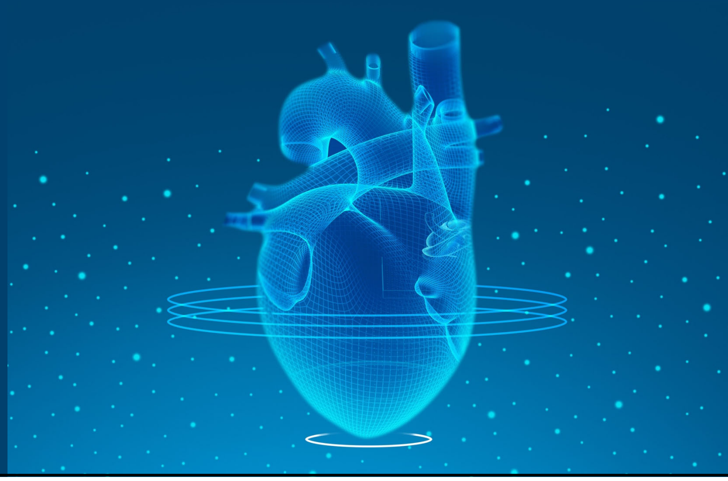
Minneapolis Heart Institute Foundation

GRAND ROUNDS



1

Appropriate Utilization of Novel Medications to Reduce CVD risk in Individuals with Type 2 Diabetes

Abdul Gamam, MD

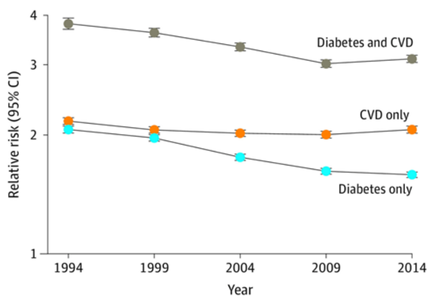
Minneapolis Heart Institute Foundation | **PREVENTION:** Nolan Family Center for Cardiovascular Health

Minneapolis Heart Institute

Allina Health
ABBOTT NORTHWESTERN HOSPITAL

2

An Increasing Prevalence of Diabetes



- In 2019, 11% of the US population had diabetes compared to 6.9% 10 years prior.
- 45% of those with diabetes had established CVD
- Intensive glucose therapy alone does not decrease CV mortality

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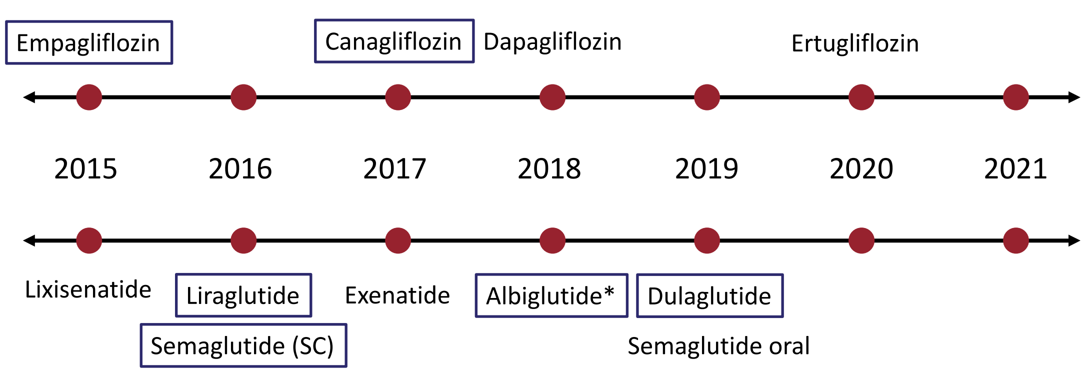
3

Timeline of GLP-1 and SGLT2 Cardiovascular outcome Trials



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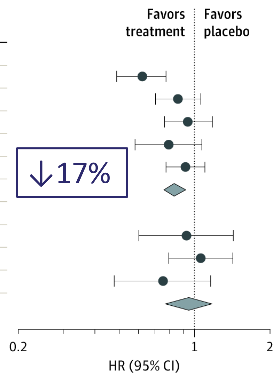
4

SGLT2 inhibitors: Reduction in CV death most prominent in those with ASCVD

B CV death by ASCVD status

	Treatment		Placebo			
	No./total No.	Rate/1000 patient-years	No./total No.	Rate/1000 patient-years	Hazard ratio (95% CI)	Weight, %
Patients with ASCVD						
EMPA-REG OUTCOME	172/4687	12.4	137/2333	20.2	0.62 (0.49-0.77)	18.61
CANVAS program	NA/3756	14.8	NA/2900	16.8	0.86 (0.70-1.06)	22.08
DECLARE-TIMI 58	153/3474	10.9	163/3500	11.6	0.94 (0.76-1.18)	19.64
CREDENCE	75/1113	25.7	93/1107	32.4	0.79 (0.58-1.07)	10.14
VERTIS CV	341/5499	17.6	184/2747	19.0	0.92 (0.77-1.10)	29.52
Fixed-effects model (Q = 9.10; *df* = 4; *P* = .06; I^2 = 56.1%)					0.83 (0.76-0.92)	
Patients without ASCVD						
CANVAS program	NA/2039	6.5	NA/1447	6.2	0.93 (0.60-1.43)	24.02
DECLARE-TIMI 58	92/5108	4.4	86/5078	4.1	1.06 (0.79-1.42)	52.70
CREDENCE	35/1089	12.2	47/1092	16.4	0.75 (0.48-1.16)	23.27
Fixed-effects model (Q = 1.65; *df* = 2; *P* = .44; I^2 = 0.0%)					0.95 (0.77-1.17)	



McGuire et al 2021

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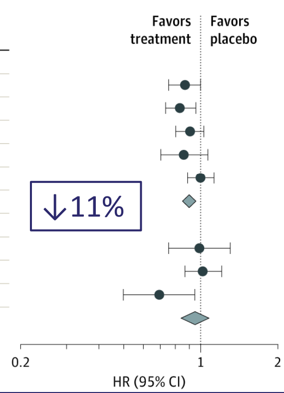
5

SGLT2 inhibitors: Reduction in MACE most prominent in those with ASCVD

B MACEs by ASCVD status

	Treatment		Placebo			
	No./total No.	Rate/1000 patient-years	No./total No.	Rate/1000 patient-years	Hazard ratio (95% CI)	Weight, %
Patients with ASCVD						
EMPA-REG OUTCOME	490/4687	37.4	282/2333	43.9	0.86 (0.74-0.99)	19.19
CANVAS program	NA/3756	34.1	NA/2900	41.3	0.82 (0.72-0.95)	21.16
DECLARE-TIMI 58	483/3474	36.8	537/3500	41.0	0.90 (0.79-1.02)	24.90
CREDENCE	155/1113	55.6	178/1107	65.0	0.85 (0.69-1.06)	8.82
VERTIS CV	735/5499	40.0	368/2747	40.3	0.99 (0.88-1.12)	25.93
Fixed-effects model (Q = 4.53; *df* = 4; *P* = .34; I^2 = 11.8%)					0.89 (0.84-0.95)	
Patients without ASCVD						
CANVAS program	NA/2039	15.8	NA/1447	15.5	0.98 (0.74-1.30)	21.70
DECLARE-TIMI 58	273/5108	13.4	266/5078	13.3	1.01 (0.86-1.20)	62.07
CREDENCE	62/1089	22.0	91/1092	32.7	0.68 (0.49-0.94)	16.23
Fixed-effects model (Q = 4.59; *df* = 2; *P* = .10; I^2 = 56.5%)					0.94 (0.83-1.07)	



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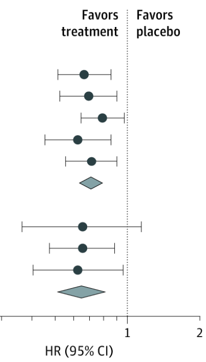
6

SGLT2 Inhibitors: Reduction in Heart Failure Hospitalization independent of ASCVD

B HHF by ASCVD status

	Treatment No./total No.	Treatment Rate/1000 patient-years	Placebo No./total No.	Placebo Rate/1000 patient-years	Hazard ratio (95% CI)	Weight, %
Patients with ASCVD						
EMPA-REG OUTCOME	126/4687	9.4	95/2333	14.5	0.65 (0.50-0.85)	19.62
CANVAS program	NA/3756	7.3	NA/2900	11.3	0.68 (0.51-0.90)	17.13
DECLARE-TIMI 58	151/3474	11.1	192/3500	14.1	0.78 (0.63-0.97)	29.66
CREDENCE	59/1113	20.6	92/1107	33.2	0.61 (0.44-0.85)	12.74
VERTIS CV	139/5499	7.3	99/2747	10.5	0.70 (0.54-0.90)	20.84
Fixed-effects model ($Q = 1.97$; $df = 4$; $P = .74$; $I^2 = 0.0\%$)					0.70 (0.62-0.78)	
Patients without ASCVD						
CANVAS program	NA/2039	2.6	NA/1447	4.2	0.64 (0.35-1.15)	16.38
DECLARE-TIMI 58	61/5108	3.0	94/5078	4.6	0.64 (0.46-0.88)	55.07
CREDENCE	30/1089	10.6	49/1092	17.5	0.61 (0.39-0.96)	28.56
Fixed-effects model ($Q = 0.03$; $df = 2$; $P = .99$; $I^2 = 0.0\%$)					0.63 (0.50-0.80)	



Overall ↓32%

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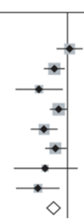
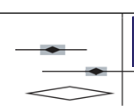
7

GLP-1 RA: Reduction in MACE most Prominent in those with ASCVD

	GLP-1 receptor agonist, n/N (%)	Placebo, n/N (%)	Hazard ratio (95% CI)	NNT (95% CI)	p value
Three-point MACE					
ELIXA	400/3034 (13%)	392/3034 (13%)	1·02 (0·89–1·17)		0·78
LEADER	608/4668 (13%)	694/4672 (15%)	0·87 (0·78–0·97)		0·01
SUSTAIN-6	108/1648 (7%)	146/1649 (9%)	0·74 (0·58–0·95)		0·016
EXSCEL	839/7356 (11%)	905/7396 (12%)	0·91 (0·83–1·00)		0·061
Harmony Outcomes	338/4731 (7%)	428/4732 (9%)	0·78 (0·68–0·90)		0·0006
REWIND	594/4949 (12%)	663/4952 (13%)	0·88 (0·79–0·99)		0·026
PIONEER 6	61/1591 (4%)	76/1592 (5%)	0·79 (0·57–1·11)		0·17
AMPLITUDE-O	189/2717 (7%)	125/1359 (9%)	0·73 (0·58–0·92)		0·0069
Subtotal (I^2=44·5%, p=0·082)			**0·86 (0·80–0·93)**	**65 (45–130)**	**<0·0001**



	GLP-1 receptor agonist, n/N (%)	Placebo, n/N (%)	Hazard ratio (95% CI)	$P_{interaction}$
Established cardiovascular disease				
Yes	2608/23673 (11%)	2877/22432 (13%)	0·85 (0·78–0·92)	0·18
No	492/6725 (7%)	521/6684 (8%)	0·94 (0·83–1·06)	
Subtotal (I^2=44·1%, p=0·181)			0·88 (0·80–0·97)	



↓15%

Sattar et al 2021

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8

Summary: SGLT2 inhibitor vs GLP-1RA

Consider SGLT2 inhibitor first	Consider GLP-1RA first
Reduces MACE & CV death	Reduces MACE & CV death
Reduction heart failure hospitalization	No proven reduction in heart failure hospitalization
Reduction in creatinine doubling and albuminuria progression	Reduction in albuminuria progression
	Substantial weight loss

9

Current recommendations on novel therapies for CVD risk reduction in patients with T2D

Committee	Selected Recommendations for patients with T2D
ADA 2023	Consider SGLT-2 inhibitor and/or GLP-1 receptor agonists in those **with established ASCVD or at high risk for ASCVD independent of hemoglobin A1c**
ESC 2021	Consider SGLT-2 inhibitor or GLP-1 receptor agonist in those **with established ASCVD or target organ damage independent of hemoglobin A1c**
ACC 2020	For patients **with clinical ASCVD** consider an SGLT-2 inhibitor or GLP-1 RA with proven CV benefit.

