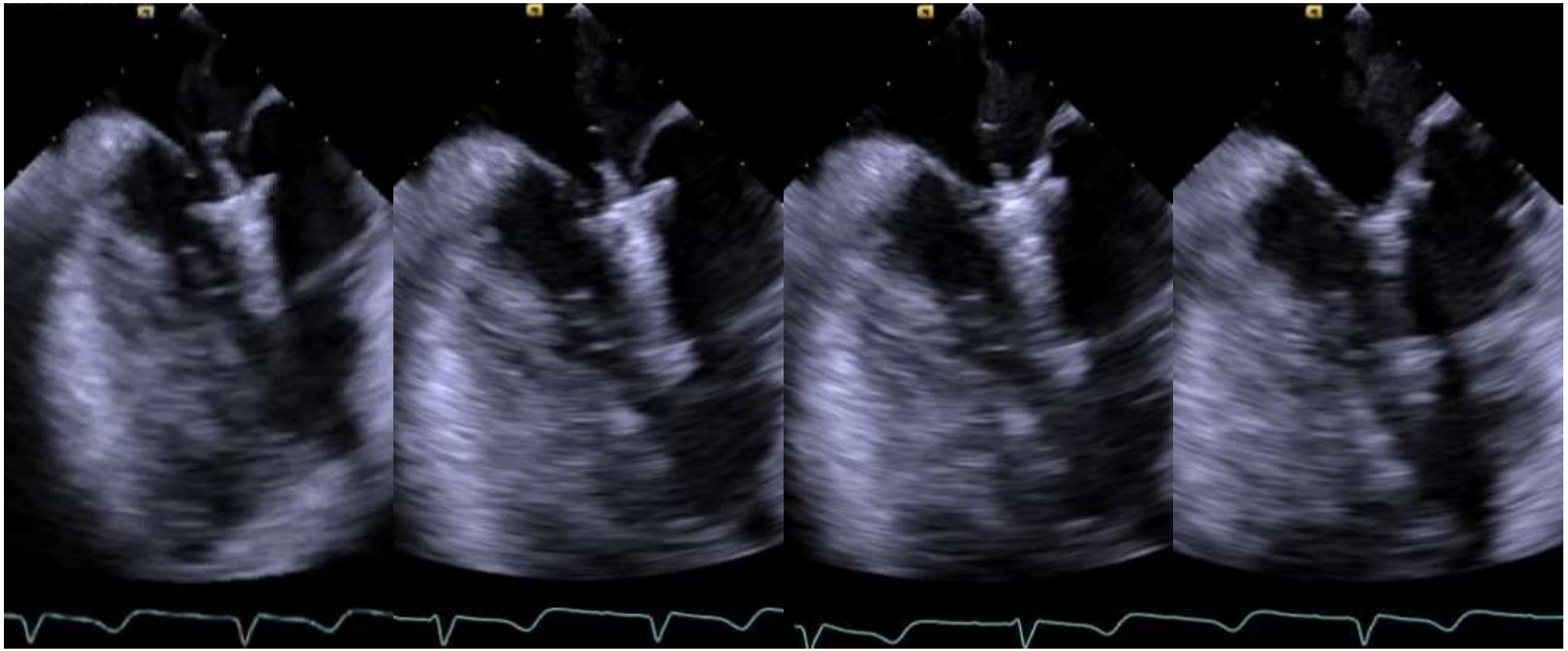


K-fold CV	Accuracy	Sensitivity	Specificity
1	80.95%	75.00%	81.58%
2	76.19%	66.67%	76.92%
3	78.57%	71.43%	79.49%
4	90.48%	83.33%	91.67%
Average	81.55%	70.76%	82.42%



