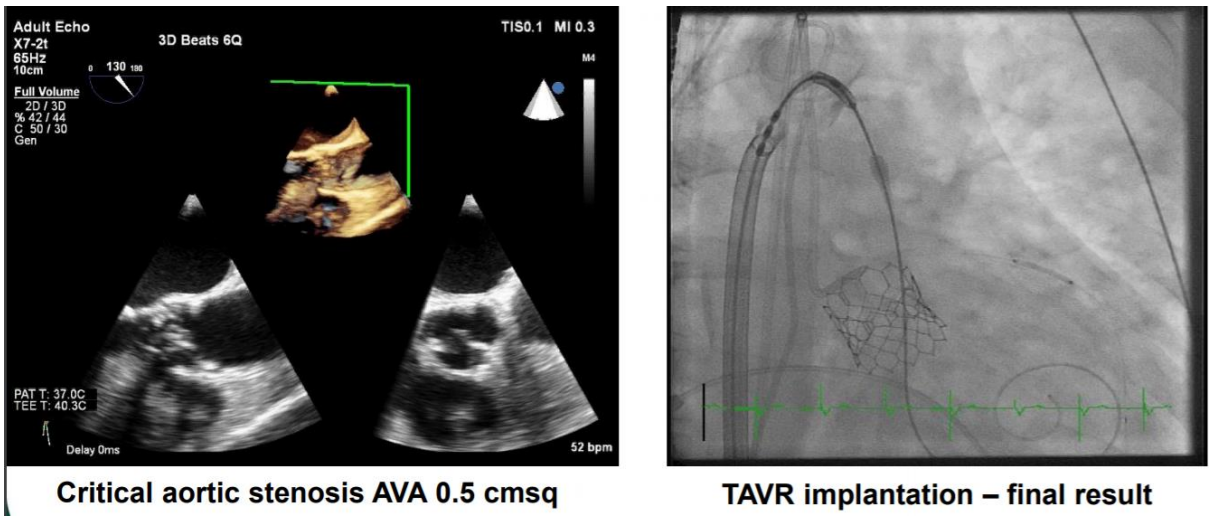
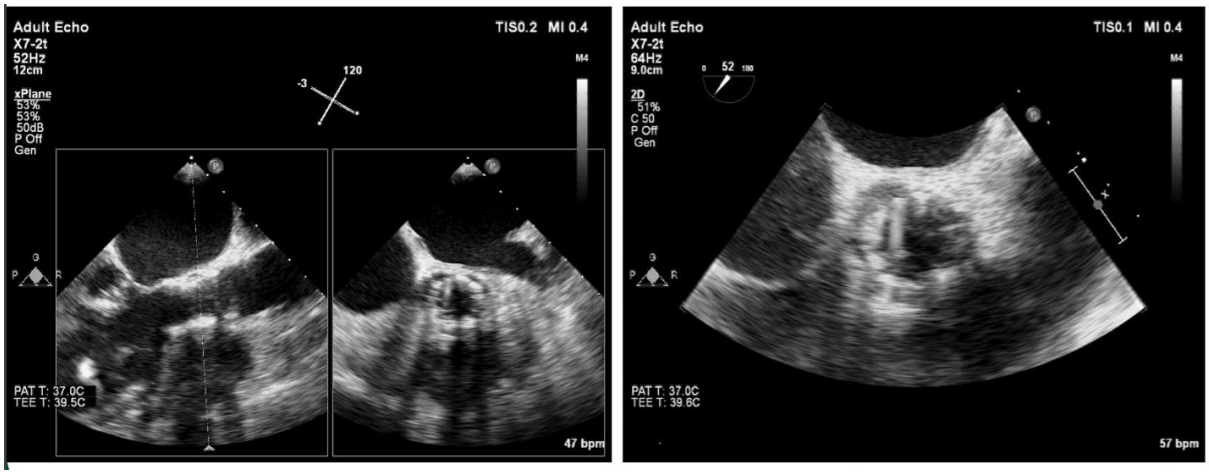
Supplementary material:

Supplemental Figure 1: Critical aortic stenosis with aortic valve area



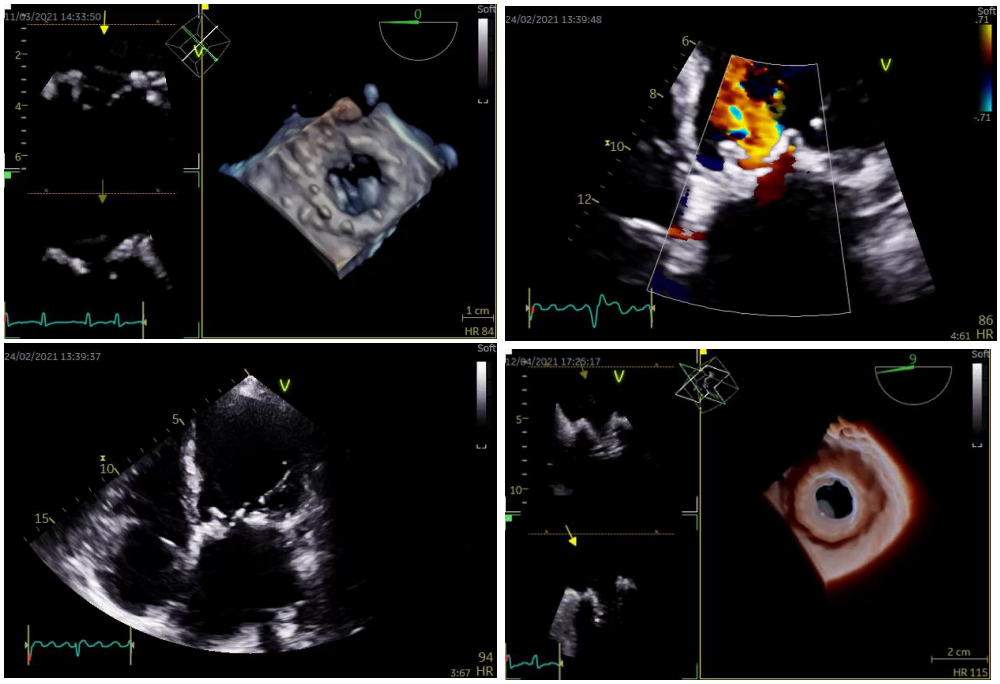
(AVA 0.5 cm sq) on the left which required transcatheter aortic valve replacement (fluoroscopy on the right).

Supplemental Figure 2: Post procedural assessment of the transcatheter aortic valve implantation result



On the right short axis of the prosthesis and on the left X plane to facilitate long axis view as well.

Supplemental Figure 3: Severe stenosis (degeneration) of a bioprosthetic mitral valve

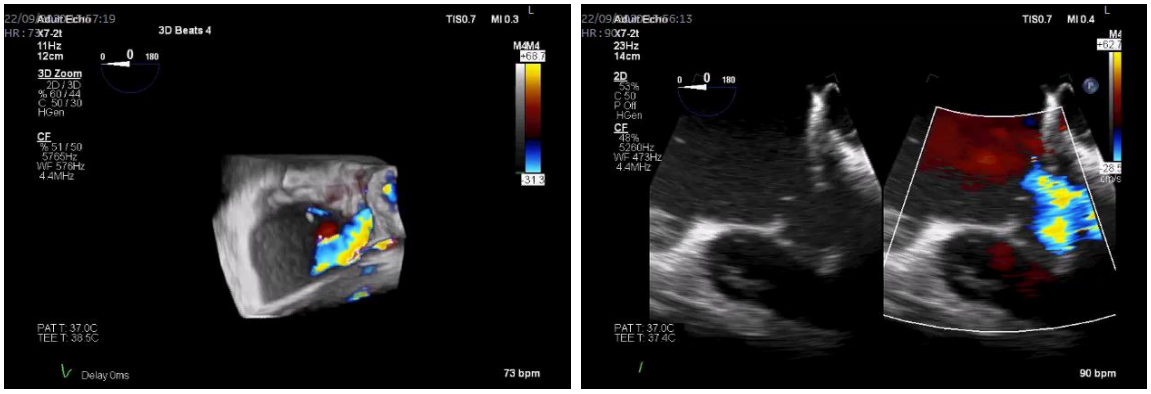


Clockwise 3-dimensional tranesophageal echocardiogram (3D-TEE) upper left, 2D transthoracic assessment with colour Doppler upper right and with plain 2D lower left and on the lower right the postoperative result with 3D TEE after valve in valve.