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Project background and Objective

- Despite CV benefit, nationwide cohort studies estimate that **less than 15% of those with T2D and CVD** are on an SGLT2 inhibitor or GLP-1RA.
- The purpose of this study was to:
  - determine uptake of these novel agents in the Allina Health System and
  - Identify potential barriers to access

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Methods

- Data was obtained through Allina Health's Electronic Data Warehouse
- We identified patients who received care from the Allina Health System between October 1, 2021, and October 1, 2022
- Medical and procedure history was obtained through ICD-10 codes

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Patient Demographics by CVD Status

	T2D w/o CVD, N = 40,667[1]	T2D w/CVD, N = 23,048[1]	p-value[2]
Male	20,395 (50%)	13,864 (60%)	<0.001
Race			<0.001
White	32,716 (80%)	20,521 (89%)	
Black	3,551 (8.7%)	1,234 (5.4%)	
Asian	2,314 (5.7%)	650 (2.8%)	
Other	2,086 (5.1%)	643 (2.8%)	
Hgb A1c	6.90 (6.20, 7.70)	6.90 (6.30, 7.70)	0.082
Obesity	21,327 (66%)	10,740 (60%)	<0.001
Hypertension	29,816 (73%)	21,845 (95%)	<0.001
CHF	2,470 (6.1%)	9,145 (40%)	<0.001

[1] n (%); Median (IQR)

[2] Pearson's Chi-squared test; Wilcoxon rank sum test

- 63,715 patients with T2D in Allina Health System
- 35% of those with T2D also had established clinical ASCVD.

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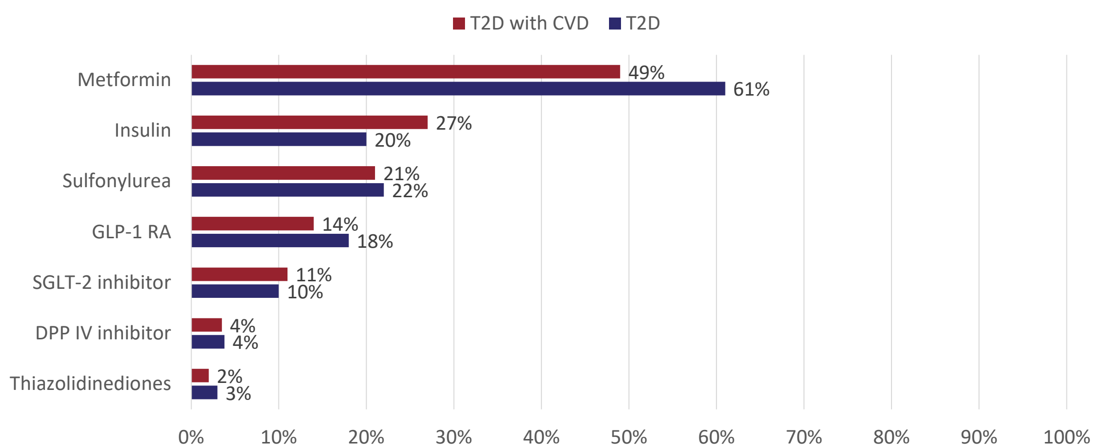
Use of Glucose Lowering Medications in T2D by CVD Status



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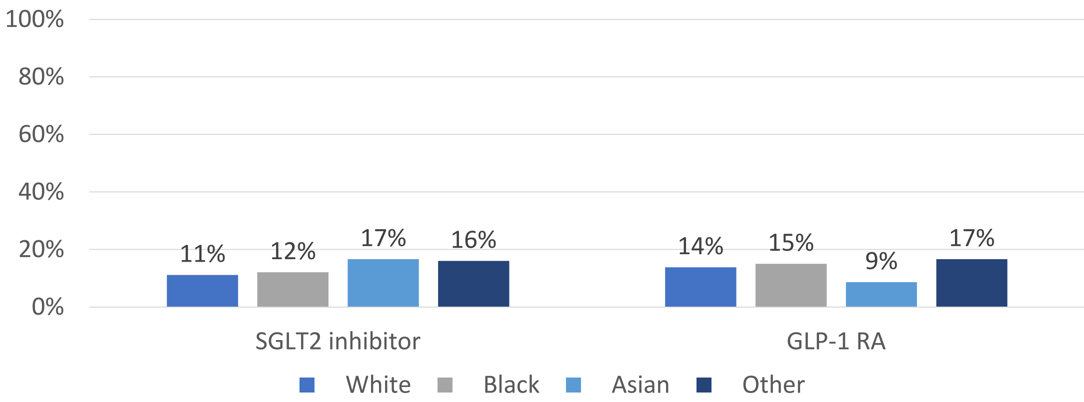
14

SGLT2 inhibitor and GLP-1RA by Race



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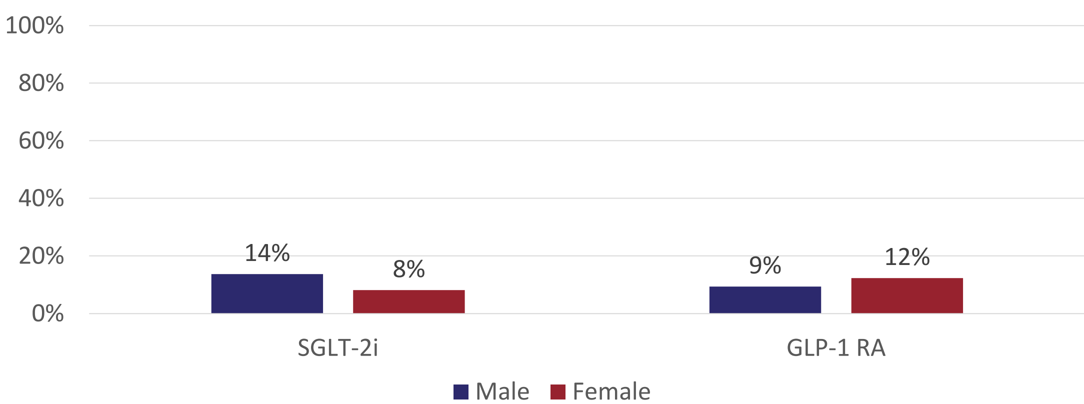
15

SGLT2 inhibitor and GLP-1RA by Gender



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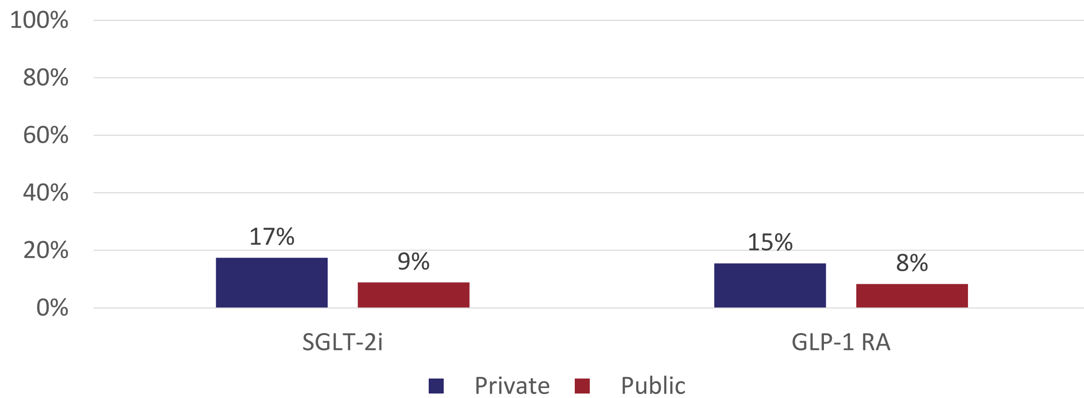
SGLT2 inhibitor and GLP-1RA by Insurance



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Discussion

- The use of SGLT2 inhibitors and GLP-1RA in T2D with ASCVD in our cohort was low at less than 15%, this is comparable to nationwide estimates
- The use of these novel agents was similar between those with and without ASCVD.
- Although there was a statistically significant differences in use of SGLT2 inhibitors and GLP-1RA across gender, race, insurance type, and history of ASCVD

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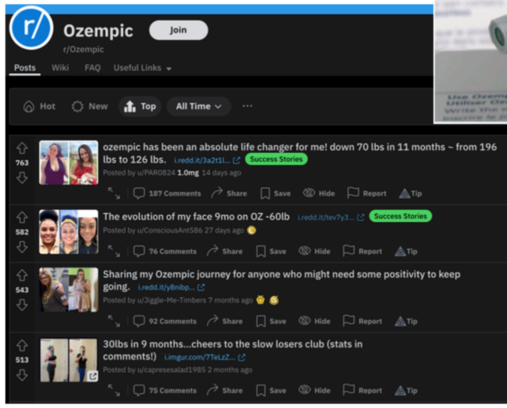
Illustration by Vartika Sharma; Getty Images

Those Weight Loss Drugs May Do a Number on Your Face



Canada's health minister calls mass exports of Ozempic to U.S. an 'outrageous' abuse

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Proposed GLP-1RA project

- Physician orders GLP-1RA
- Pharmacist starts prior-authorization process and titrates medication
- Follow up scheduled in 3 months with APP

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Thank you!

Mike Miedema, Gretchen Benson, Evan Walser-Kuntz, Larissa Stanberry

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Questions?

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22

Advances and Future of Cardiovascular Computed Tomography

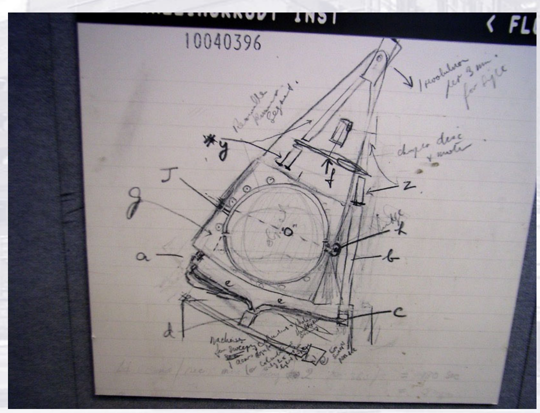
Amr Idris, MD
Advanced Cardiovascular Imaging Fellow
Minneapolis Heart Institute at Abbott Northwestern Hospital

5/8/2023

23

History of CT Scan (1971)

The idea of "looking inside a box without opening it."



British engineer sir Godfrey Hounsfield introduced the first CT scanner

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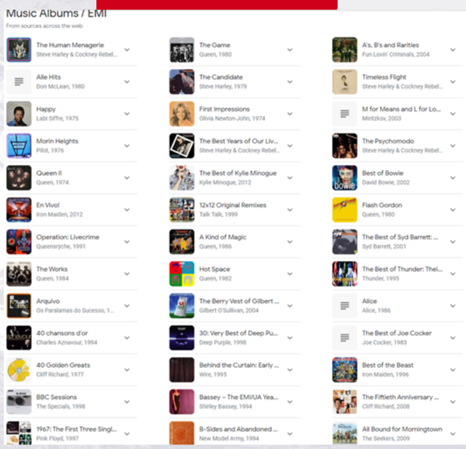
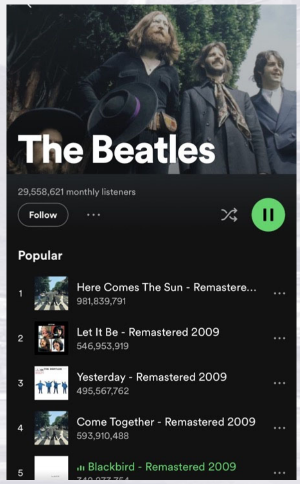
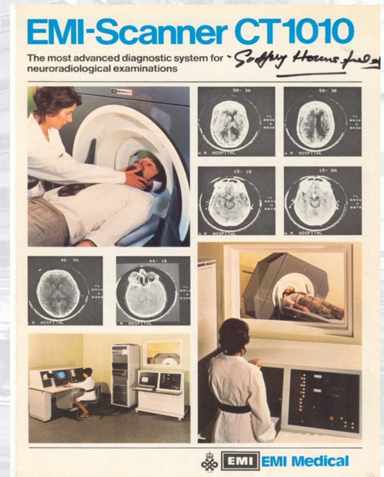
Electric and Musical Industries (EMI Records Ltd)

EMI







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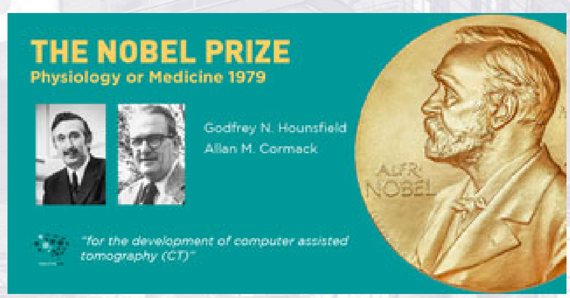
Above: Godfrey Hounsfield with the first commercial CT scanner.