Procedure Guidance

ICE – Tricuspid Clip



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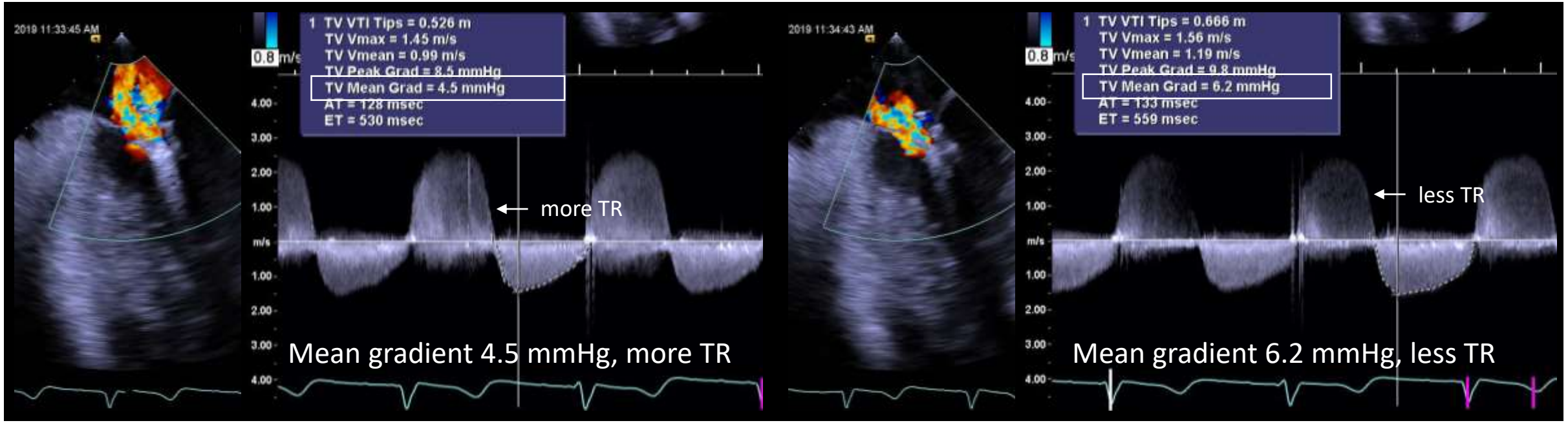
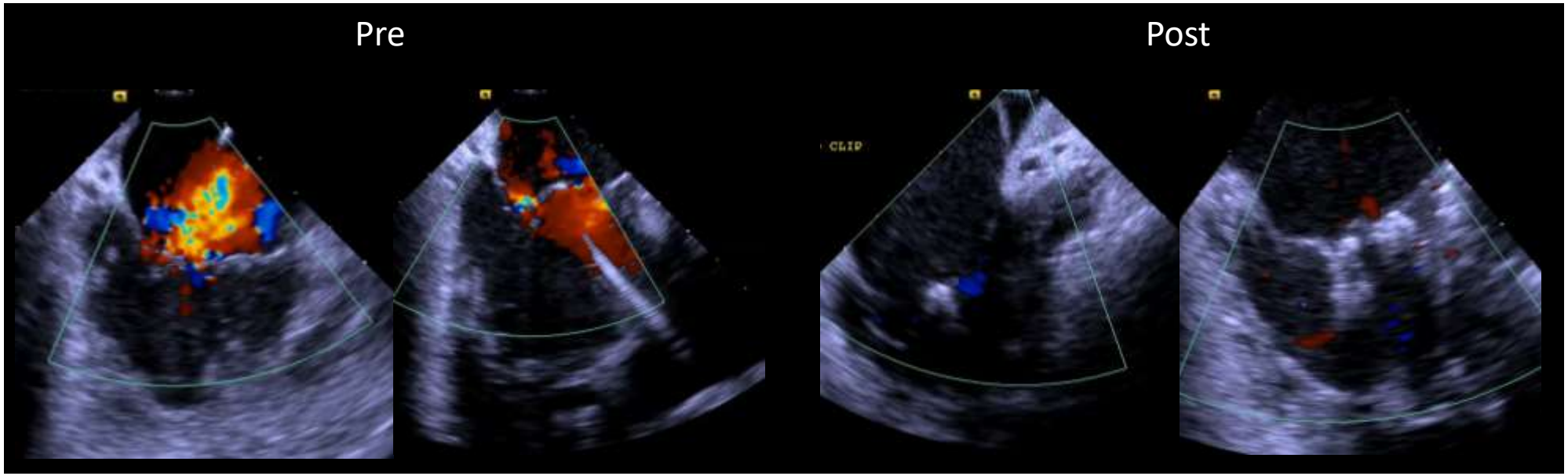
Procedure Guidance/Outcome