Supplemental Figure 4: Severe tricuspid regurgitation from apical 4 chamber view snd continuous wave Doppler assessment

Left: Apical 4 chamber view; Right: Continuous wave Doppler assessment

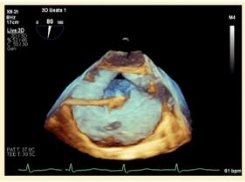
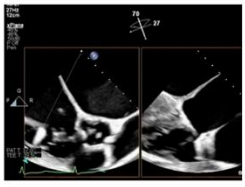
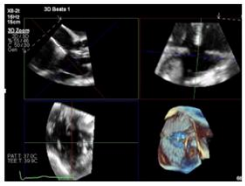
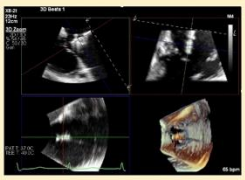
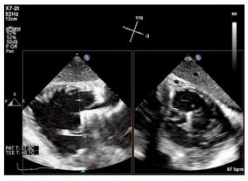
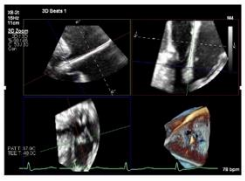
Supplemental Figure 5: Pre-Triclip assessment with 3-dimensional tranesophageal echocardiogram (3D-TEE)



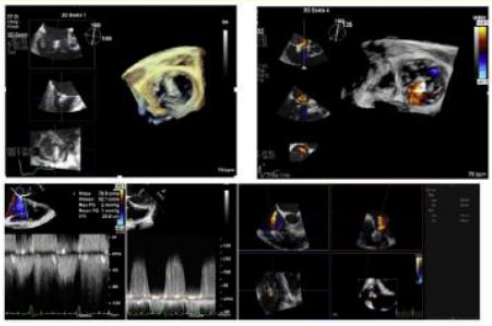
Left: 3D-TEE upper oesophageal view; right: colour Doppler.

Supplemental figure 6: Intraprocedural transesophageal (TEE) echocardiographic steps for transcatheter edge to edge tricuspid repair.

A

Procedural Step	Imaging Recommendations	Imaging Example: 2D and 3D		Comments
1. Navigating CDS to TV.	TEE Bicaval view of the navigate clip delivery system within the right atrium to TV.			2D imaging with cross-plane or 3D imaging should follow the tip of the clip delivery system to prevent tissue damage during clip delivery system advancement.
2. Adjustment of CDS trajectory and clip rotation (in right atrium).	TEE Mid-/deep-esophageal "commissural" view (60° to 80°) with bi-plane imaging to optimize the clip delivery system trajectory to the TV, and for preliminary adjustment of clip position and rotation at the target zone. Complete valve analysis by secondary sweeping through valve in secondary plane.			3D enface imaging or transgastric short-axis view (see Step 3 image) should be used to orient clip arms Live 3D multiplanar imaging can used to image the CDS trajectory in orthogonal planes.
3. Final positioning of clip at target site (in right atrium).	TEE Transgastric short axis view (10°—40°) to visualize all 3 leaflets and analyze valve anatomy; localize leaflet coaptation gaps (at leaflet tips) and associated regurgitation based on flow convergence and vena contracta.			Multiple angulations of the imaging or live 3D multiplanar reconstruction may be required if no single 2D view can display the lines of coaptation.
4. CDS advancement into right ventricle.	TEE Transgastric imaging with bi-plane imaging facilitates navigation of clip while providing simultaneous visualization of clip in the right ventricle. Allows for final adjustment of clip delivery system position and rotation.			Live 3D multiplanar imaging can used to confirm clip location and orientation.