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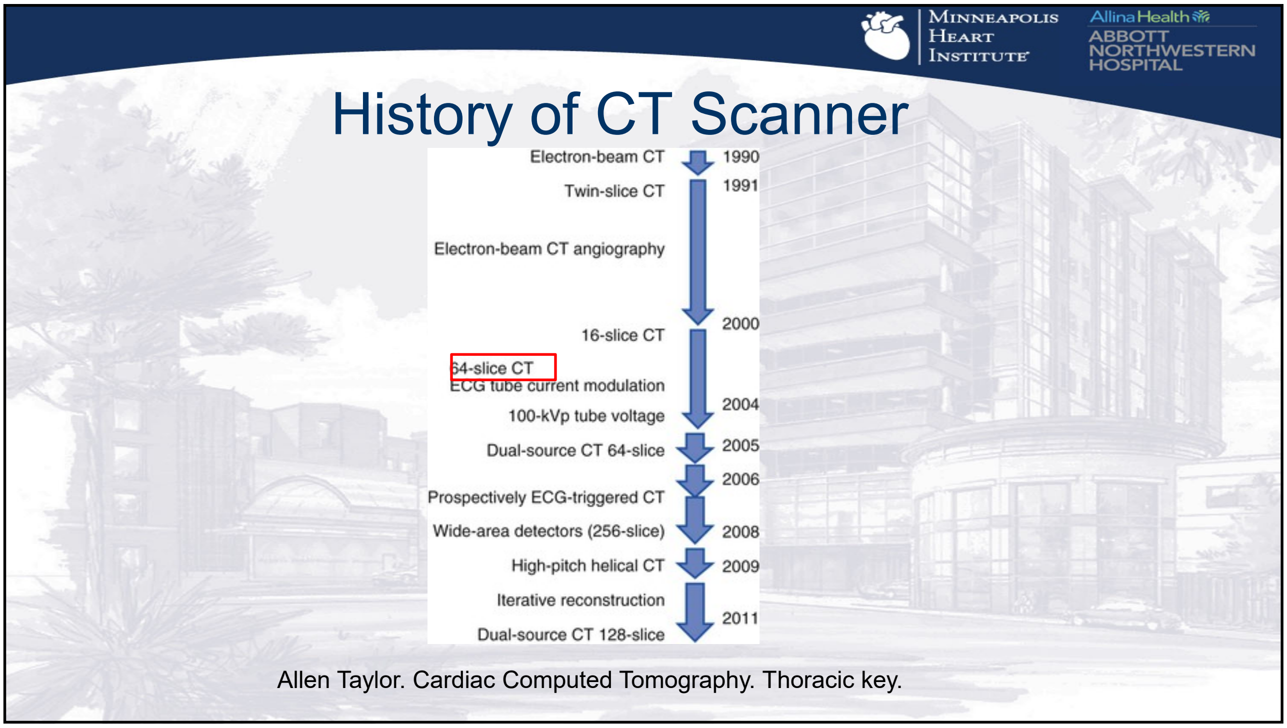
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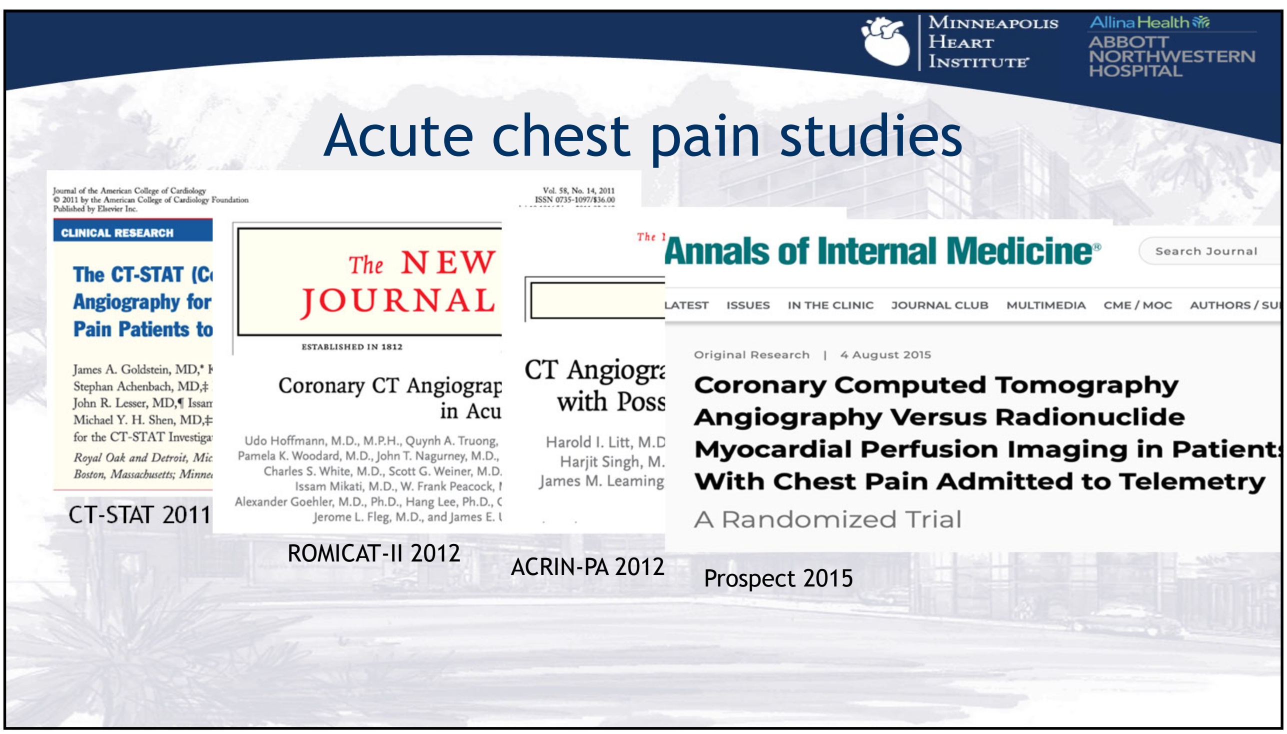
Allina Health
Abbott Northwestern Hospital
History of CT Scanner
Electron-beam CT 1990
Twin-slice CT 1991
Electron-beam CT angiography
16-slice CT 2000
64-slice CT
ECG tube current modulation
100-kVp tube voltage 2004
Dual-source CT 64-slice 2005
Prospectively ECG-triggered CT 2006
Wide-area detectors (256-slice) 2008
High-pitch helical CT 2009
Iterative reconstruction
Dual-source CT 128-slice 2011
Allen Taylor. Cardiac Computed Tomography. Thoracic key.

27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Abbott Northwestern Hospital
Acute chest pain studies
CLINICAL RESEARCH
CT-STAT 2011
The NEW JOURNAL
ESTABLISHED IN 1812
Coronary CT Angiograp
ROMICAT-II 2012
CT Angiogra
with Poss
ACRIN-PA 2012
Annals of Internal Medicine
Original Research | 4 August 2015
Coronary Computed Tomography Angiography Versus Radionuclide Myocardial Perfusion Imaging in Patients With Chest Pain Admitted to Telemetry
A Randomized Trial
Prospect 2015

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Stable chest pain studies
The New England Journal of Medicine
Outcomes of
Pamela S. Douglas, M.D., Udo Ho
Hussein R. Al-Khalidi, Ph.D
Christopher B. Fordyce, M.D., Meg
Mitchell W. Krucoff, M.D., V
Eric J. Velazquez, M.D., Eri
PROMISE 2015
European Heart Journal
doi:10.1093/eurheartj/
Calcium ima
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artery diseas
CRESCENT
Marisa Lubbers, A
Jurgen Akkerhuis, T
Mohamed Ouhlous,
and Koen Nieman
CRESCENT 2016
Coronary
SCOT-HEART 2018
JACC: CARDIOVASCULAR IMAGING
ORIGINAL RESEARCH
Selective Re
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to Invasive
for Suspect
A Randomized, C
Hyuk-Jae Chang, MD, PhD
Ravi Bathina, MD, Andrea B
Jung-Hyun Choi, MD, So-Ye
Sang-Jin Ha, MD, Ae-Young
Sang-Wook Kim, MD, Woon
Yao Lu, MS, Amit Kumar, M
Sang-Eun Lee, MD, Ji Hyun
Joseph Zullo, BA, Leslee J. S
CONSERVE 2019
The NEW ENGLAND JOURNAL of MEDICINE
ESTABLISHED IN 1812
APRIL 9, 2020
VOL. 382 NO. 15
Initial Invasive or Conservative Strategy for Stable Coronary Disease
D.J. Maron, J.S. Hochman, H.R. Reynolds, S. Bangalore, S.M. O'Brien, W.E. Boden, B.R. Chaitman, R. Senior, J. López-Sendón, K.P. Alexander, R.D. Lopes, L.J. Shaw, J.S. Berger, J.D. Newman, M.S. Sidhu, S.G. Goodman, W. Ruzyllo, G. Gosselin, A.P. Maggioni, H.D. White, B. Bhargava, J.K. Min, G.B.J. Mancini, D.S. Berman, M.H. Picard, R.Y. Kwong, Z.A. Ali, D.B. Mark, J.A. Spertus, M.N. Krishnan, A. Elghamaz, N. Moorthy, W.A. Hueb, M. Demkow, K. Mavromatis, O. Bockeria, J. Peteiro, T.D. Miller, H. Szwed, R. Doerr, M. Keltai, J.B. Selvanayagam, P.G. Steg, C. Held, S. Kohsaka, S. Mavromichalis, R. Kirby, N.O. Jeffries, F.E. Harrell, Jr., F.W. Rockhold, S. Broderick, T.B. Ferguson, Jr., D.O. Williams, R.A. Harrington, G.W. Stone, and Y. Rosenberg, for the ISCHEMIA Research Group
ISCHEMIA 2020

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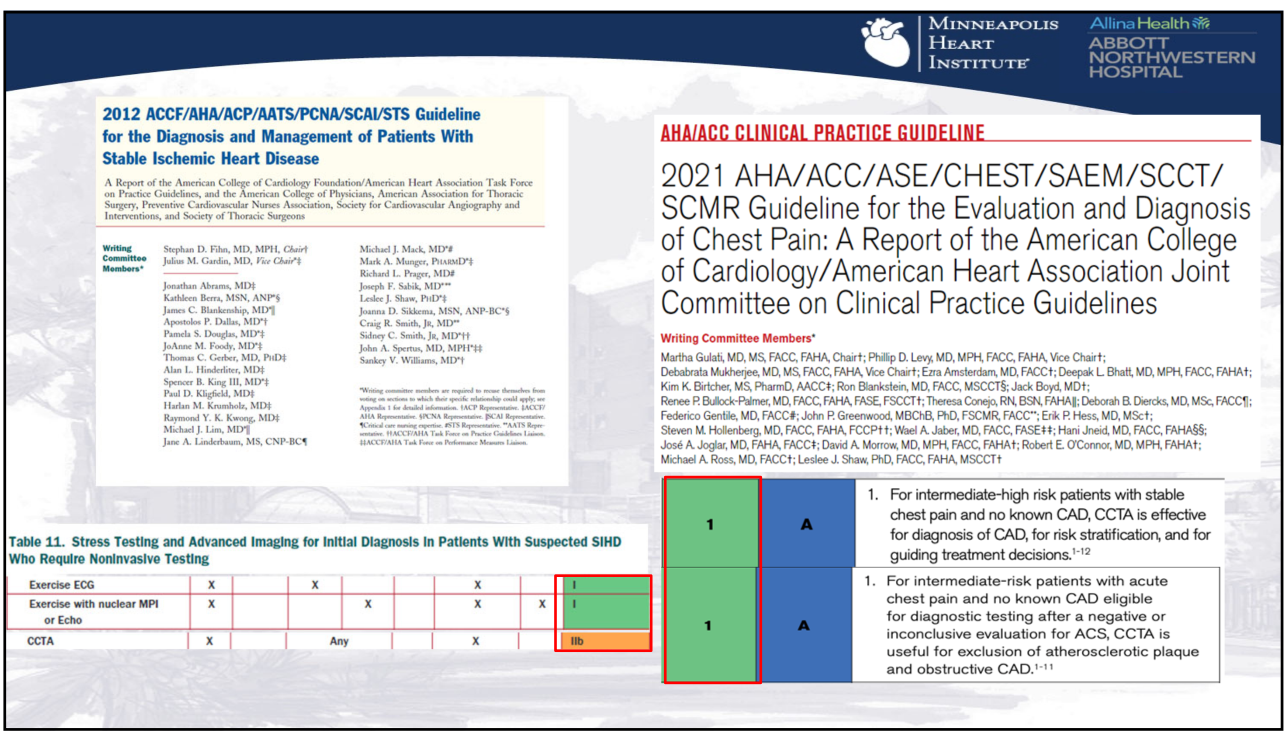
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Abbott Northwestern Hospital
2012 ACCF/AHA/ACP/AATS/PCNA/SCAI/STS Guideline for the Diagnosis and Management of Patients With Stable Ischemic Heart Disease
A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines, and the American College of Physicians, American Association for Thoracic Surgery, Preventive Cardiovascular Nurses Association, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons
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Julius M. Gardin, MD, Vice Chair
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Kathleen Berra, MSN, ANP
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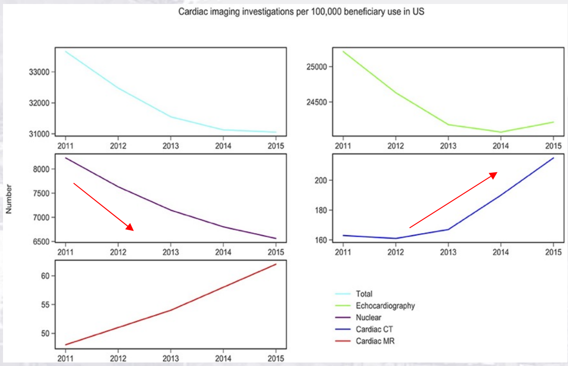
Craig R. Smith, Jr, MD
Sidney C. Smith, Jr, MD
John A. Spertus, MD, MPH
Sankey V. Williams, MD
Table 11. Stress Testing and Advanced Imaging for Initial Diagnosis in Patients With Suspected SIHD Who Require Noninvasive Testing
Exercise ECG X X X I
Exercise with nuclear MPI or Echo X X X X I
CCTA X Any X IIb
AHA/ACC CLINICAL PRACTICE GUIDELINE
2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR Guideline for the Evaluation and Diagnosis of Chest Pain: A Report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines
Writing Committee Members
Martha Gulati, MD, MS, FACC, FAHA, Chair; Phillip D. Levy, MD, MPH, FACC, FAHA, Vice Chair; Debabrata Mukherjee, MD, MS, FACC, FAHA, Vice Chair; Ezra Amsterdam, MD, FACC; Deepak L. Bhatt, MD, MPH, FACC, FAHA; Kim K. Birtcher, MS, PharmD, AACC; Ron Blankstein, MD, FACC, MSCCT; Jack Boyd, MD; Renee P. Bullock-Palmer, MD, FACC, FAHA, FASE, FSCCT; Theresa Conejo, RN, BSN, FAHA; Deborah B. Diercks, MD, MSc, FACC; Federico Gentile, MD, FACC; John P. Greenwood, MBChB, PhD, FSCMR, FACC; Erik P. Hess, MD, MSc; Steven M. Hollenberg, MD, FACC, FAHA, FCCP; Wael A. Jaber, MD, FACC, FASE; Hani Jneid, MD, FACC, FAHA; José A. Joglar, MD, FAHA, FACC; David A. Morrow, MD, MPH, FACC, FAHA; Robert E. O'Connor, MD, MPH, FAHA; Michael A. Ross, MD, FACC; Leslee J. Shaw, PhD, FACC, FAHA, MSCCT
1 A 1. For intermediate-high risk patients with stable chest pain and no known CAD, CCTA is effective for diagnosis of CAD, for risk stratification, and for guiding treatment decisions.1-12
1 A 1. For intermediate-risk patients with acute chest pain and no known CAD eligible for diagnostic testing after a negative or inconclusive evaluation for ACS, CCTA is useful for exclusion of atherosclerotic plaque and obstructive CAD.1-11