ICE – Tricuspid Clip



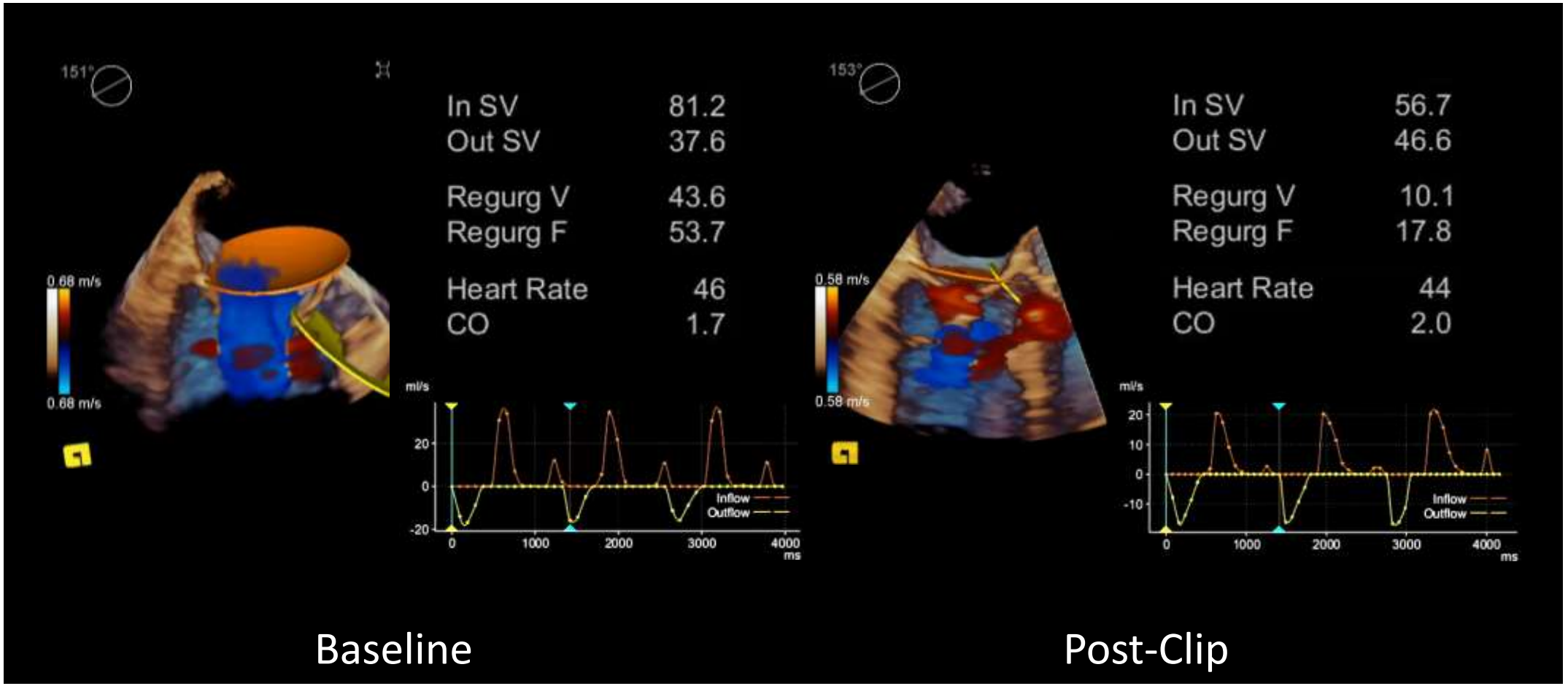
Procedure Outcome

ICE – Tricuspid Clip



Procedure Outcome

Quantitative Flow - MitraClip



Baseline

Post-Clip

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Procedure Outcome

Quantitative Anatomy - MitraClip