B

Procedural Step	Imaging Recommendations	Imaging Example: 2D and 3D	Comments
5. Grasping view.	TEE A mid-/deep-esophageal "commissural" view (60° to 80°) with bi-plane imaging. Adjust primary plane perpendicular to clip arms to verify the clip position along commissure, and to simultaneously display both arms and leaflets in the secondary plan. TTE If adequate leaflet visualization cannot be obtained by TEE, additional TTE views with bi-plane imaging may be used for grasping and confirmed by TEE.		Live 3D multiplanar reconstruction allows for device/leaflet alignment from any window. Small tidal ventilation volumes or breath-holds reduce out-of-plane movements of the clip during the grasping process.
6. Reevaluation of TV repair.	TEE A mid-/deep-esophageal "commissural" view (60° to 80°) with bi-plane imaging is also useful for reevaluation of TR severity and inflow gradient. 3D imaging allows for assessment of tissue bridge, planimetry of TV area (sum of orifices), and 3D vena contracta area. TTE A post procedure TTE for grading of TR is recommended as baseline for follow-up.		3D vena contracta area planimetered from multi-planar reconstruction is recommended for TR severity grading post edge-to-edge leaflet repair. CW of the diastolic and systolic transtricuspid flow should be recorded.

Source: Lebehn M et al. 2020. Reproduced with permission from Elsevier.[1]

Tables:

Table 1: Echocardiographic criteria for disproportionate secondary mitral regurgitation (MR). Abbreviations: EROA: effective regurgitant orifice area, RV: regurgitant volume, LVEF: left ventricular ejection fraction, LVEDD: left ventricular end-diastolic diameter

Disproportionate Secondary MR echo criteria
EROA>=30 cm2
RV >45 ml
LVEF 20-50%
LVEDD < 70 mm

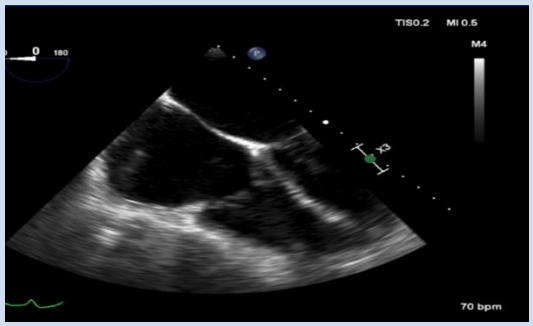
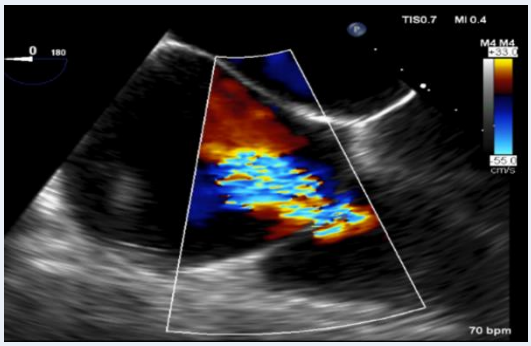
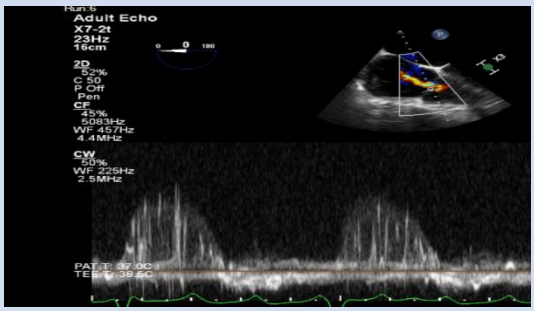
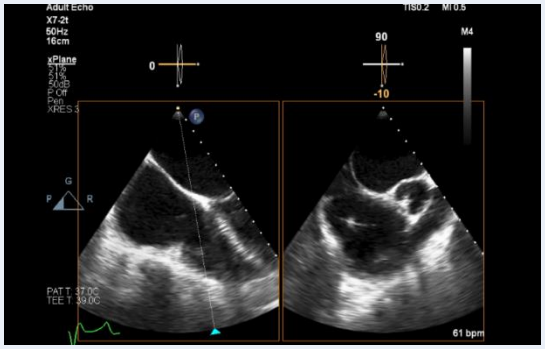
Table 2: Favourable anatomical morphology on tranesophageal echocardiogram (TEE). Abbreviations: MR: mitral regurgitation, MV: mitral valve:

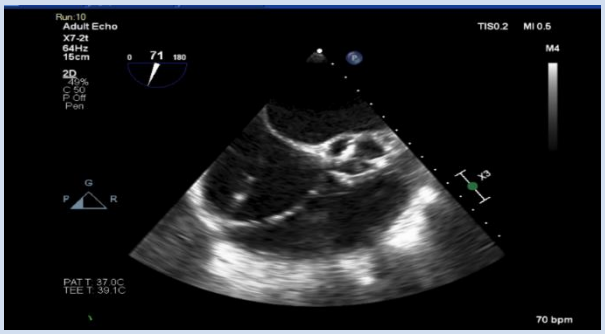
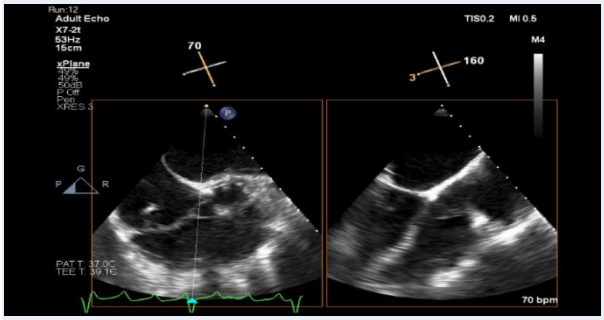
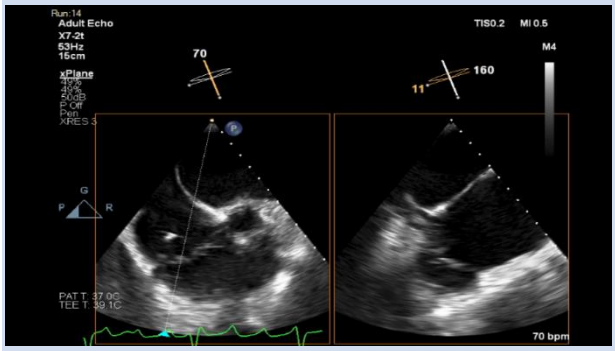
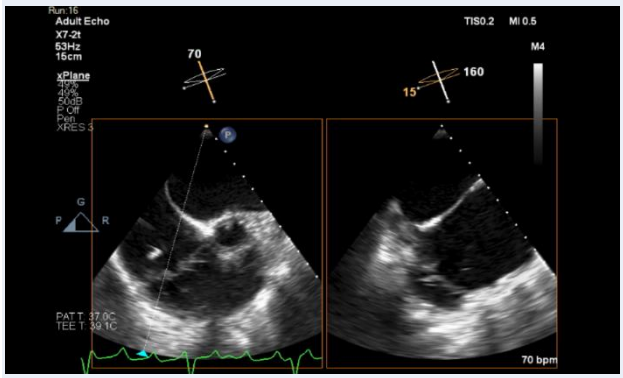
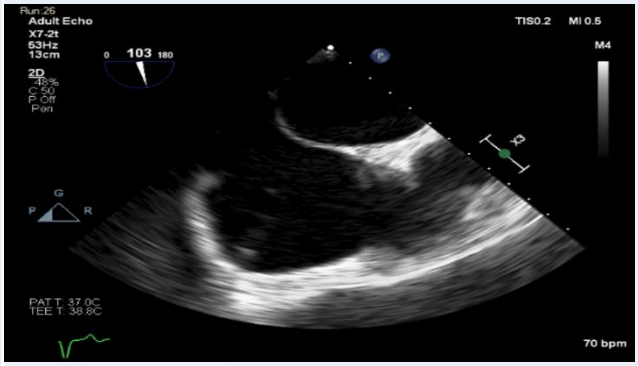
Favourable anatomical morphology on TEE
Central origin of the MR jet in the A2/P2 area
No calcification in the grasping area
Opening area of the MV >= 4 cm2
Length of mobile posterior leaflet >=10 mm
Coaptation depth <11 mm
Preserved leaflet mobility
Flail width <15 mm, flail gap <10 mm
In secondary MR at least 2 mm coaptation length