30

Cardiac CT utilization



Scan volumes 2022

CMR Total	2203
Stress	187
Pediatric	130
MRA	446
Other	1440

8 – 10 studies per day

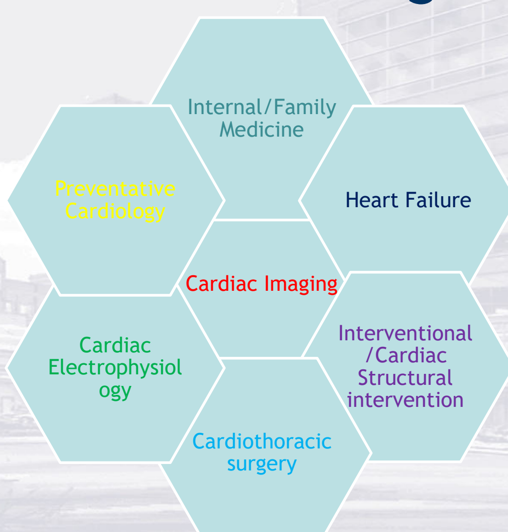
CT Total	5970+
Coronary CTA	3578
Pre-TAVR	556
Morphology	1015
Vascular	578+
Congenital	243

25 - 35 studies per day

Peterson S et al. Recent trends and potential Drivers of Non-invasive Cardiovascular Imaging Use in the United States of America and England. Frontiers in Cardiovascular Medicine 2021.

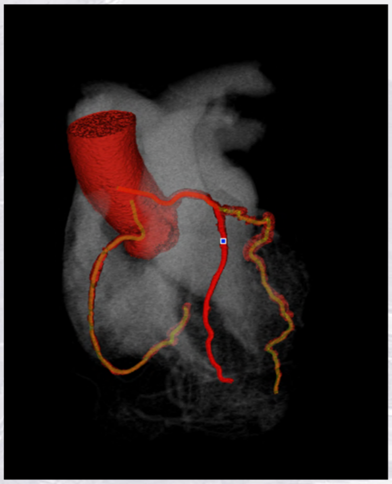
31

Where do Cardiac Imagers stand?



32

Evaluate coronary arteries



Normal anatomy

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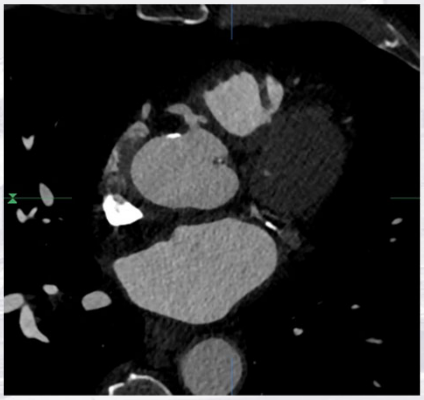
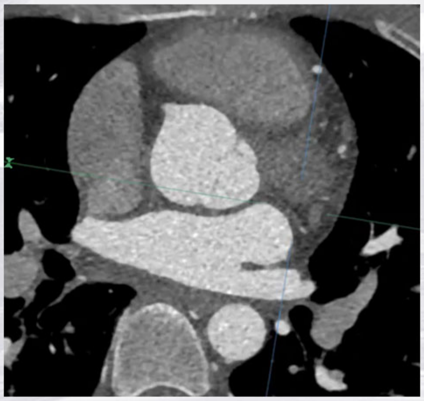
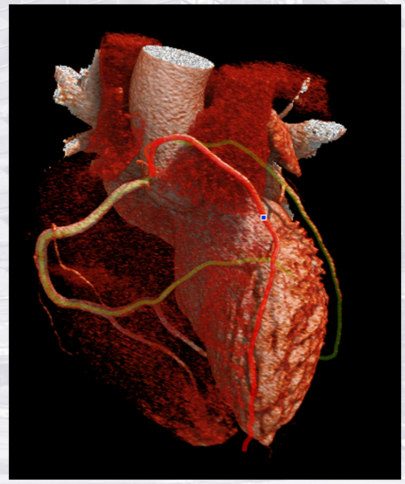
Anomalous Coronary artery



Anomalous LCx from RCA

34

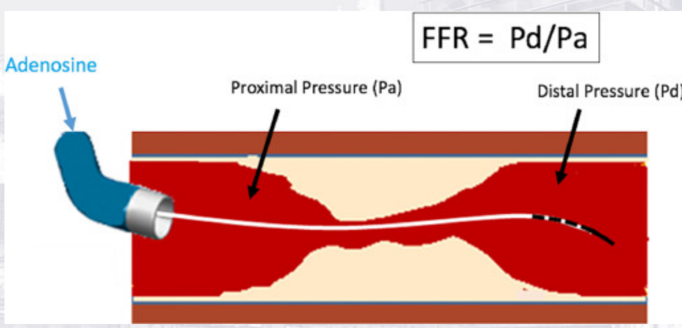




Anomalous LAD from right coronary cusp

35

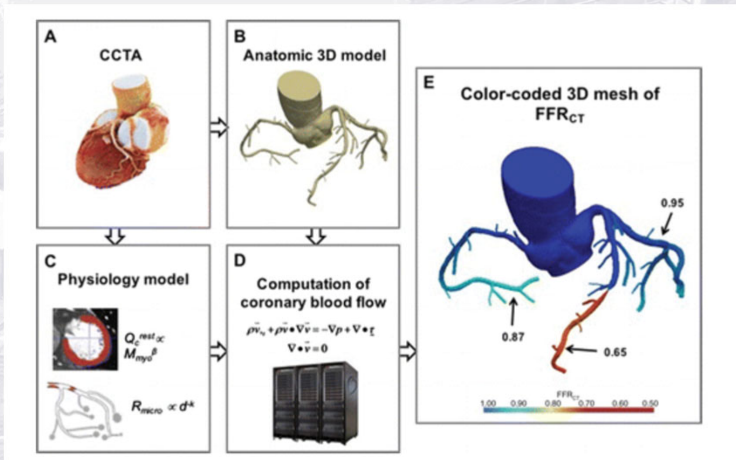
Invasive FFR



Shah et al. CT Coronary Angiography Fractional Flow Reserve: New Advances in the Diagnosis and Treatment of Coronary Artery Disease. Current Problems in Diagnostic Radiology

36

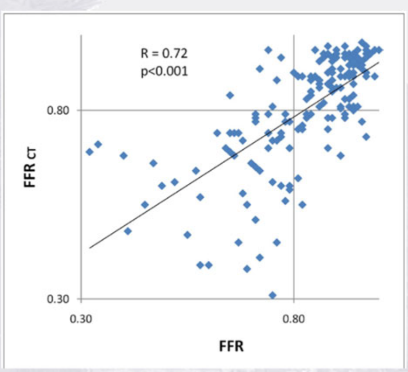
CT-FFR



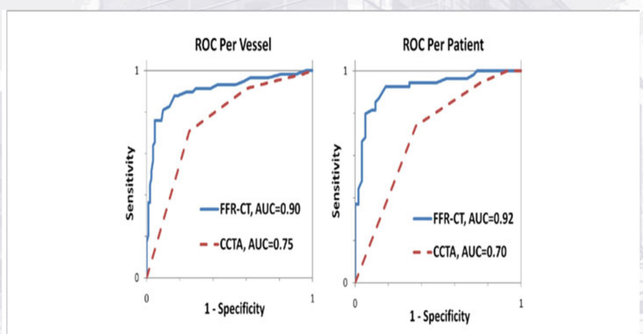
Tesche et al. Coronary CT Angiography-derived Fractional Flow Reserve. Radiology 2017

37

FFR-CT vs. Invasive FFR correlation



Correlates well



Improves diagnostic accuracy of CTA alone in intermediate lesions

Discover-Flow 2011

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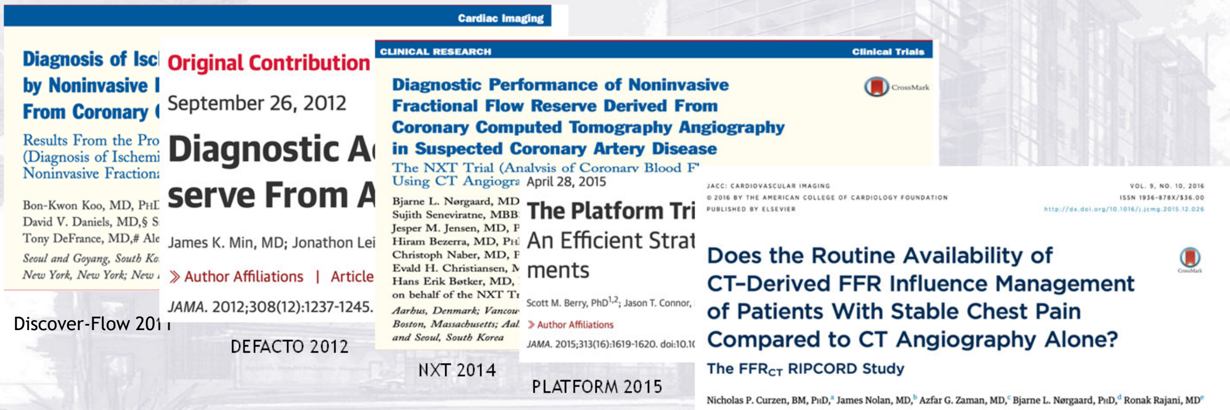
Trials validating CT-FFR



Discover-Flow 2011

DEFACTO 2012

NXT 2014

PLATFORM 2015

FFR-CT RIPCORD 2016

39

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CT FFR guidelines recommendations

