

Advanced Echocardiography: Case-Based Learning

Dr. Alison Duncan
MB BS BSc PhD FRCP FESC

The Royal Brompton Hospital, London
Part of Guys and St. Thomas' Foundation Trust

60 year old male

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Diagnoses

- Multi-vessel coronary artery disease
- Severe biventricular impairment (LVEF 27%, RVEF 31%)
- Transmural scar basal lateral and inferior walls on CMR
- Severe ischaemic secondary mitral regurgitation
- LV thrombus
- LBBB on ECG (QRS 150ms)

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First presentation September 2024:

- NYHA Class III breathlessness, fluid overload
- No angina
- Ex-smoker. No other cardiovascular risk factors
- Inpatient diuresis and medical optimisation

Discharge Medications

- Bisoprolol 1.25mg od
- Dapagliflozin 10mg od
- Eplerenone 25mg od
- Sacubitril 24mg/Valsartan 26mg bd
- Furosemide 40mg bd
- Atorvastatin 80mg on
- Lansoprazole 30mg od
- Apixaban 5mg bd
- Clopidogrel 75mg od

- CRT-D implanted, Sept 2024
- High risk CABG planned
- Further uptitration of HF medications limited by persistent hypotension

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December 2024:

Progressive heart failure symptoms

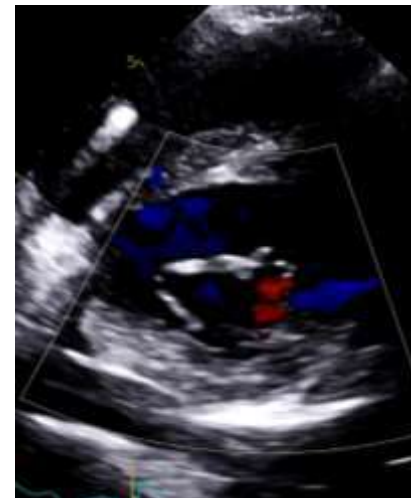
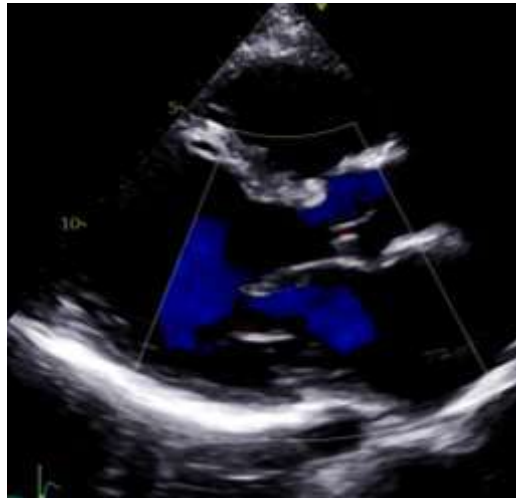
- switch to Bumetanide 3mg bd
- addition of Bendroflumethiazide 2.5mg od

Deterioration of LVEF to 15% on echo.

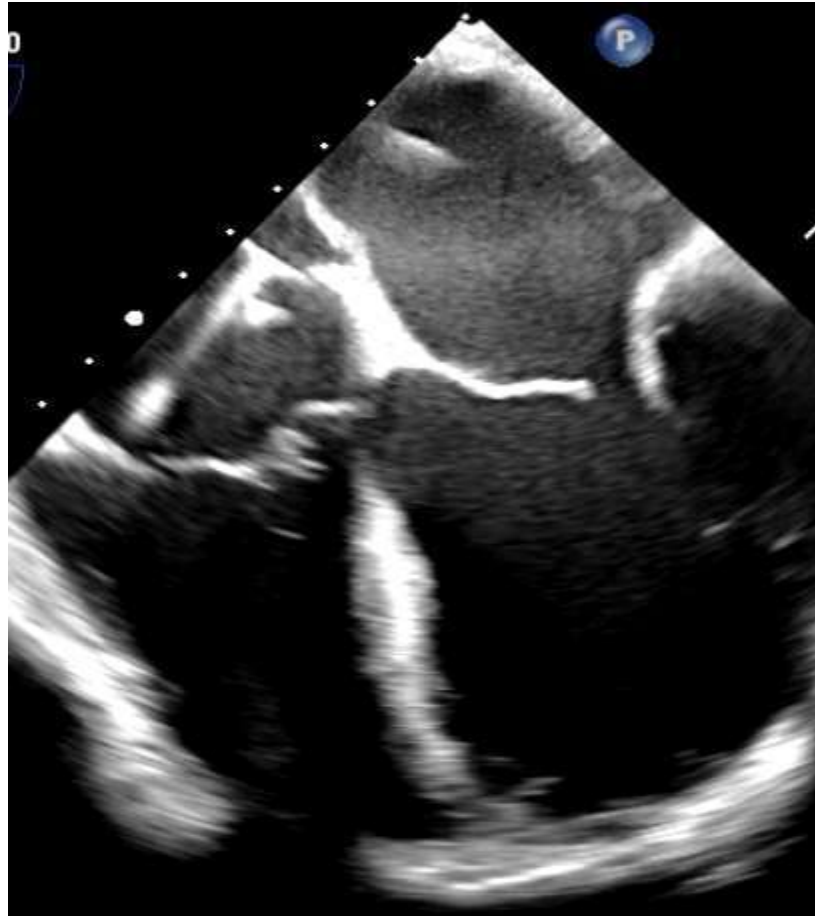
NTproBNP 5380

- Hb 124g/l
 - Sodium 131
 - Urea 9.0
 - Creatinine 66
 - ALP 183
-
- repeat NT proBNP 1581ng/l