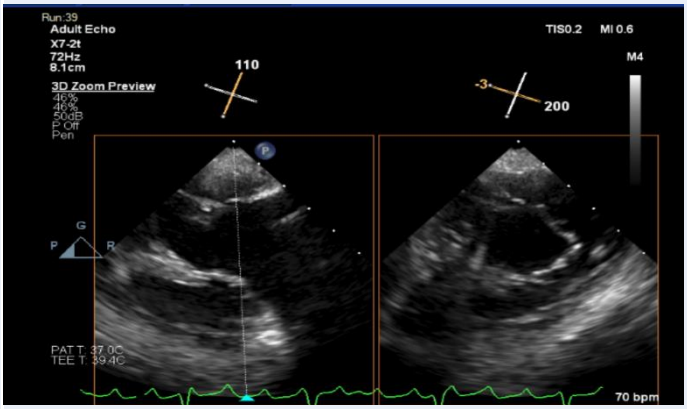
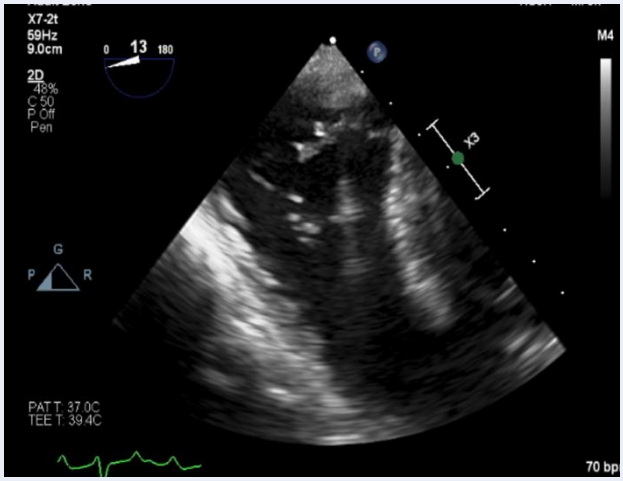
Table 3 : Procedural steps for transcatheter edge to edge mitral repair (MitraClip). Abbreviations: Steerable Guide Catheter (SGC), Clip Delivery System (CDS)

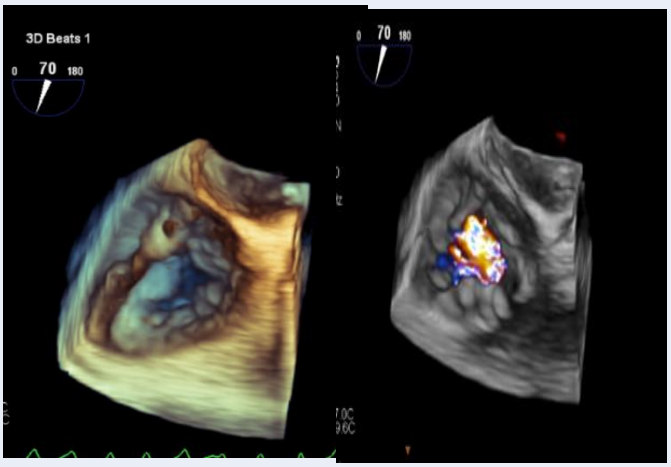
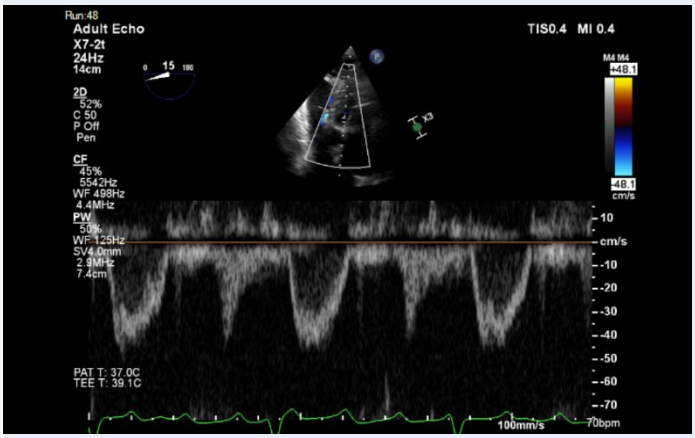
Procedural steps for MitraClip
Transseptal puncture
Insertion of the SGD into the left atrium
Insertion of the CDS into the left atrium
Steering and positioning of the MitraClip above the mitral valve
Advancing the MitraClip into the left ventricle
Grasping of the leaflets and assessment of proper leaflet insertion
Assessment of the results and Clip detachment