2a	B-NR	4. For intermediate-risk patients with acute chest pain and coronary artery stenosis of 40% to 90% in a proximal or middle segment on CCTA, FFR-CT is reasonable for diagnosis of vessel-specific ischemia and to guide decision-making regarding the use of coronary revascularization.[12-17]

Gulati et al. Chest pain guidelines 2021

40

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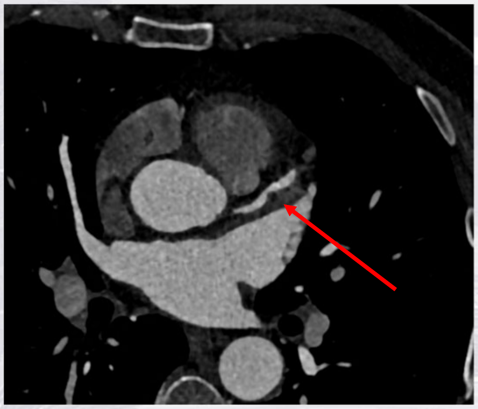
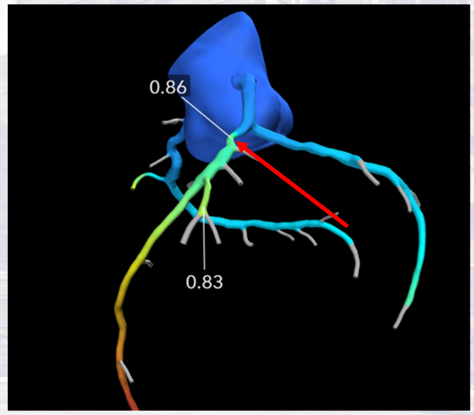
Normal CT FFR case (Normal anatomy)



Proximal LAD lesion



CT-FFR insignificant at 0.86

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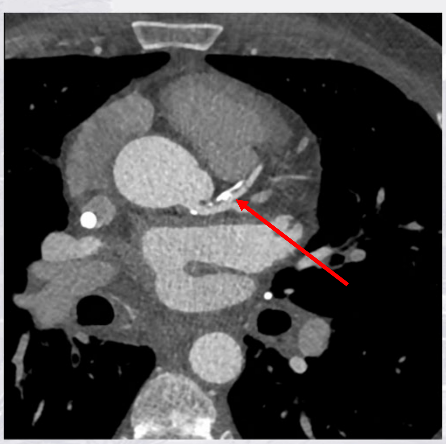
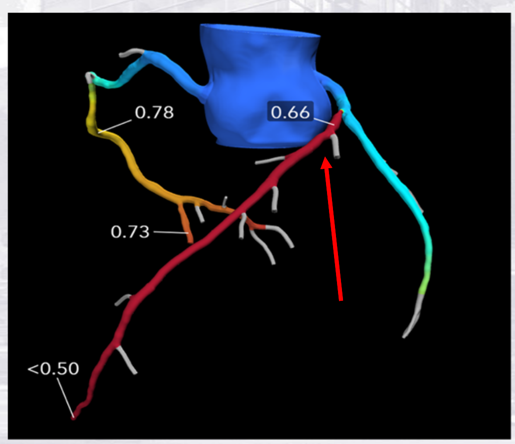
Abnormal CT FFR case (Normal anatomy)

56 y.o. male with ESRD, DM2, tobacco use disorder who presents with chest pain.



Distal left main/proximal LAD lesion



CT-FFR significant at 0.66

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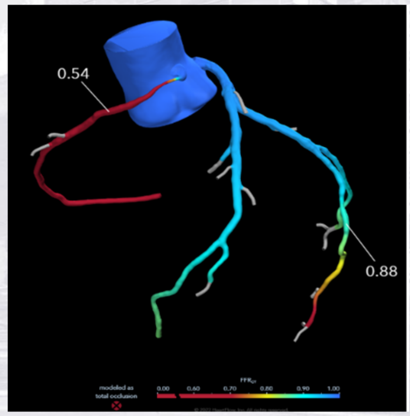
Anomalous Coronary artery with positive FFR



Anomalous RCA with positive CT-FRR

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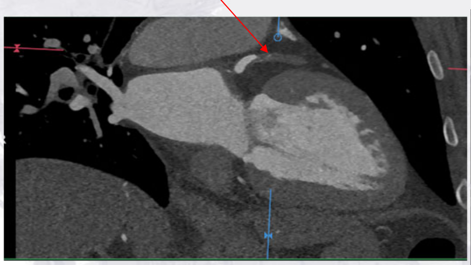
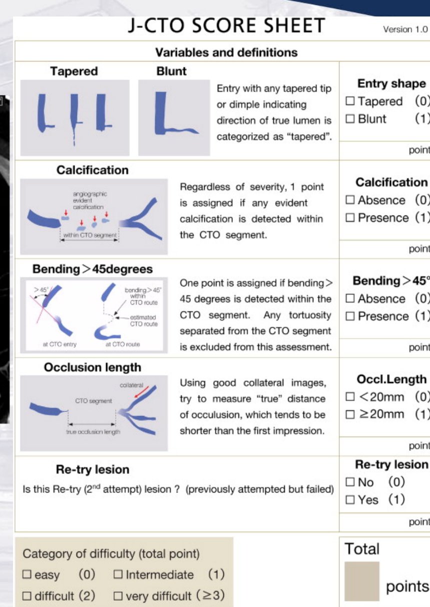
CTO Planning



J-CTO 2.
1. Tapering of the cap
2. No calcification
3. angulation < 45 degrees
4. CTO length of 28 mm.
5. Re-try lesion


J-CTO SCORE SHEET Version 1.0

Variables and definitions

Tapered / Blunt — Entry with any tapered tip or dimple indicating direction of true lumen is categorized as "tapered". Entry shape: ☐ Tapered (0) ☐ Blunt (1) point

Calcification — Regardless of severity, 1 point is assigned if any evident calcification is detected within the CTO segment. Calcification: ☐ Absence (0) ☐ Presence (1) point

Bending > 45degrees — One point is assigned if bending > 45 degrees is detected within the CTO segment. Any tortuosity separated from the CTO segment is excluded from this assessment. Bending > 45°: ☐ Absence (0) ☐ Presence (1) point

Occlusion length — Using good collateral images, try to measure "true" distance of occlusion, which tends to be shorter than the first impression. Occl.Length: ☐ <20mm (0) ☐ ≥20mm (1) point

Re-try lesion — Is this Re-try (2nd attempt) lesion ? (previously attempted but failed) Re-try lesion: ☐ No (0) ☐ Yes (1) point

Category of difficulty (total point): ☐ easy (0) ☐ Intermediate (1) ☐ difficult (2) ☐ very difficult (≥3)

Total points

44

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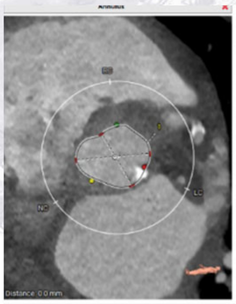
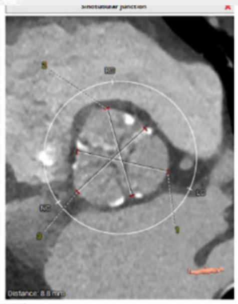
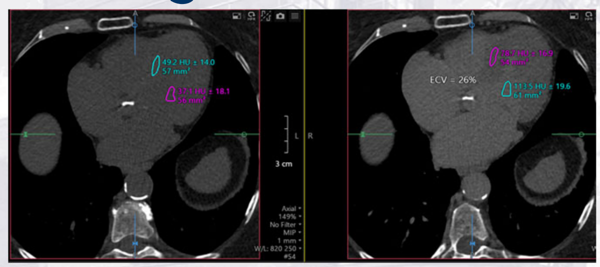
TAVR Planning



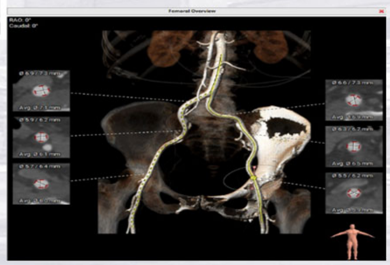
Annulus size



Severe AV calcification



ECV screening



TAVR Access

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Bicuspid AV

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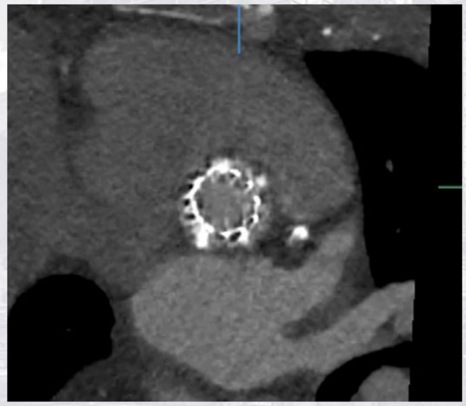
Post TAVR CT

Post TAVR
HALT



4 Months on warfarin
HALT resolved

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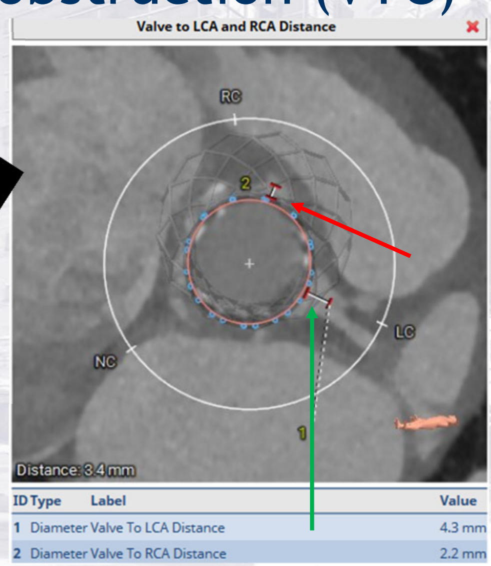
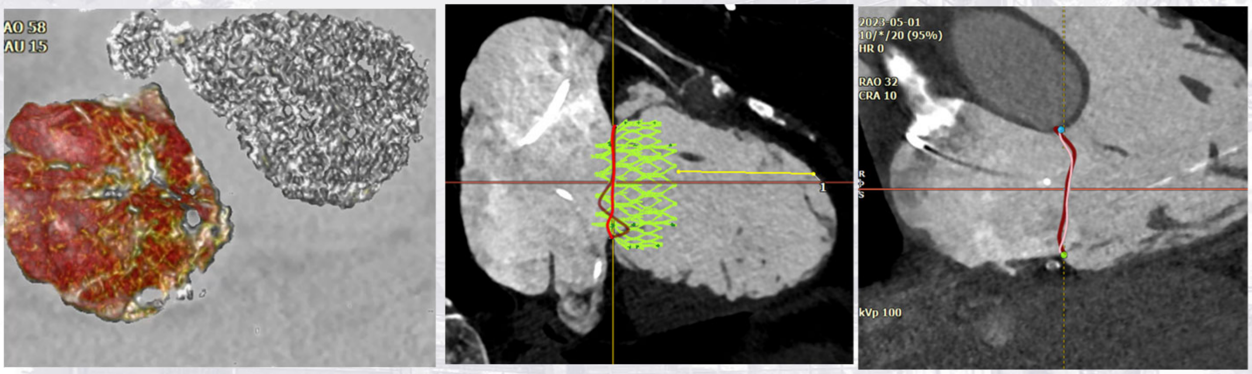
ViV Planning Coronary obstruction (VTC)