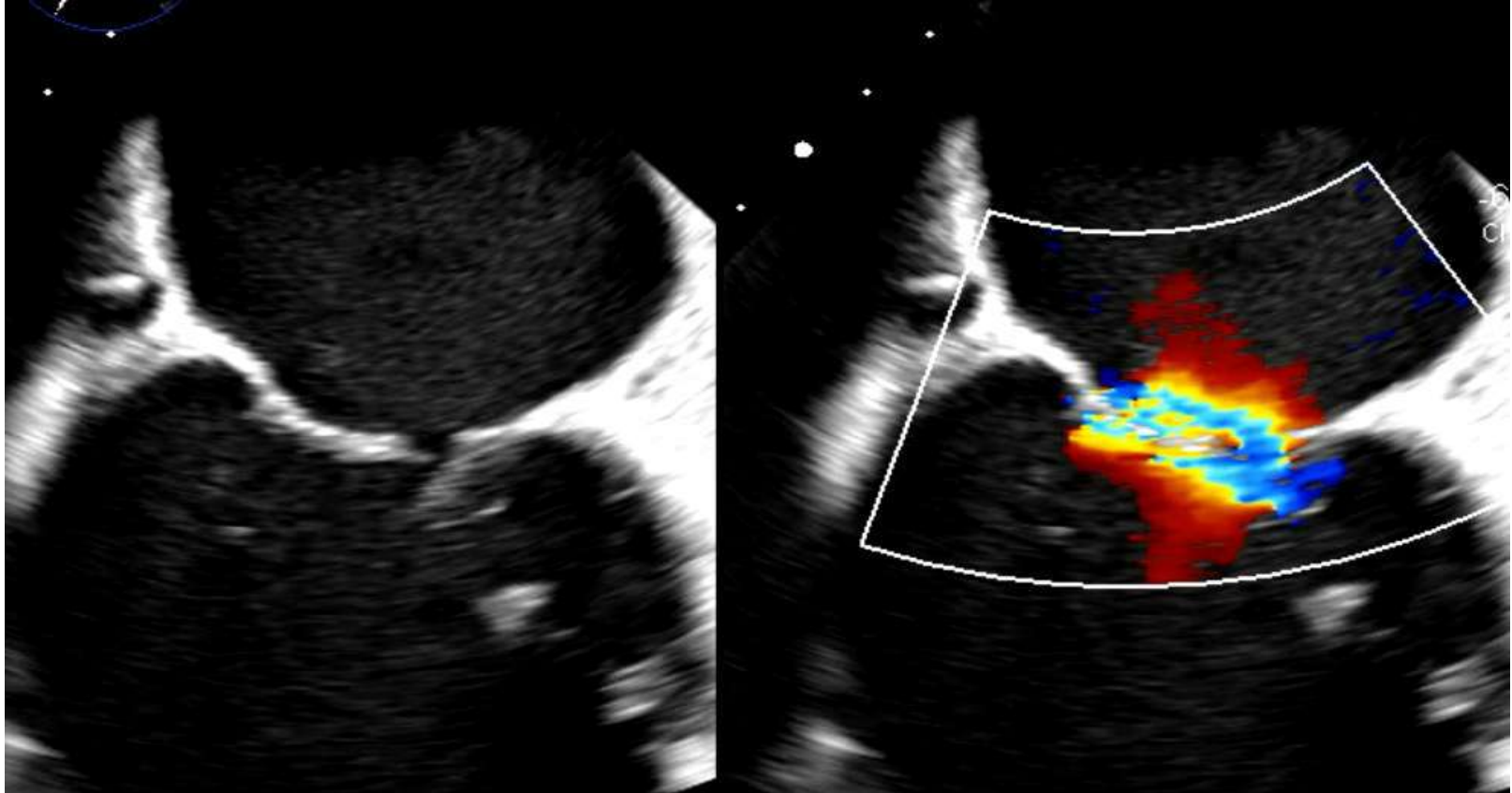
Transthoracic Echo



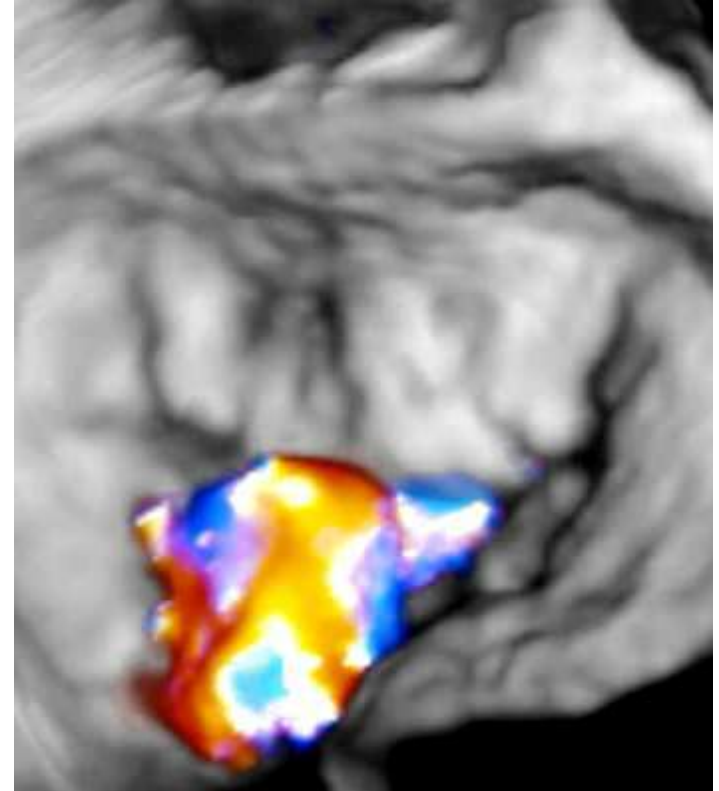
Transoesophageal Echo



Transoesophageal Echo

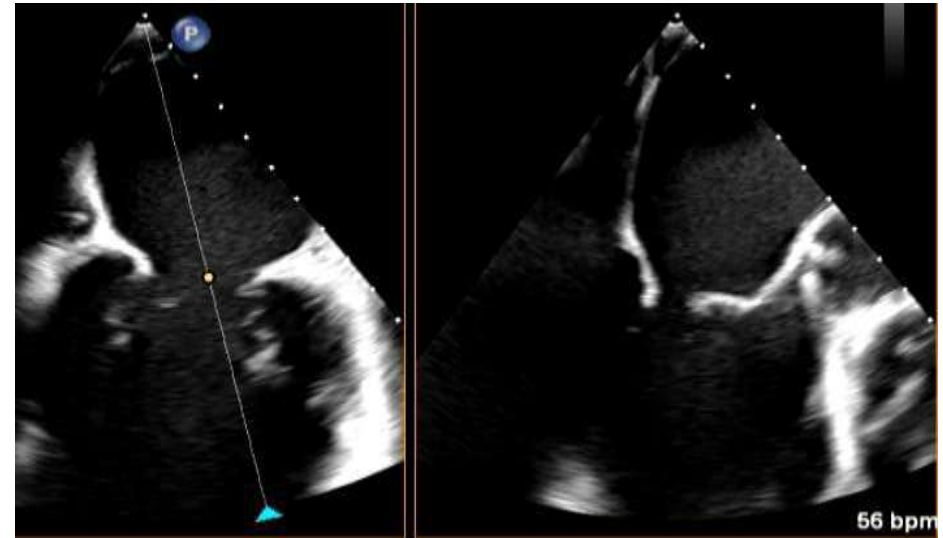
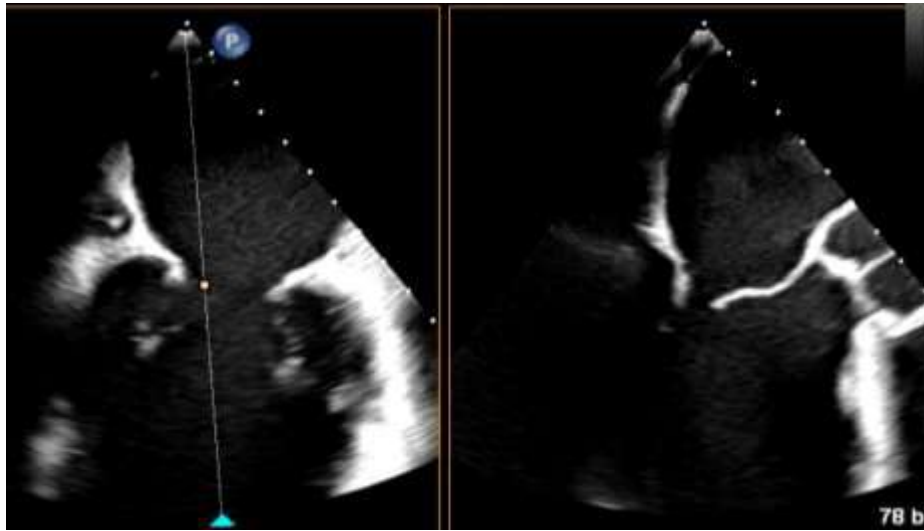


Transoesophageal Echo



MR PISA 1.1cm
EROA 0.59cm²
Regurgitant volume 66ml
MVA 6.5cm²

Transoesophageal Echo



Coronary Angiogram:

Subtotal mid LAD occlusion, severe intermediate and Cx disease.
CTO of RCA with collaterals.

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CTO of RCA with collaterals.

Right heart catheter:

RA mean 11mmHg

RV 55 – EDP 11mmH

PA 57/23 mean 36

PCWP v wave 36 mean 22

TPG 14mmHg

Cardiac output 2.96l/min, cardiac index 1.88ml/min/m²

PVR 4.73 WU

Coronary Angiogram:

Subtotal mid LAD occlusion, severe intermediate and Cx disease. CTO of RCA with collaterals.

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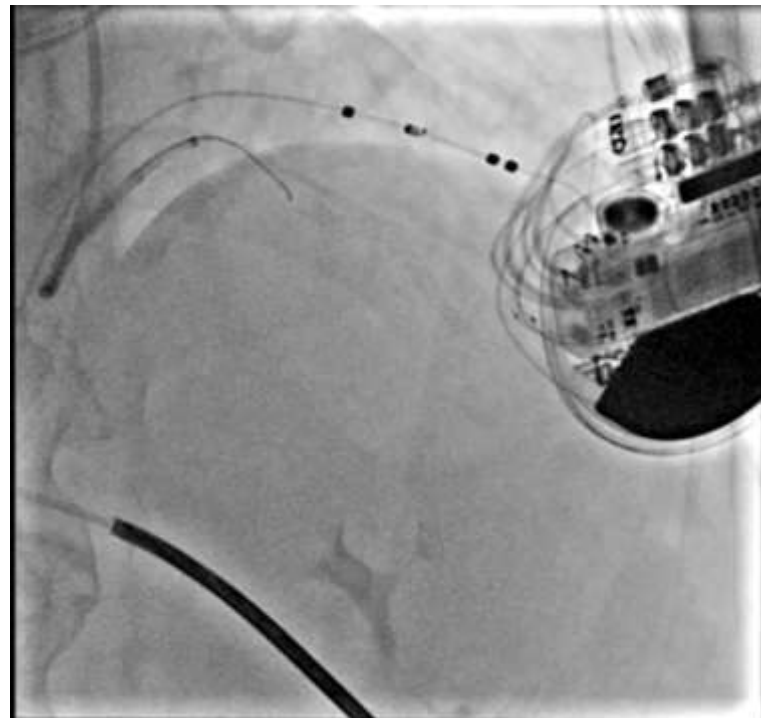
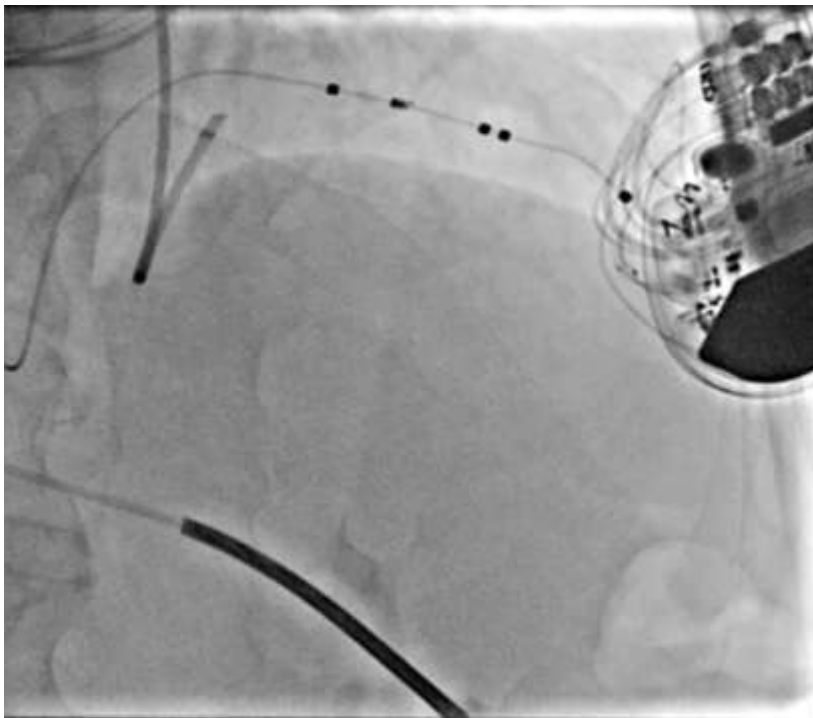
RA mean 11mmHg, RV 55 – EDP 11mmHg, PA 57/23 mean 36, PCWP v wave 36 mean 22. TPG 14mmHg, cardiac output 2.96l/min, cardiac index 1.88ml/min/m², PVR 4.73 WU

CMR:

- Biventricular dilatation: LVEDV 311ml RVEDV 227ml
- LVEF 25%, RVEF 31%
- Thinned and akinetic mid anterior wall, basal inferolateral and entire inferior wall.
- Akinetic and aneurysmal apex.
- Evidence of old transmural infarct in RCA territory, non-viable.
- Subacute infarctions LAD and circumflex territories, with myocardial oedema and microvascular obstruction. LV apical thrombus.
- Moderate ischaemic MR.