Table 4 : Preprocedural transesophageal (TEE) echocardiographic steps for transcatheter edge to edge tricuspid repair

View	Projection	Example	
Mid esophageal (0-30°) *	4 chambers view focusing on tricuspid valve		✓ Main view for pre-procedural assessment ✓ On the right of the plane, the septal leaflet of the tricuspid valve is seated ✓ On the left of the plane, the anterior ✓ (most commonly) or the posterior leaflet is seated ✓ It is important to assess the coaptation zone and whether there is a gap
Mid esophageal (0-30°)	4 chambers view focusing on tricuspid valve – colour Doppler		✓
Mid esophageal (0-30°)	Continuous wave Doppler across tricuspid		✓ Consider that it may be suboptimal because of malignment with the colour jet ✓ Compare with TTE views for accuracy
Mid esophageal (0-30°)	Biplane view – 4 chambers with focus on tricuspid		✓ Xplane or biplane view is a good way to Review coaptation from two simultaneous planes ✓ We may be able to view all three leaflets ✓ If the patient has a pacemaker, this view allows the identification of pacemaker lead and exclude impingement

Mid-esophageal (60-90°)*	RV inflow-outflow – focusing on tricuspid		✓ The anterior leaflet is usually visualized from this view along with either the posterior leaflet or septal leaflet. ✓ The septal leaflet appears when angulating towards the ostium of the coronary sinus
Mid-esophageal (60-90°)	RV inflow-outflow – biplane – anterior focus		
Mid-esophageal (60-90°)	RV inflow-outflow – biplane – central focus		
Mid-esophageal (60-90°)	RV inflow-outflow – biplane – posterior focus		
Bicaval (90-100o)	Inferior vena cava, Eustachian ridge, right atrium		✓ Mid-esophageal modified bicaval view. A, anterior; CS, coronary sinus; P, posterior; SVC, superior vena cava

Mid-esophageal (60-90°)	RV inflow-outflow – sweep during biplane	✓ Mid-esophageal right inflow view: we visualise on the left the posterior leaflet and on the right either the anterior or the septal leaflets.
Deep Trans gastric (30o)	Right ventricular inflow & Short axis of the tricuspid valve Biplane on leaflet tips	 ✓ Deep transgastric view to visualise right ventricular entrance and right atrium – here with the biplane view the short axis of the tricuspid valve is visualised : top left posterior, top right septal and bottom anterior leaflets ✓ Pay attention to 2D gain
Trans gastric (0 or 145o)	Short axis of the tricuspid valve – biplane - sweep	 ✓ In the trans gastric short axis view all three leaflets are visualised: top left is the posterior, top right the septal and at the bottom the anterior leaflets ✓ most common strategy is to place a clip between the anterior and septal leaflets and towards the tricuspid most central region ✓ pay attention on 2D gain here
Trans gastric (0 or 145o)	RV inflow with biplane	✓ Passing the diaphragm, the inflow tract of the right ventricle and the tricuspid valve are visualized in a long-axis view ✓ Immediately adjacent to the septal tricuspid leaflet, the orifice of the coronary sinus is seen courses upward ✓ The anterior tricuspid leaflet is seen to the left, and the septal to the right

trans gastric	3D volume with and without colour		✓ Single-beat (real-time) acquisition from transesophageal approach ✓ Be careful of stitching artefact ✓ 3D vena contracta measurement ✓ This is a good view to assess clip position and lead impingement (if present)
Deep trans gastric (0 or 120-140°)	Pulsed wave Doppler LVOT and continuous wave Doppler through aortic valve		

References:

1. Lebehn M, Nikolou E, Grapsa J et al. Edge-to-Edge Tricuspid Valve Repair: Closing the Gap on Tricuspid Regurgitation. JACC Case Rep. 2020 Jul 15;2(8):1093-1096. doi: 10.1016/j.jaccas.2020.06.018. eCollection 2020 Jul. PMID: 34317422