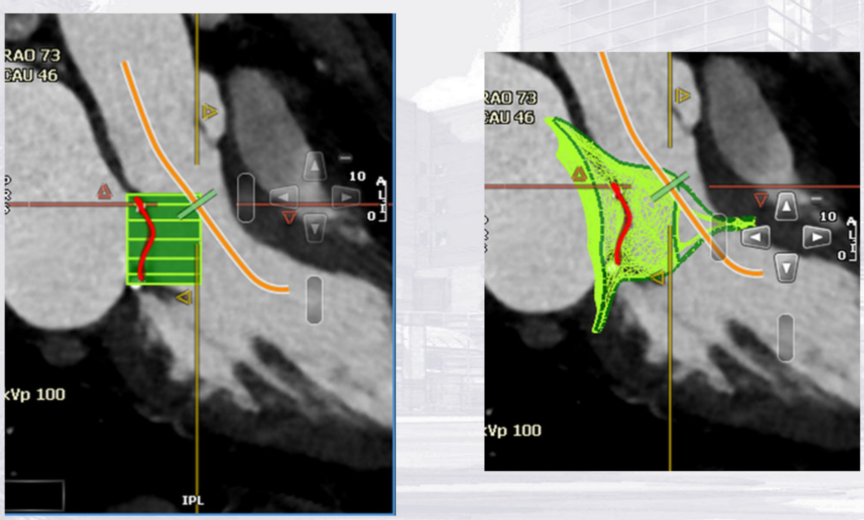
48

Tricuspid valve planning



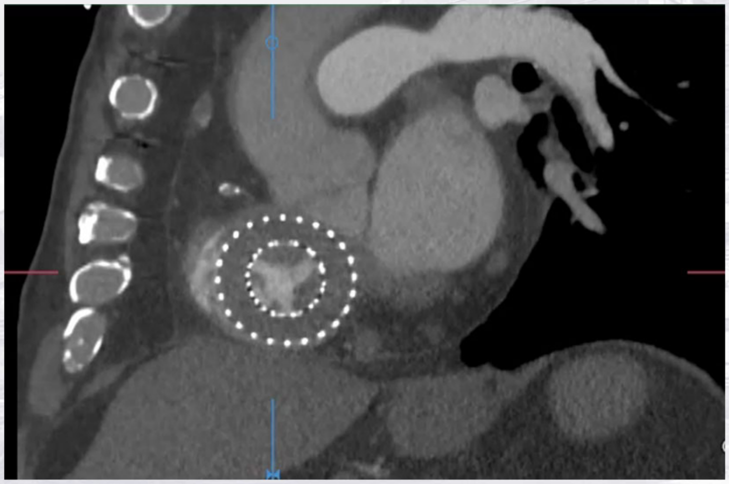
49

Mitral valve planning



50

Post Intrepid CT



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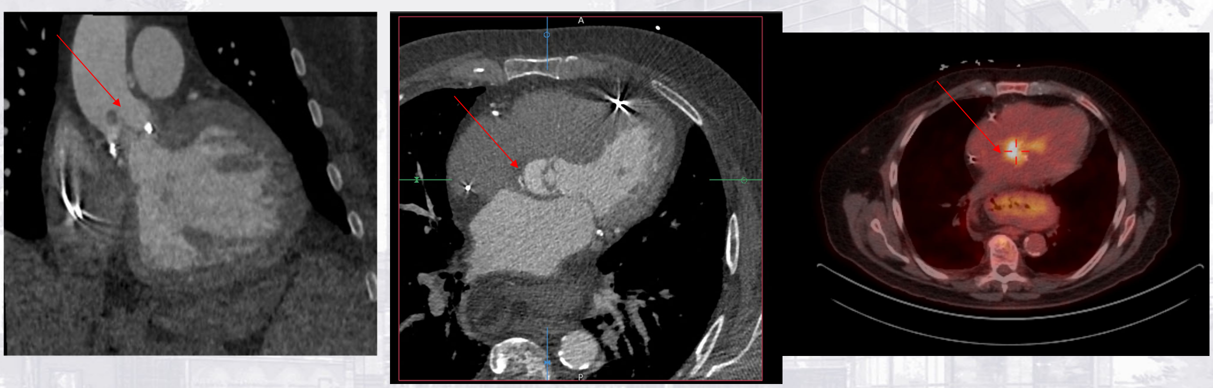
Infectious endocarditis



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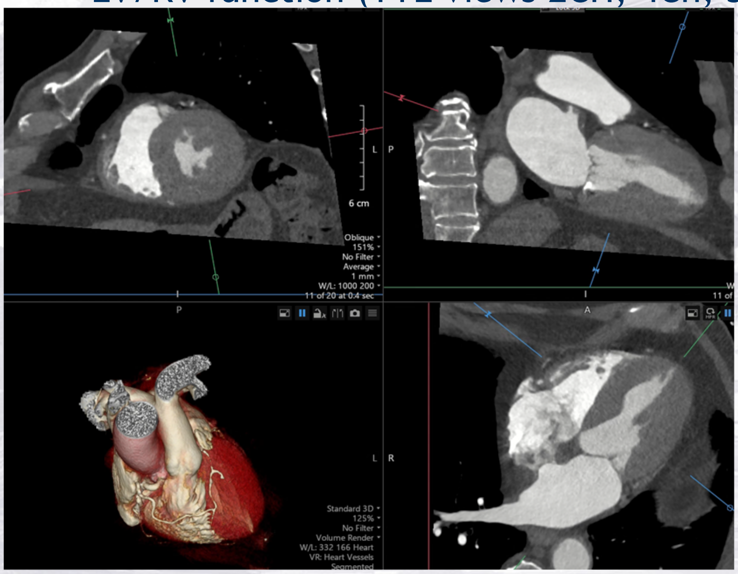
LV/RV function (TTE views 2CH, 4Ch, SA)

SA

2 CH



3D

4 CH

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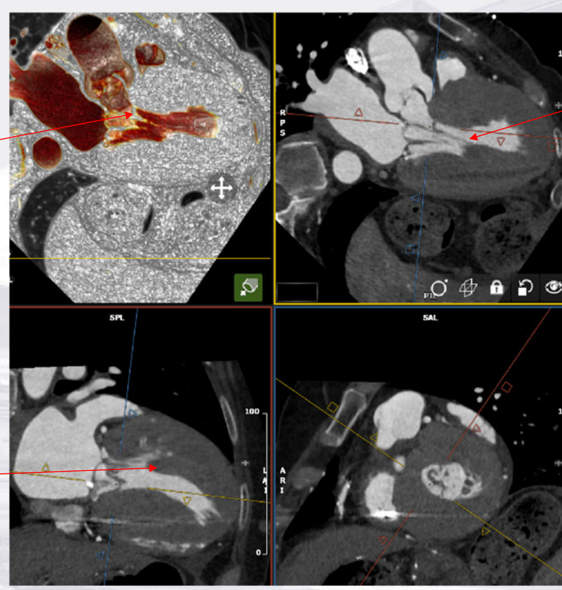
HCM

Severe asymmetric hypertrophy with obstructive cardiomyopathy and complex mechanism of LVOT obstruction

Elongated anterior mitral valve leaflet (31 mm).

Bifid anteriorly and apically inserted papillary muscle



Anomalous papillary muscle insertion into the anterior mitral valve leaflet, producing also chordal SAM.

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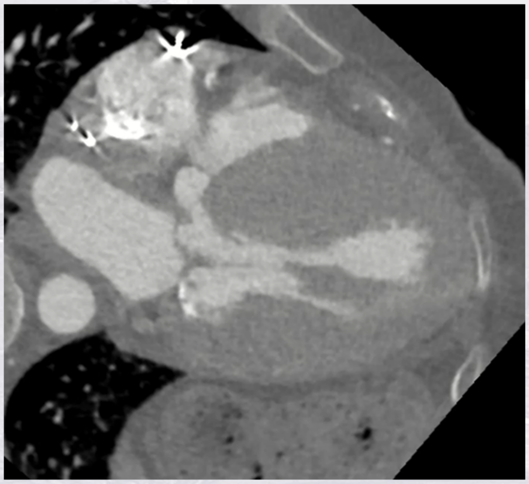

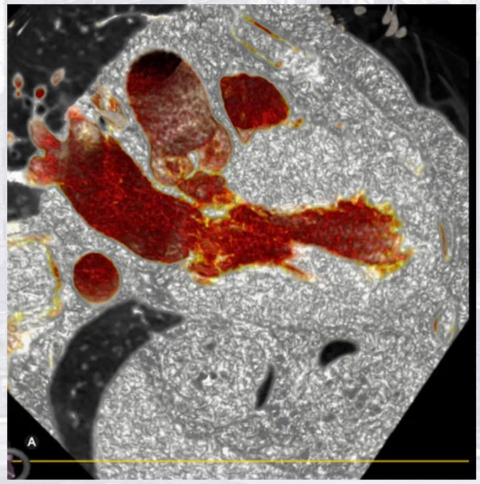

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Pulmonary veins anatomy prior to Afib ablation

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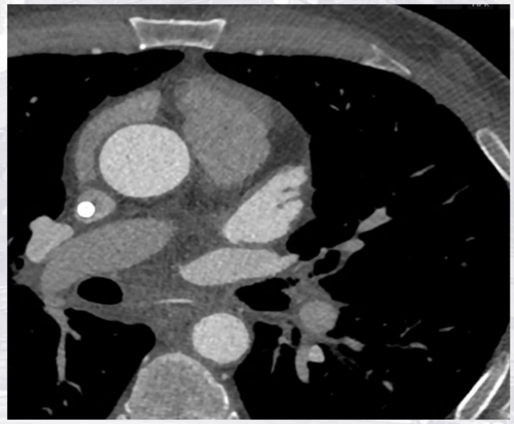
Left atrial appendage anatomy

Evaluated left atrial appendage morphology



Evaluate left atrial appendage thrombus

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CT vs. TEE to rule out thrombus (Metanalysis)

Cardiac Computed Tomography Versus Transesophageal Echocardiography for the Detection of Left Atrial Appendage Thrombus: A Systemic Review and Meta-Analysis

Shandong Yu, **Heping Zhang** and **Hongwei Li**

Originally published 19 Nov 2021 | https://doi.org/10.1161/JAHA.121.022505 | Journal of the American Heart Association. 2021;10:e022505

Conclusions

Cardiac computed tomography with a delayed imaging is a reliable alternative to TEE. It may save the patient and health care from an excess TEE.

100 sen, 99% spec

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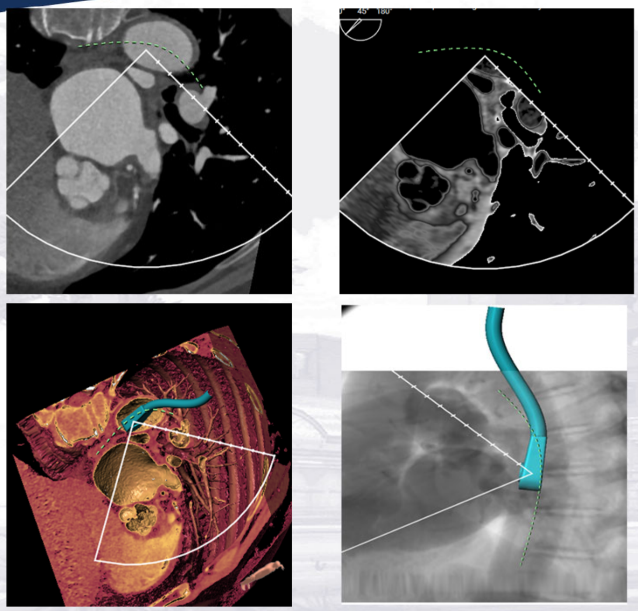
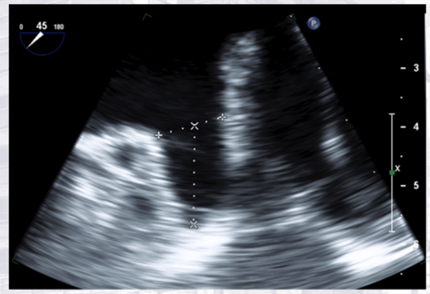
Pre Watchman Planning



CT Stimulated TEE planning



Intraprocedural TEE planning

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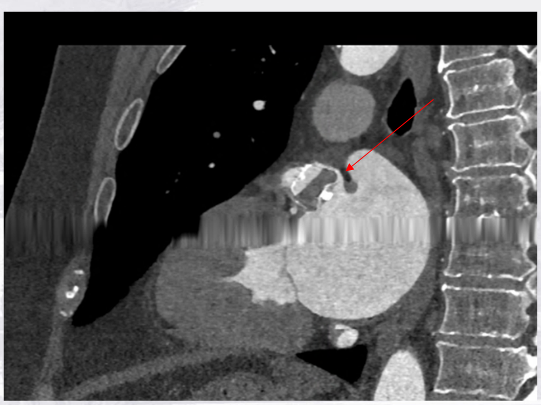
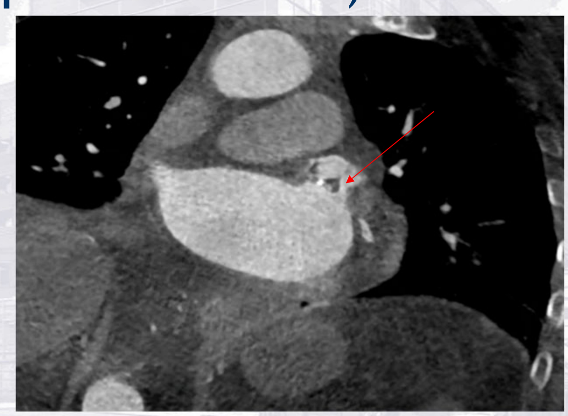
Post Watchman (Complete closure/incomplete closure)