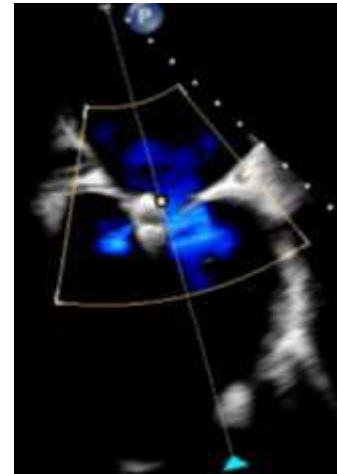
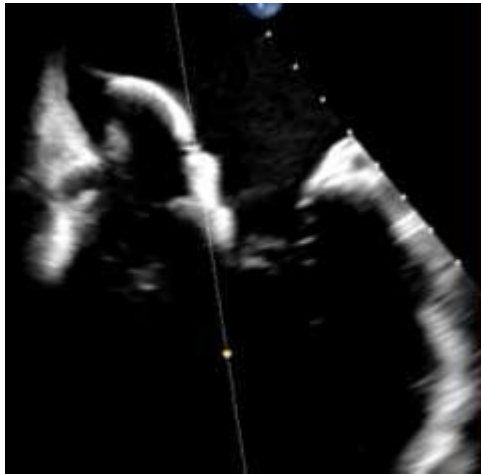
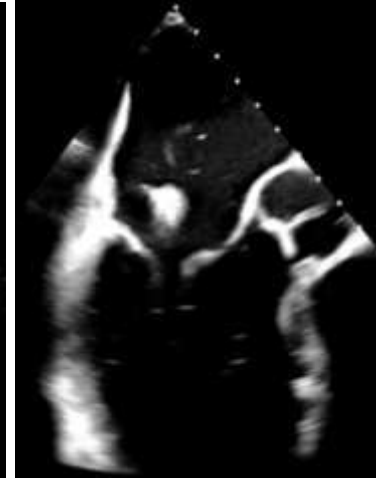
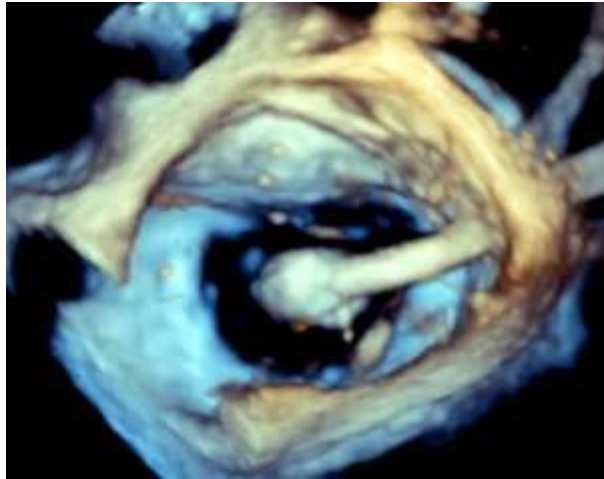
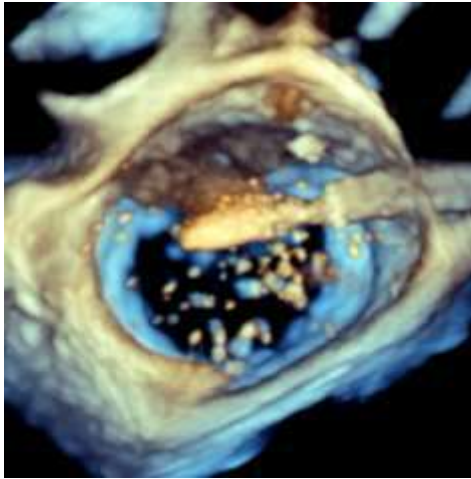
How would you treat?

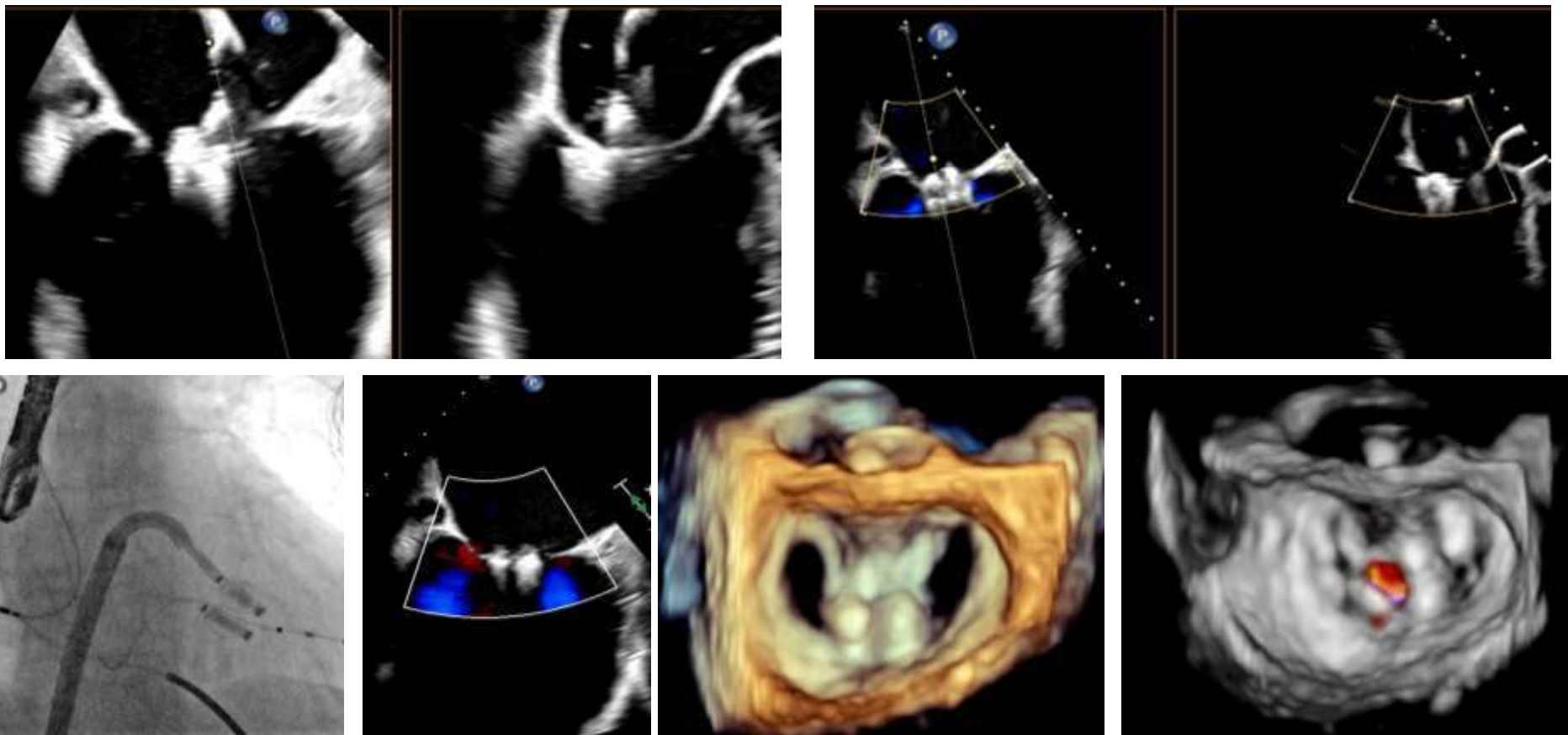
Heart Team discussions including Transplant cardiologists and surgeons
Consensus for PCI + TEER



PCI to LAD and intermediate

Treatment





Final LA pressure: v wave 37 → 24 mmHg; mean 25 → 19 mmHg
Trivial residual MR, Mean MV gradient 2mmHg



Symptomatic improvement.

Higher systemic blood pressure – further uptitration of HF medical therapy

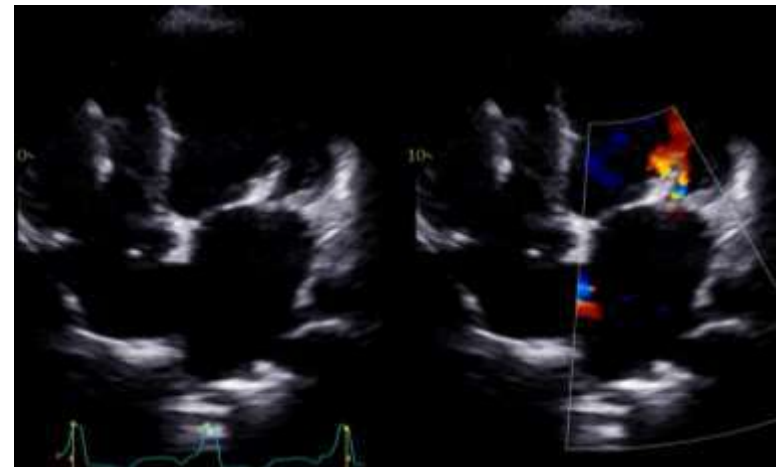
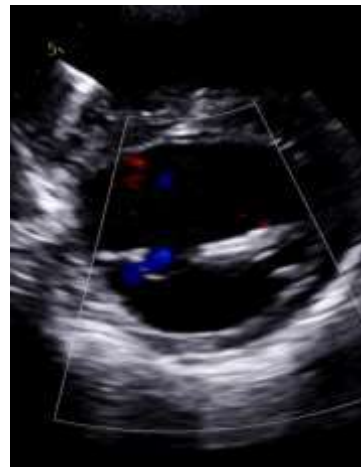
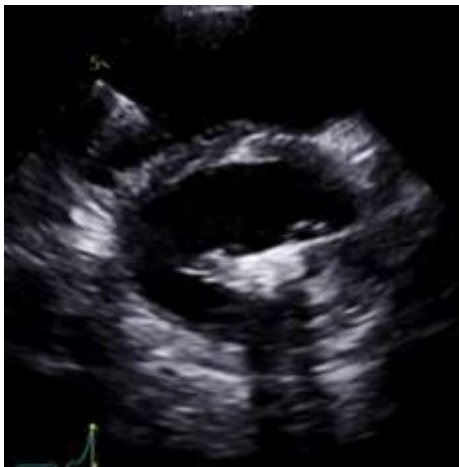
Post-procedural echo:

Mild residual MR. Mean MV 3mmHg

Severely dilated and impaired LV, EF 20-25%

Mild-moderate RV impairment

NYHA Class I – II at 3 month FU. LVEF 35% on latest echo



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- CABG x4 2001
- ICD implantation, VT ablation, CKD,

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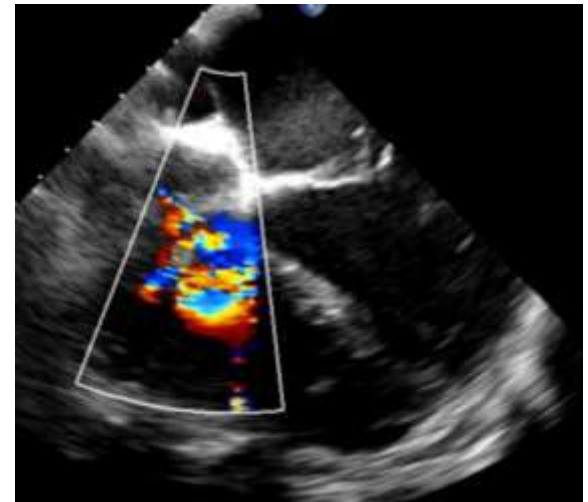
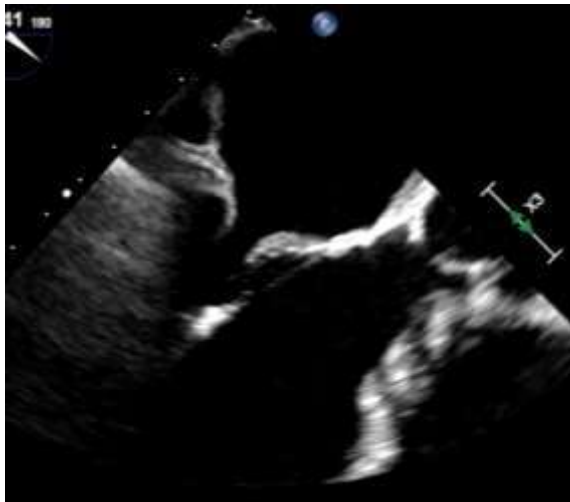
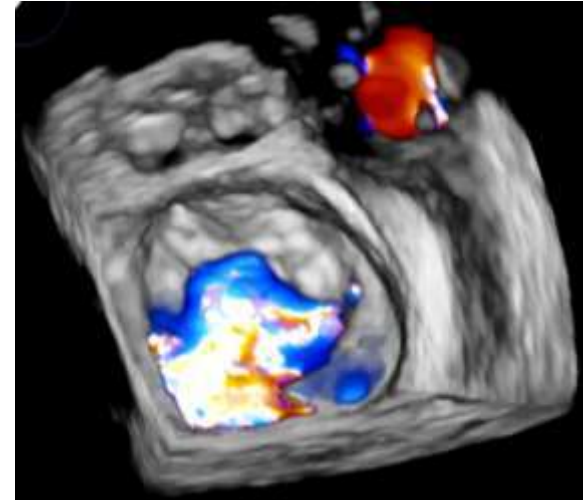
Diagnoses

- Ischaemic cardiomyopathy, impaired biventricular impairment.
- CABG x4 2001
- ICD implantation, VT ablation, CKD,
- Recent ITU admission with acute onset SOB, August 2020.
- Fluid overloaded - offloaded and medically optimised.
- TOE showed severe MR due to ruptured chordae AMVL.
- Hb 131 Cr 108
- Local heart team discussion: High risk for surgery. For optimisation of medical therapy
- Discharged on GMDT
- Further heart failure readmission to L&D only 2 weeks later

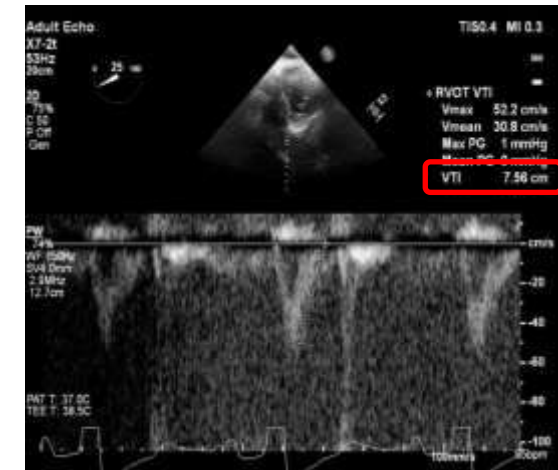
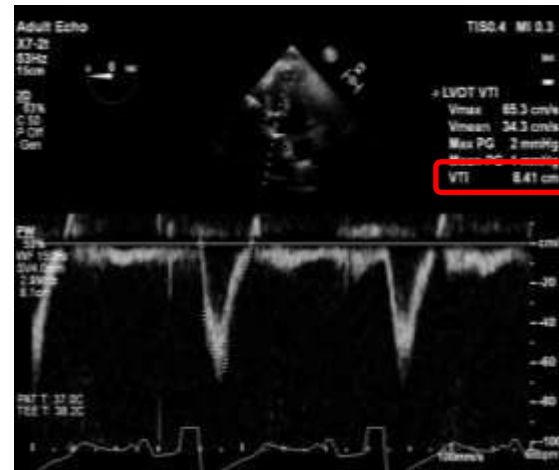
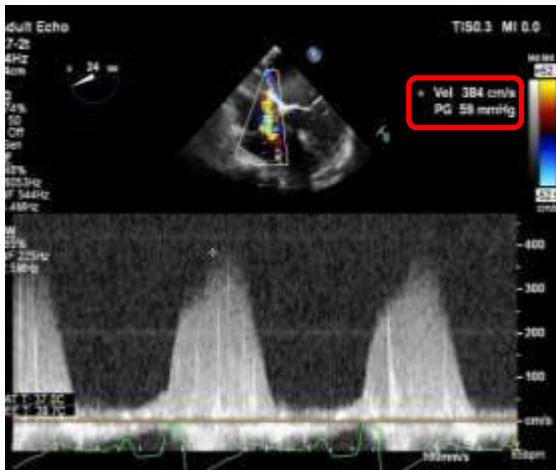
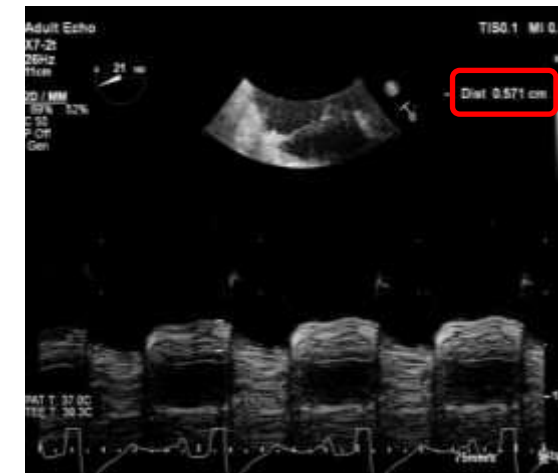
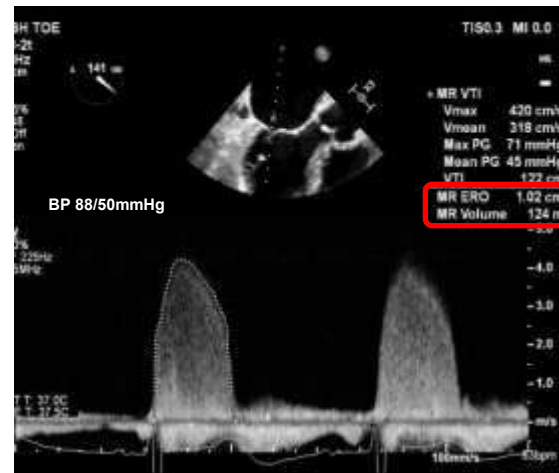
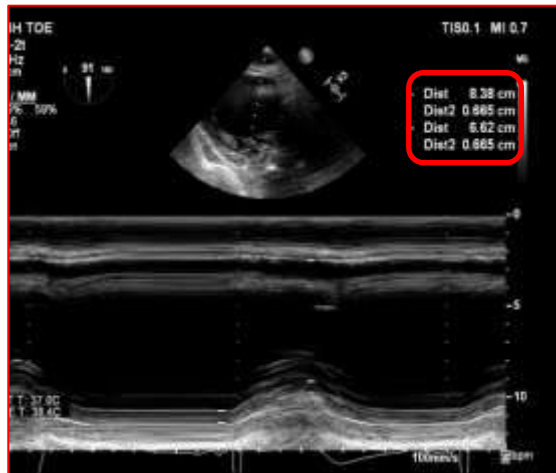
Right Heart Catheterisation

- RV 60/4/13
- PCW 28/59/27
- SV 64mls
- CO 5.18 L/min
- CI 2.37 L/min/m²
- TPG 10
- PVR 1.9 Woods units

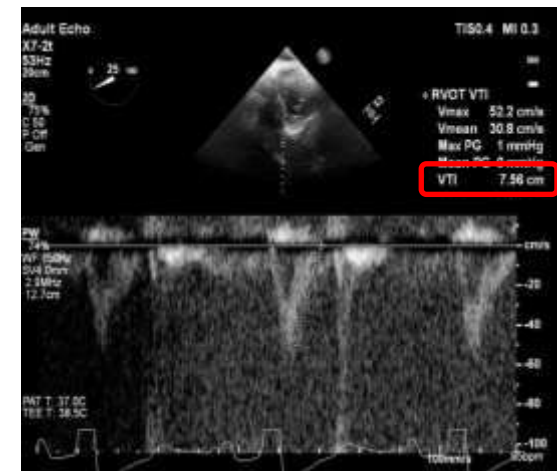
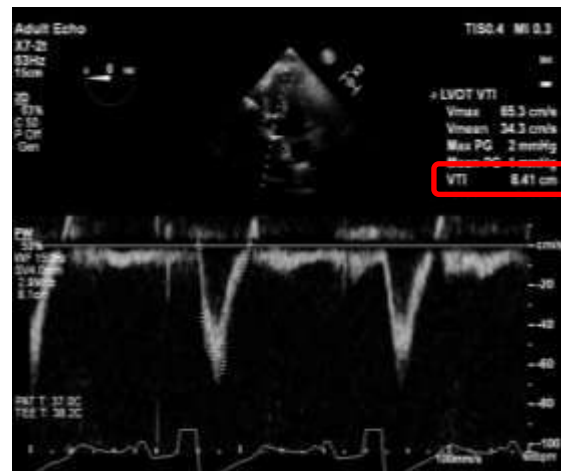
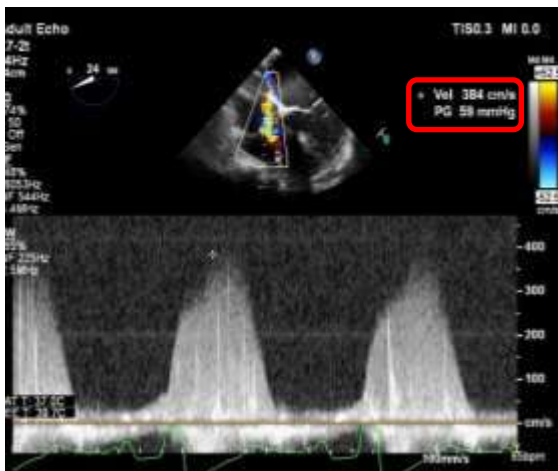
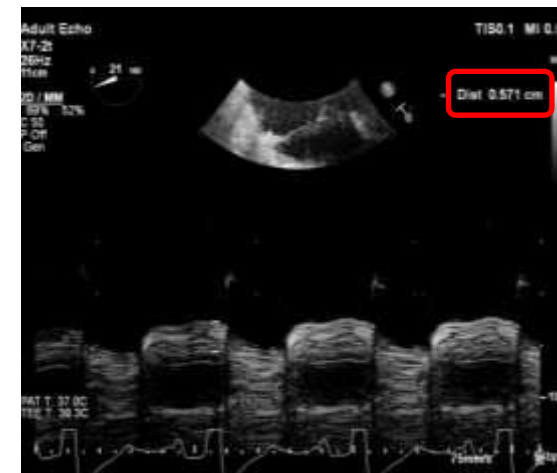
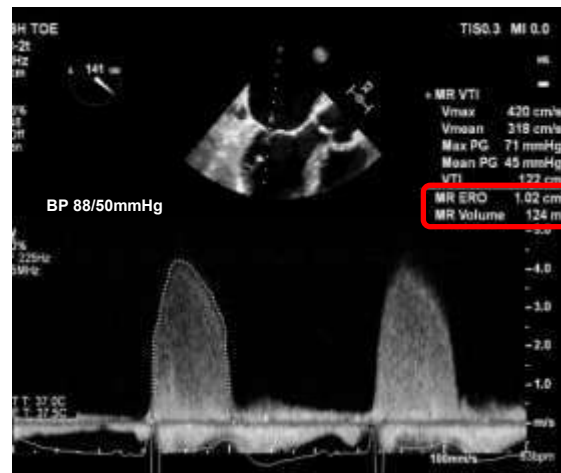
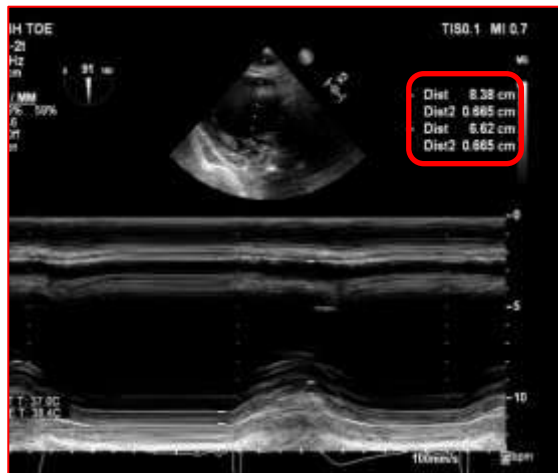
Transoesophageal echo



Baseline Physiology



Baseline Physiology



SV 29ml, CO 2.0L/min, CI 0.93

Baseline Physiology

Flowsheet (Anesthetic)	18/11/2020														
	09:00	09:15	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30
Central Temperature (T1)							35.6	35.8	35.8	35.8	35.7	35.6	35.5	35.5	35.3
Blood Temperature (TBlood)															
Peripheral Temperature (T2)															
Heart Rate (ECG/HR)	56	57	60	63	68	68	64	90	90	90	90	92	92	90	94
Pulse Rate															
Art Blood Press (Art)	96/50	88/50	107/67	106/66	110/71	113/71	90/59	119/76	138/69	130/58	124/51	114/46	120/46	147/67	126/57
Mean Art Blood Press (ArM)	63	62	78	76	81	83	69	88	88	85	78	69	72	89	75
Non-Invasive BP (NBP)															
Mean Non-Invasive BP (NIBP)															
Right Atrial Press (RAP/CVP)							30	36	25	20	19	17	16	13	16
Pulm Art Press (PAP)		58/26 (39)	85/34 (48)	82/34 (46)		/ (68)	71/36 (52)	77/43 (60)	71/41 (54)	55/34 (45)	52/30 (39)	46/30 (37)	45/27 (34)	53/31 (40)	46/28 (35)
Pulm Art Wedge Pr (PAWP)															
PA Catheter Events															
PA Catheter sheath distanc...															
Cardiac Output (TD)							2.11	3.05		5.41		4.60			
Cardiac Index							8.98	1.27	1.41	2.5	2.5	2.13	2.13	2.13	
SVR							1251	1838	1783	975	902	921	1026	574	
PVR															
Stroke Volume							33	30.4	33.9	60.1	60.1	50	50	50.5	
SpO2	97	96	97	97	98	98	97	99	97	99	99	100	100	100	100
Bispectral Index (BIS)						48	27	40	45	53	43	41	41	45	37
Underlying Rhythm															
Pacemaker 1															
Pacemaker 2															
Care Unit															
PROPOFOL 1% INJ 500...							300		400						(15)
REMIFENTANIL INJ 5 m...															(8)
DOBUTAMINE INJ 250 mg L...								5							(8)
NORADRENALINE INJ 4 mg...							0.01								(8)

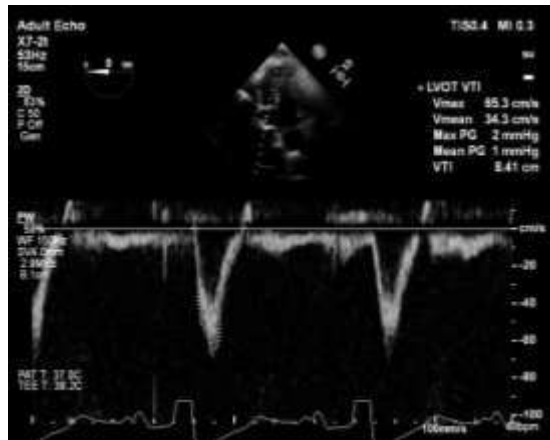
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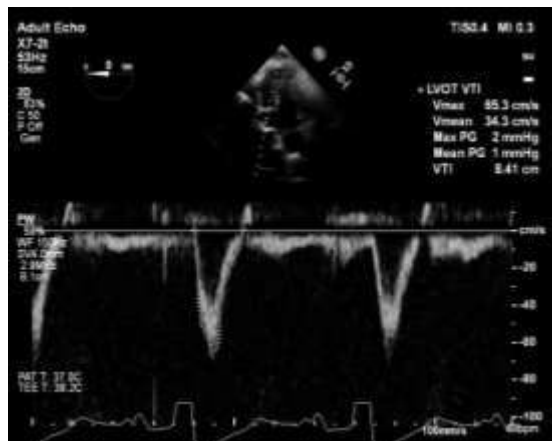
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SV 29ml, CO 2.0L/min. CI 0.93

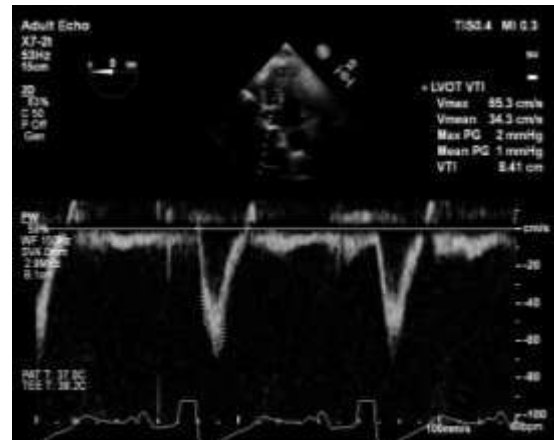


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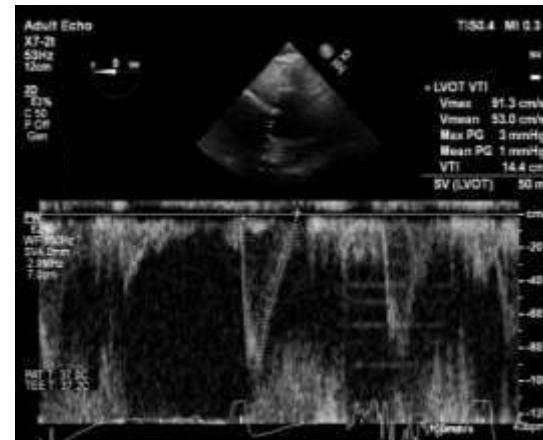