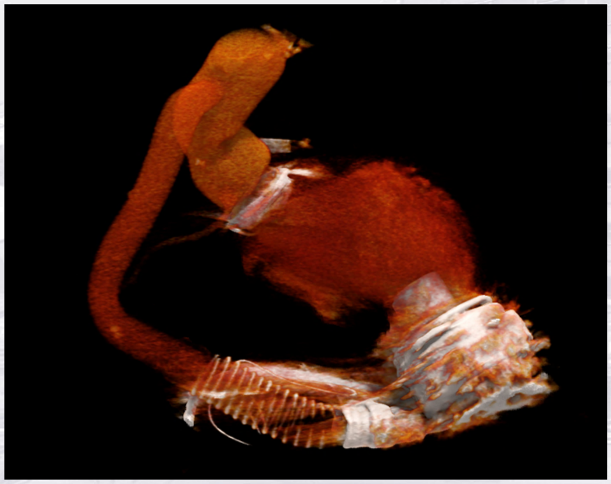
60 days post 24 mm Watchman implantation



60 days post 20 mm Watchman FLX implantation

60

LVAD



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Cardiac Tumor (Leiomyosarcoma)

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Peripheral arterial disease


Severe peripheral arterial disease


EVAR


Subclavian artery stenosis

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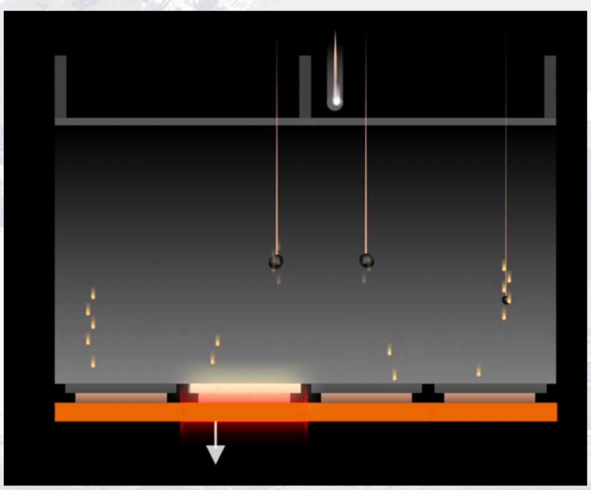
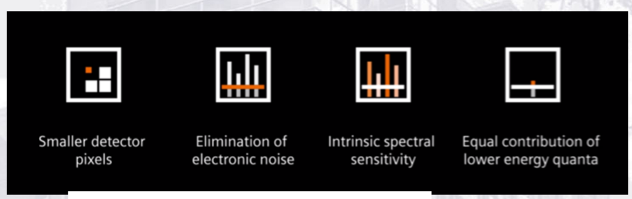
New Scanners





NAEOTOM Alpha photon-counting CT scanner - Siemens Healthineers (siemens-healthineers.com)

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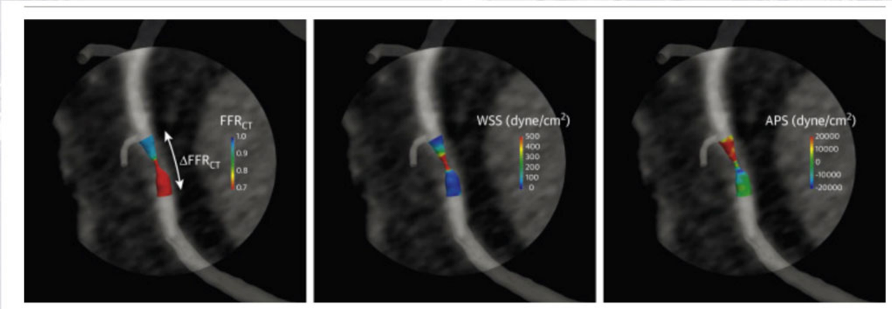
Novel Applications



Beyond traditional coronary CFD parameters, EMERALD trial introduced additional CFD parameters for CT for the evaluation of coronary plaque and risk including: Delta fractional flow reserve computed tomography, Wall shear stress (WSS), Axial plaque stress (APS)

Nicole et al. The Future of Cardiovascular Computed Tomography. JACC Cardio Imag 2019
Lee et al. Identification of High-Risk Plaques Destined to Cause Acute Coronary Syndrome Using Coronary Computed Tomographic Angiography and Computational Fluid Dynamics. JACC Cardio Imag 2018

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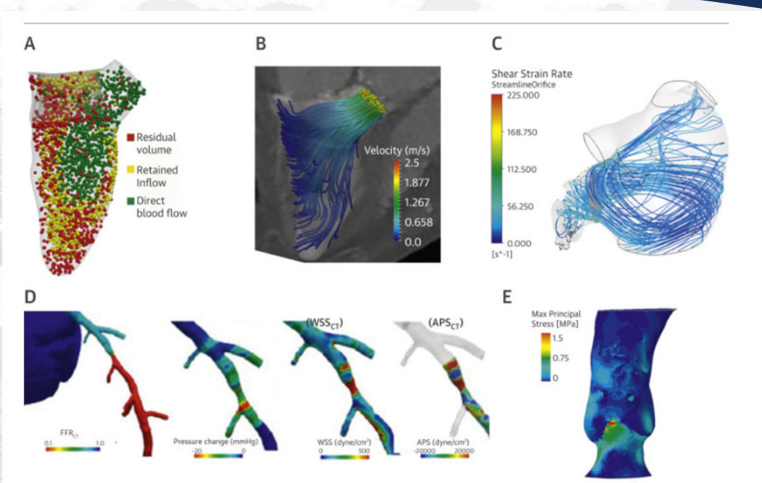

Blood stasis analysis in the left ventricle post-TMVR with associated flow modelling
Left atrial computational flow dynamics used in modelling of LAA thrombus risk
Shear stress applications in the coronary arteries
Shear stress post TAVR in the aortic root

Lee et al. Identification of High-Risk Plaques Destined to Cause Acute Coronary Syndrome Using Coronary Computed Tomographic Angiography and Computational Fluid Dynamics. JACC Cardio Imag 2018

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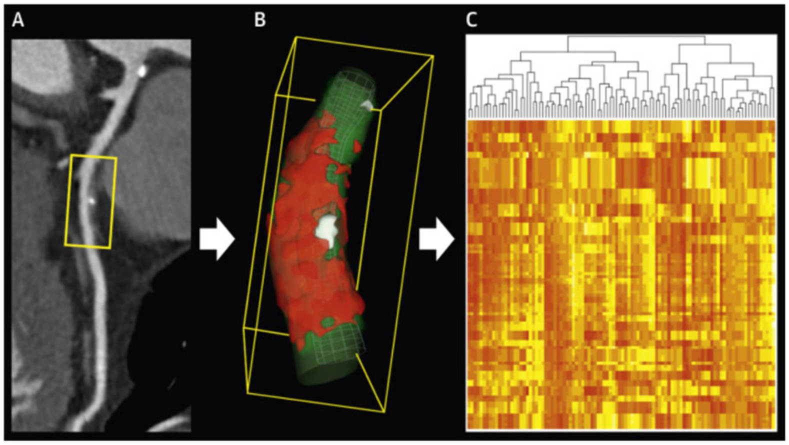

Curved multiplanar reconstruction with a partially calcified plaque in the LAD. Radiomic analysis, voxels containing plaque are extracted from the image which are analyzed using novel analytic techniques, such as machine learning.

Lee et al. Identification of High-Risk Plaques Destined to Cause Acute Coronary Syndrome Using Coronary Computed Tomographic Angiography and Computational Fluid Dynamics. JACC Cardio Imag 2018

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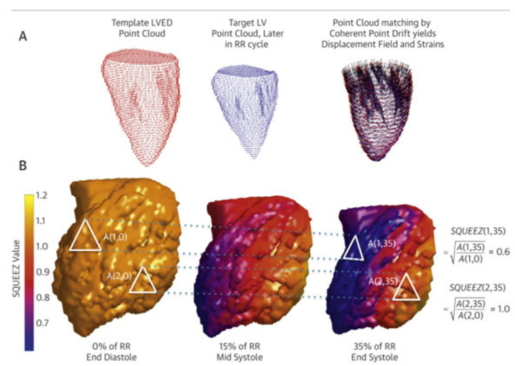

Download : Download high-res image (1MB)

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Figure 6. Advanced Image Analyses Enabling Strain Analysis With CT

Lee et al. Identification of High-Risk Plaques Destined to Cause Acute Coronary Syndrome Using Coronary Computed Tomographic Angiography and Computational Fluid Dynamics. JACC Cardio Imag 2018

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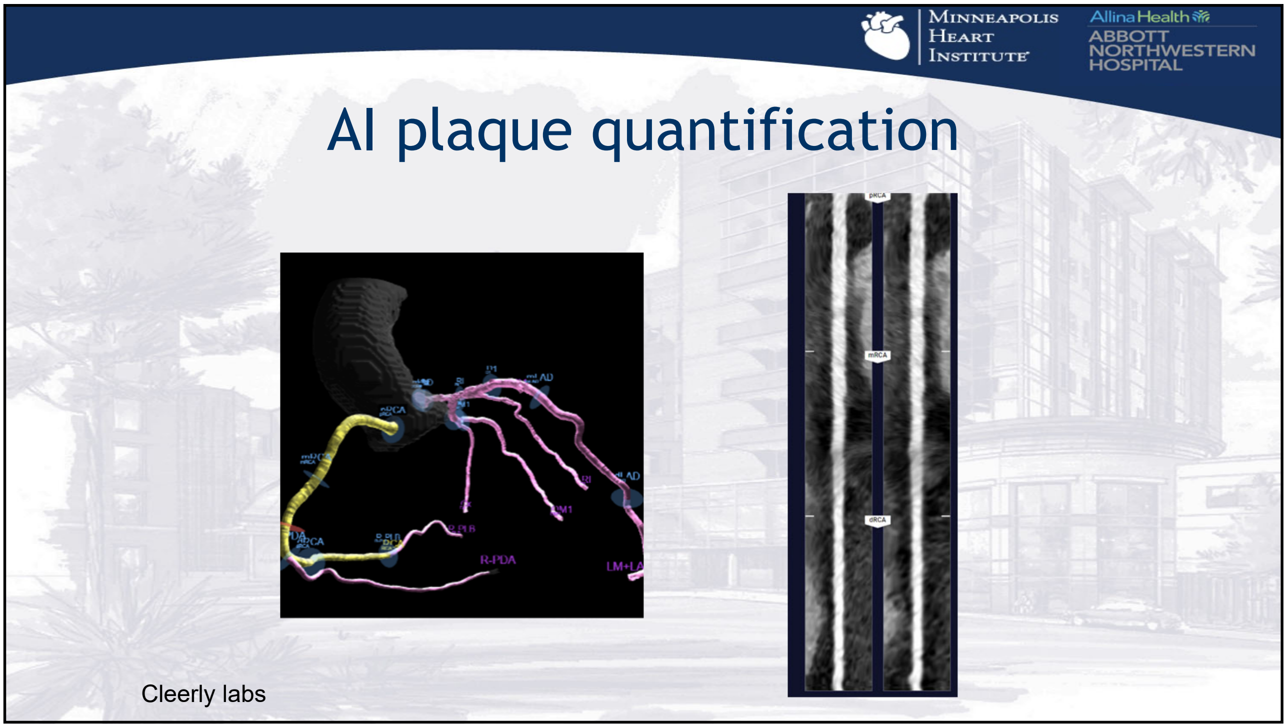

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		NONOBSTRUCTIVE				OBSTRUCTIVE			
		AIQCT determined segments with plaque				AIQCT determined segments with plaque			
		0	1 or 2	3 or 4	>4	0	1 or 2	3 or 4	>4
Reader determined	0	34	52	38	6	0	0	0	0
	1 or 2	2	35	42	21	0	1	2	2
	3 or 4	0	9	30	33	0	1	1	8
	>4	0	1	11	93	0	0	3	78
Reclassification Rate		60/407 (14.74%)				10/96 (10.42%)			

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Italian astronaut Luca Parmitano stands beside his space suit sitting under a medical imaging scanner

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MHI IMAGING!