Add NorAdrenaline

SV 29ml, CO 2.0L/min. CI 0.93

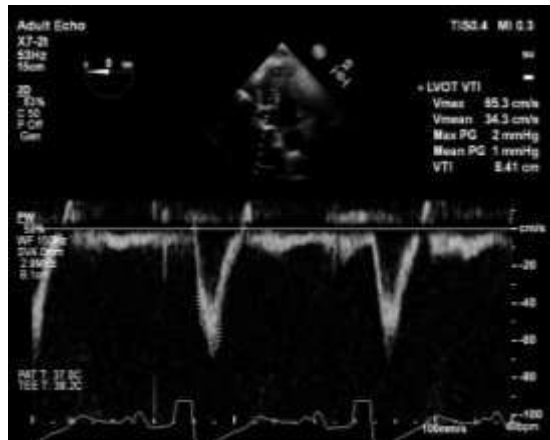


SV 50ml, CO 2.1L/min, CI 0.97

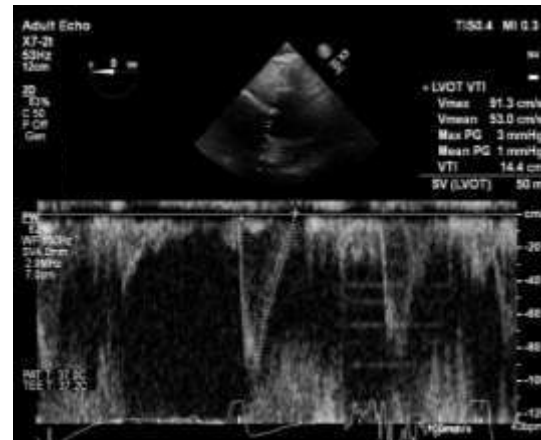


Increase pacing rate

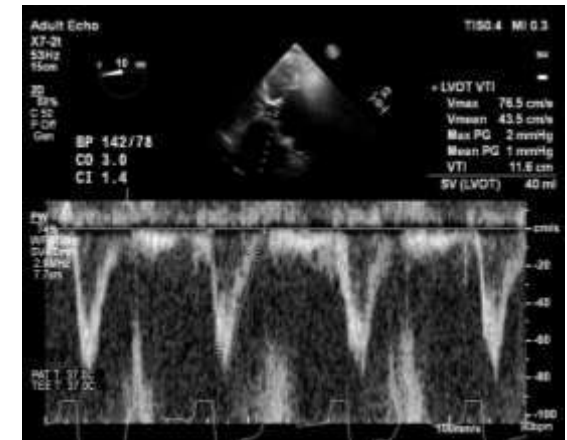
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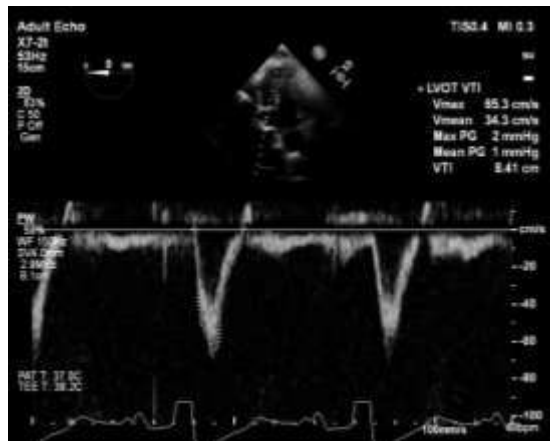
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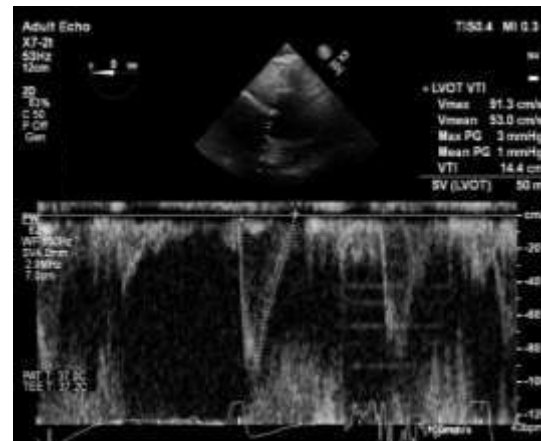
SV 40ml, CO 3.6L/min, CI 1.67



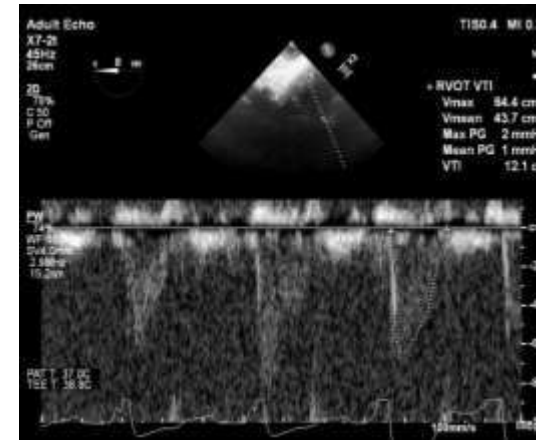
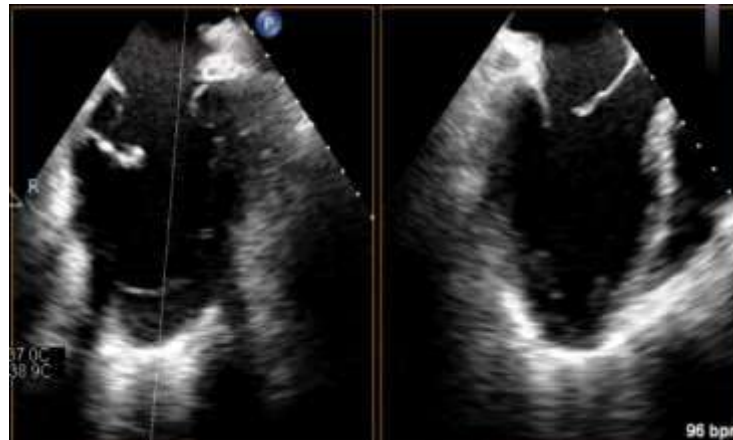
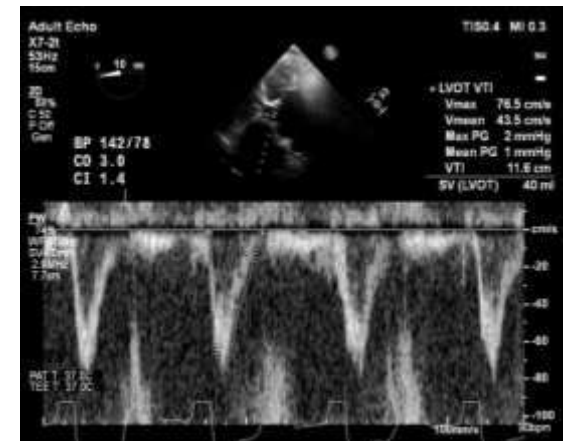
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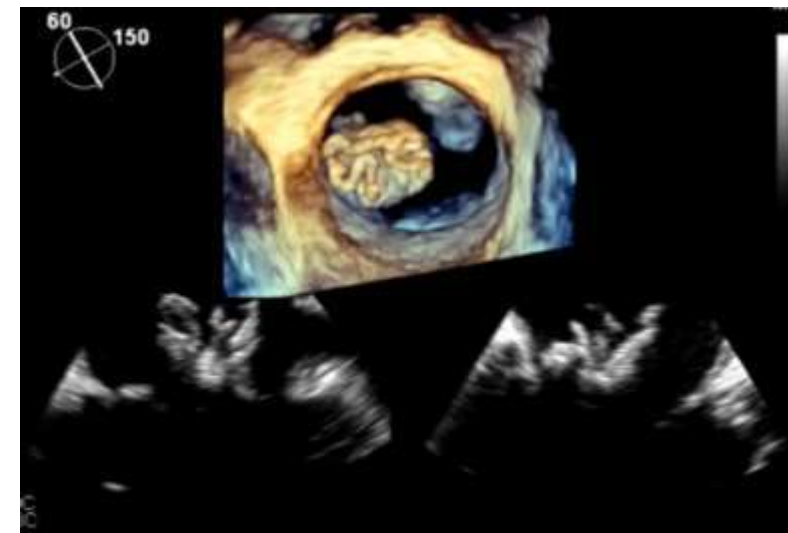
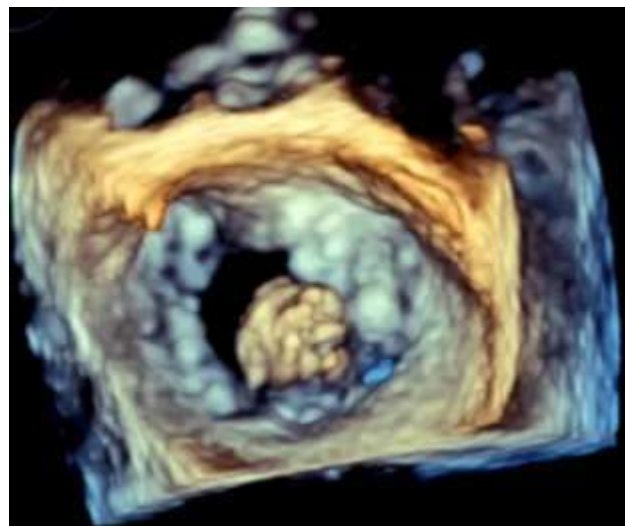
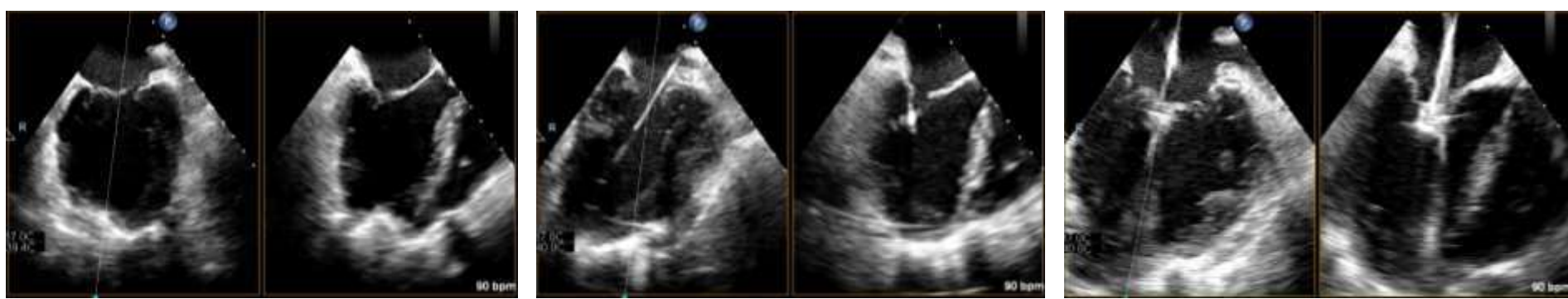


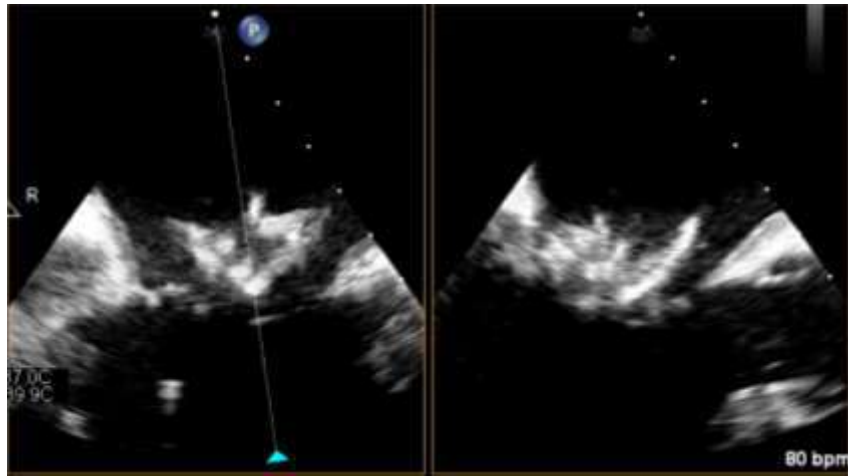
SV 40ml, CO 3.6L/min, CI 1.67

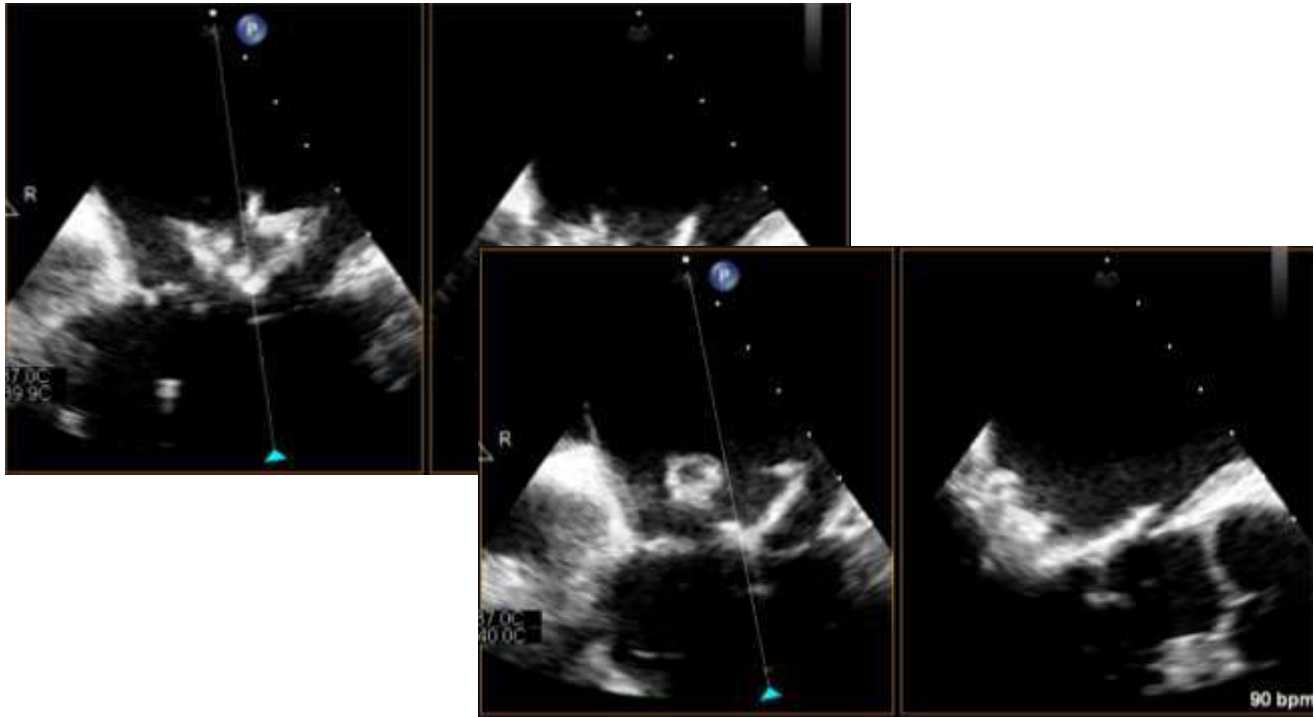


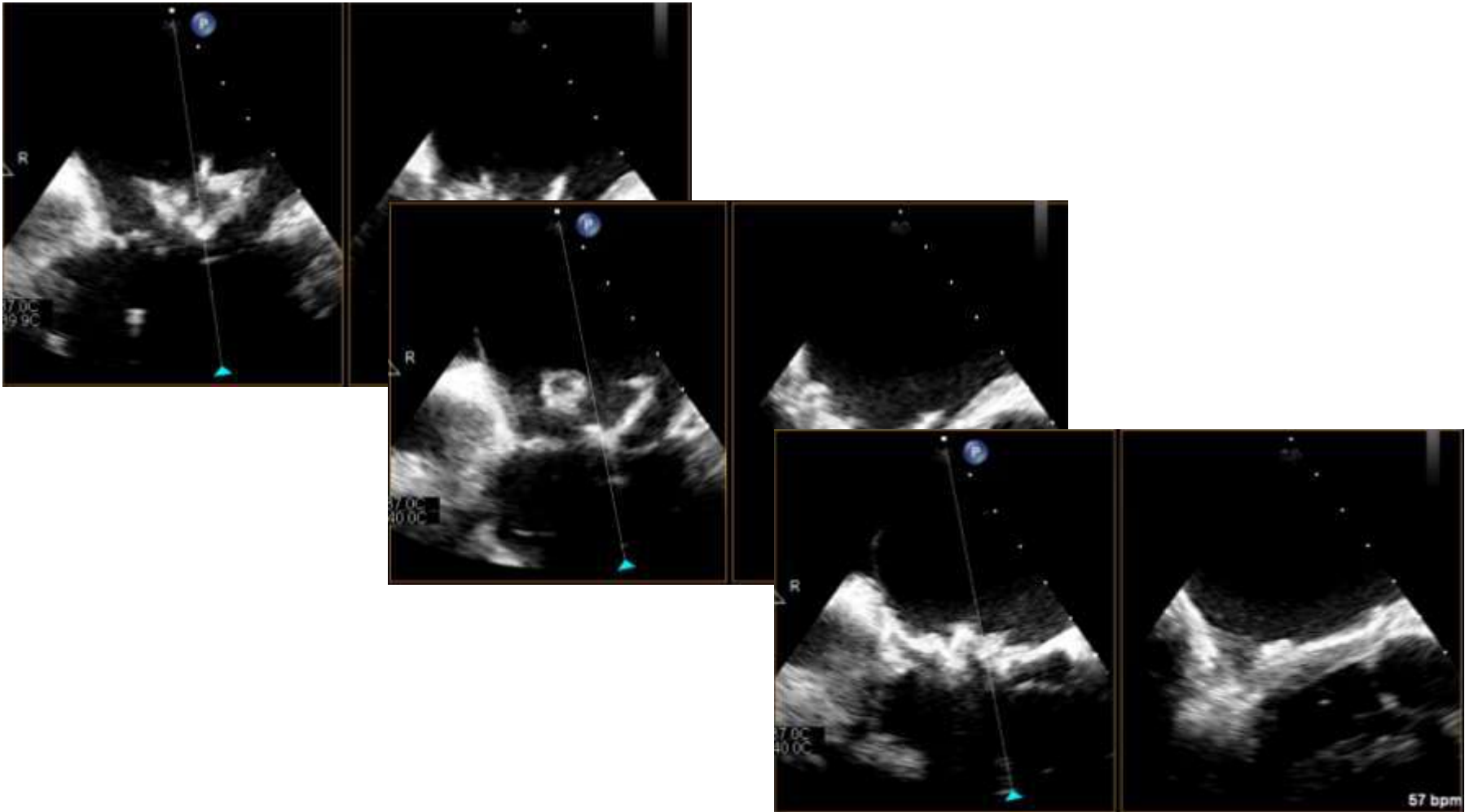
RV SV ↑ from 23ml to 50ml
RV CO ↑ from 1.5L/min to 2.1L/min

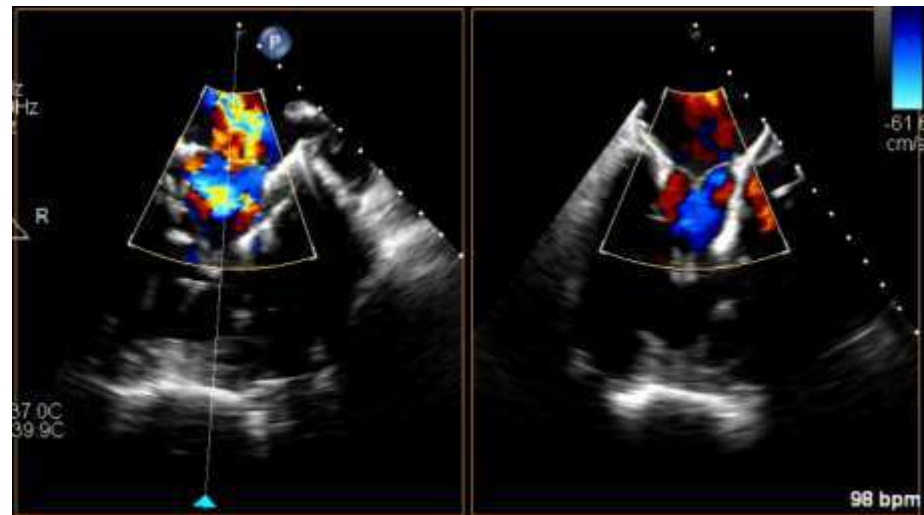
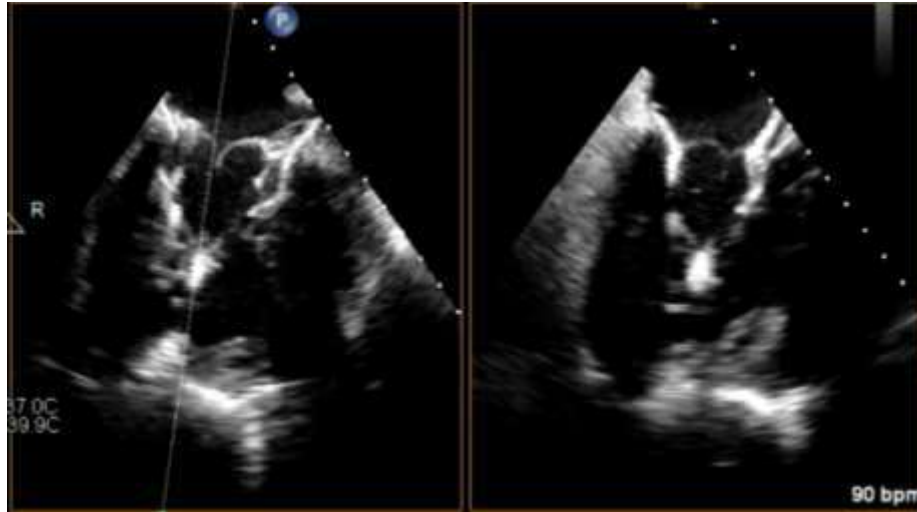
Flowsheet (Anesthetic)	18/11/2020														
	09:00	09:15	09:30	09:45	10:00	10:15	10:30	10:45	11:00	11:15	11:30	11:45	12:00	12:15	12:30
Central Temperature (T1)							35.6	35.8	35.8	35.8	35.7	35.6	35.5	35.5	35.3
Blood Temperature (TBlood)															
Peripheral Temperature (T2)															
Heart Rate (ECG/HR)	56	57	60	63	68	68	64	90	90	90	90	92	92	90	94
Pulse Rate															
Art Blood Press (Art)	96/50	88/50	107/67	106/66	110/71	113/71	90/59	119/76	138/69	130/58	124/51	114/46	120/46	147/67	126/57
Mean Art Blood Press (ArtM)	63	62	78	76	81	83	69	88	88	85	78	69	72	89	75
Non-Invasive BP (NIBP)															
Mean Non-Invasive BP (NIBP)															
Right Atrial Press (RAP/CVP)							30	36	25	20	19	17	16	13	16
Pulm Art Press (PAF)		58/26 (39)	85/34 (48)	82/34 (48)		/ (68)	71/36 (52)	77/43 (60)	71/41 (54)	55/34 (45)	52/30 (39)	46/30 (37)	45/27 (34)	53/31 (40)	46/28 (35)
Pulm Art Wedge Pr (PAWP)															
PA Catheter Events															
PA Catheter sheath distanc...															
Cardiac Output (TD)							2.11	3.05		5.41		4.60			
Cardiac Index							8.98	1.27	1.41	2.5	2.5	2.13	2.13	2.13	
SVR							1251	1838	1783	975	902	921	1026	574	
PVR															
Stroke Volume							33	30.4	33.9	60.1	60.1	50	50	50.5	
SpO2	97	96	97	97	98	98	97	99	97	99	99	100	100	100	100
Bispectral Index (BIS)							48	27	40	45	53	43	41	41	37
Underlying Rhythm															
Pacemaker 1															
Pacemaker 2															
Care Unit															
PROPOFOL 1% INJ 500...							300		400						(15)
REMIFENTANIL INJ 5 m...															(8)
DOBUTAMINE INJ 250 mg...								5							(8)
NORADRENALINE INJ 4 mg...							0.01								(8)

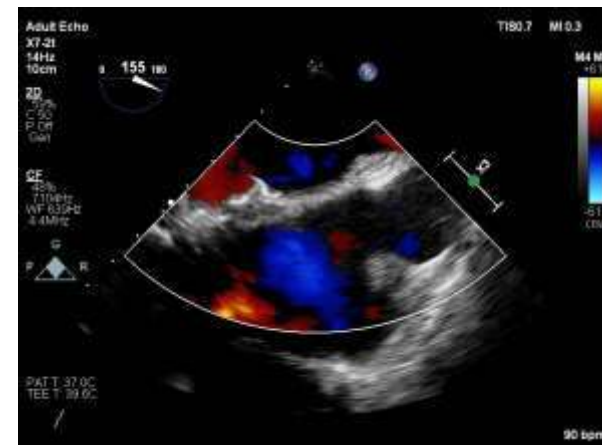
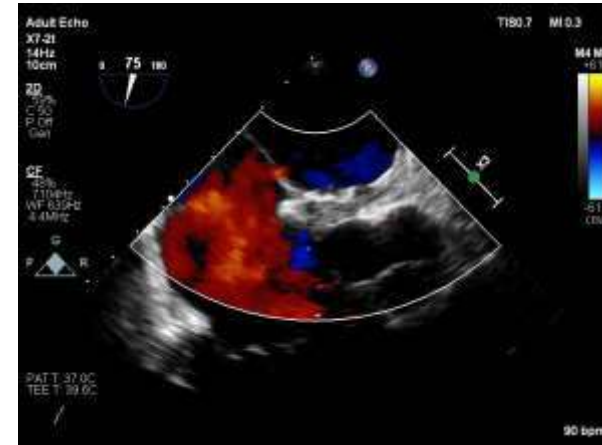
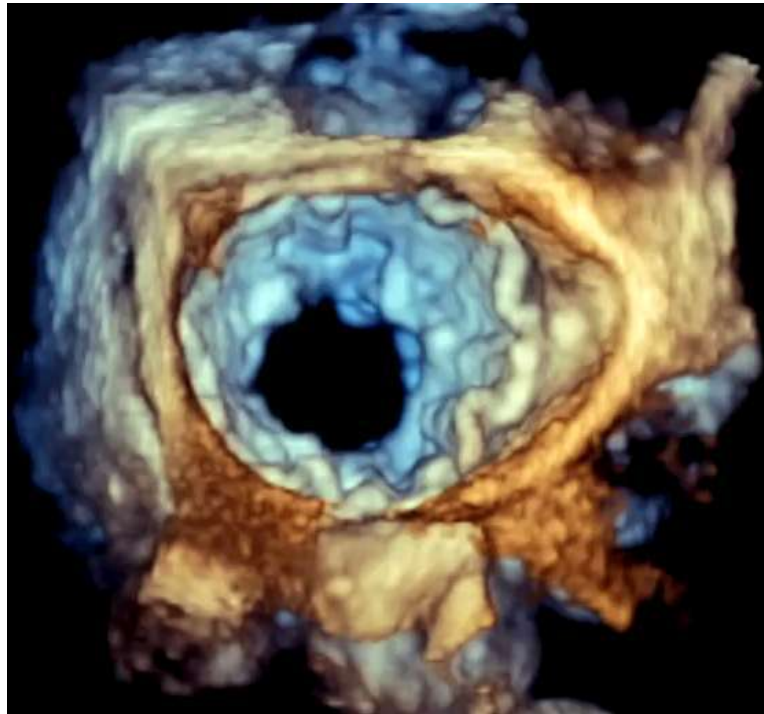












Clinical Assessment

- Patient living at home
- Independent of activities of daily living
- No heart failure admissions
- BNP decrease from >2000ng/L to 753ng/L

- Bisoprolol 2.5mg od
- Dapagliflozin 10mg od
- Eplerenone 25mg od
- Sacubitril 24mg/Valsartan 26mg bd

Echocardiography

LVEF 35-40%

Mean MV gradient 5mmHg

No transvalvular MR or PVL

LVOT gradient 1mmHg

Moderate TR

PSAP 33mmHg

Advanced Echo

Thank you very much