- John Lesser
- Victor Cheng
- Joao Cavalcante
- Marc Newell
- Michael Miedema
- Thomas Knickelbine
- David Lin
- Erik Schelbert
- Jonathan Urbach

- David Caye
- Jana Lindberg
- Lynn Klitzke
- Tanya Owens
- Deanna Knutsen
- John Rosbolt
- Antonia Sylva
- Tara Schell
- Denise Haupert
- Brad Adamski
- Rachel Copple
- Jenice Wirth

- Kristin Lambrecht
- Miho Fukui
- Hideki Koike

72

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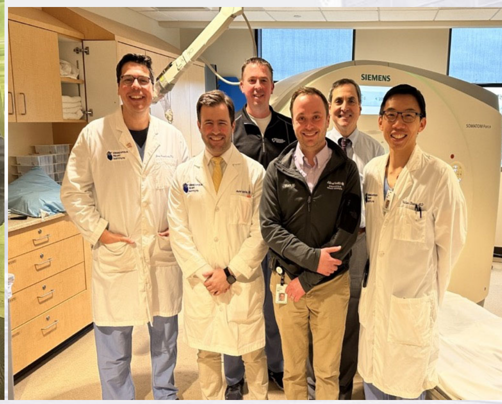

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Merci
Gracias
Thanks

75


PROACTIVE RVAD PLACEMENT IN PATIENTS UNDERGOING LVAD IMPLANTATION LEADS TO IMPROVED SHORT AND LONG TERM SURVIVAL
Ruben Crespo, MDPhD
05/08/2023

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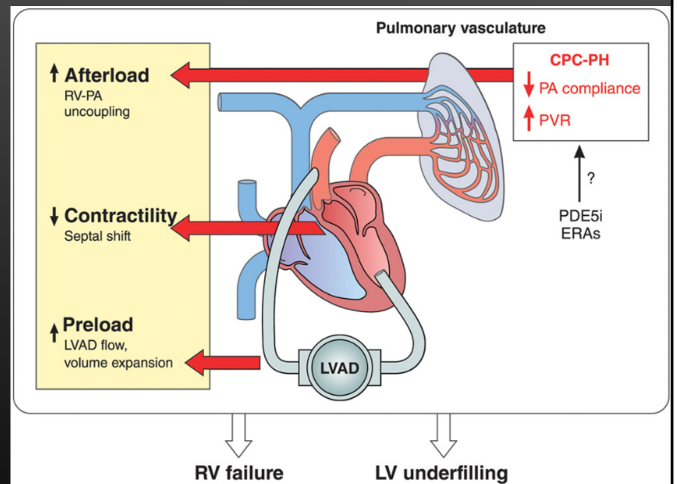
INTRODUCTION

- Right Ventricular failure (RVF) occurs in approximately 20-40% of patients early after LVAD implantation
- In turn RVADs in this setting are required in 5-10% and 15-20% pts will still need inotropic therapies for RV failure following LVAD implantation
- The mechanisms of RV failure are multifaceted (*figure on right*)
- Risk scores and prediction models are unable to mitigate the need for RVAD following LVAD implantation



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INTERMACS (2015)	Definition	**Must meet criteria 1 and 2** **Criteria 1.** Elevated CVP: CVP >16 mmHg **OR** dilated and fixed IVC **OR** JVP at half neck in upright position **Criteria 2.** Symptoms: peripheral edema ≥2+ **OR** ascites **OR** hepatomegaly **OR** bilirrubin >2 mg/dl **OR** creatinine > 2 mg/dl						
	Severity	Mild		Moderate		Severe		Severe-acute
		Implant	Follow-up	Implant	Follow-up	Implant	Follow-up	Implant
		Inotropes, iNO or IV vasodilators <7 days	No readmissions **AND** no inotropes	Inotropes, iNO or IV vasodilators 7-14 days	1 readmission for IV diuretics or vasodilators **AND** no inotropes	Inotropes, iNO or IV vasodilators >14 days **AND** CVP >16 mmHg	Use of inotropes **OR** RVAD **OR** ≥2 readmissions for IV diuretics or vasodilators **OR** death due to RVF	CVP >16 mmHg **AND** RVAD use **OR** death due to RVF
MCS-ARC INTERMACS (2021)	Definition	**At least 2**: peripheral edema ≥2+ **OR** ascites **OR** JVP at half neck in upright position **OR** CVP >16 mmHg **OR at least 1:** bilirrubin >2 mg/dl **OR** AST/ALT x2 ULN **OR** creatinine x2 baseline **OR** Svo2 <50% **OR** CI <2.2 l/min/m2 **OR** lactate >3 mmol/l **OR** drop >30% in pump flow						
	Timing	Early acute		Early		Late		
		Need for temporary or durable RVAD (or ECMO) implanted in the operating room		1) Need for RVAD within 30 days 2) Failure to wean from inotropes, vasopressors or iNO for >14 days during the initial 30 days 3) Death within 14 days while on inotropes or pressors in patients who have not received RVAD		1) Need for RVAD 30 days after LVAD implant 2) Admission at least 30 days after LVAD implant requiring IV diuretics or inotropes for >72h		

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Non-RV centered parameters
Cardiac
LVEDD < 60 mm, diffuse fibrosis
NICM: restrictive, hypertrophic, ARVC, chemo-related
Atrial fibrillation and history of VT
Non-cardiac
Female sex, BSA <1.5 m2?
BMI >30 or <18.5 kg/m2
Prealbumin <17, NRI <83.5 or PNI <30
Severity
ECMO, RRT or IMV at time of implant
INTERMACS 1/2 worse than 3; 3 worse than 4
Prolonged inotropic support (>30 days)
End-organ function
Lungs: VE/VCO2 slope >36, DLCO <80% predicted
Kidneys: eGFR <30 ml/min/1.73m2, proteinuria, high NGAL
Liver: MELD-XI >12 (or >17), high INR, high FibroScan score
Biomarkers
Labs: high BNP, WBC or neutrophile / lymphocyte ratio
High matrix turnover: osteopontin >260 ng/ml
Inflammation: ET1, IL-6, PCT, neopterin, CCR3, 4, 6, 7
Transthoracic echocardiography
RV diastolic dysfunction
Tricuspid E/e' >10
Decreased RA peak strain
(no clear cutoff)
RV systolic dysfunction
TAPSE <8 mm
RV s' < 5 cm/s
FAC < 25%
Diastolic R/L ratio >0.75
Sphericity index >0.6
RVFWLS < |5|% or <|15|%
RV to PA coupling
Load adaptation index < 14
PSSrL x mean ΔRV-PA <24
Pulmonary artery catheterization
High afterload
DTPG >7 mmHg
Indexed PA compliance < 0.89 ml/mmHg/m2
PA elastance >1.16 mmHg/ml
RV Ees / PA Ea <0.8 (?)
Poor systolic and diastolic function
RVSWI < 350 mmHg·ml/m2 (<5 g*m/m2)
PAPI <1.85
Prolonged RV diastolic plateau
Y descent deeper than X (in RA waveform)
High preload
CVP >10 mmHg
CVP/PCWP > 0.63
MAP/CVP <7.5
Poor RV reserve
PAPI <3.3 or ΔPAPI <2 after optimization
No normalization of CVP after optimization
Unchanged CVP, CVP/PCWP or PAPI on pVAD
No increase in iSV with nitroprusside

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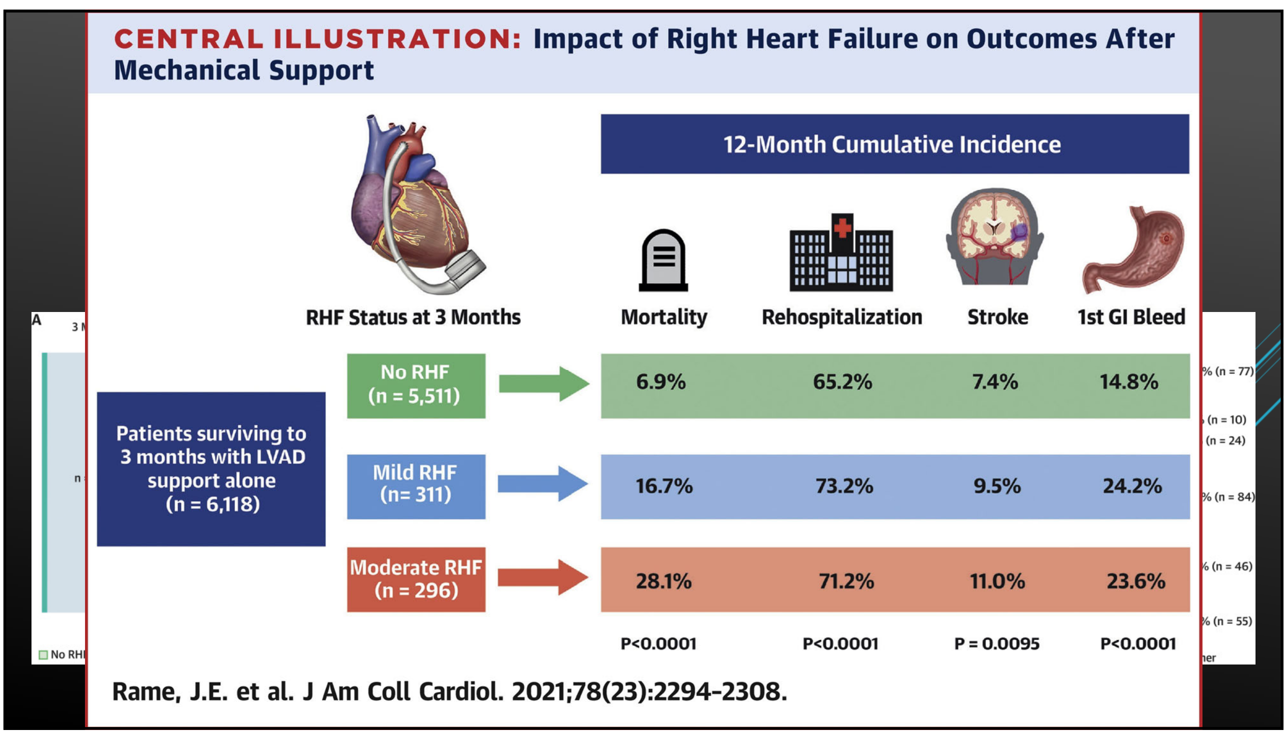
CENTRAL ILLUSTRATION: Impact of Right Heart Failure on Outcomes After Mechanical Support
12-Month Cumulative Incidence
RHF Status at 3 Months
Mortality
Rehospitalization
Stroke
1st GI Bleed
Patients surviving to 3 months with LVAD support alone (n = 6,118)
No RHF (n = 5,511)
6.9%
65.2%
7.4%
14.8%
Mild RHF (n= 311)
16.7%
73.2%
9.5%
24.2%
Moderate RHF (n = 296)
28.1%
71.2%
11.0%
23.6%
P<0.0001
P<0.0001
P = 0.0095
P<0.0001
Rame, J.E. et al. J Am Coll Cardiol. 2021;78(23):2294-2308.

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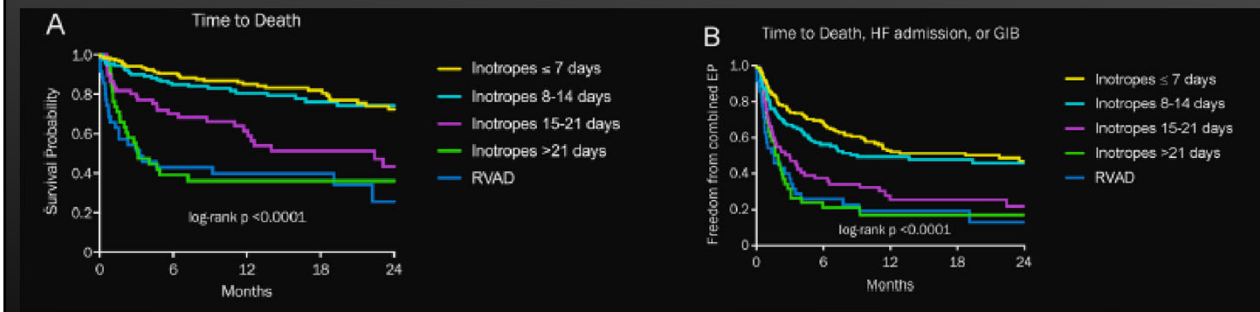
CLINICAL OUTCOMES ASSOCIATED WITH INTERMACS-DEFINED RIGHT HEART FAILURE AFTER LEFT VENTRICULAR ASSIST DEVICE IMPLANTATION



Larue JHLT 2017

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2019 EACTS Expert Consensus on long-term mechanical circulatory support

Evgenij V. Potapov[a,*,†] (EACTS Chairperson), Christiaan Antonides[b,†], Maria G. Crespo-Leiro[c], Alain Combes[d,e], Gloria Färber[f], Margaret M. Hannan[g], Marian Kukucka[h], Nicolaas de Jonge[i], Antonio Loforte[j], Lars H. Lund[k], Paul Mohacsi[l], Michiel Morshuis[m], Ivan Netuka[n], Mustafa Özbaran[o], Federico Pappalardo[p], Anna Mara Scandroglio[q], Martin Schweiger[r], Steven Tsui[s], Daniel Zimpfer[t] and Finn Gustafsson[u,*] (EACTS Chairperson), The Task Force on Long-Term Mechanical Circulatory Support of the EACTS

Recommendation	Class	Level	References
For predicting right heart failure, the use of clinical, haemody-namic, echocardiographic and biochemical parameters should be considered.	IIa	C	[170–174]
In patients with refractory right heart failure after implantation of an LVAD, early implantation of a temporary RVAD should be considered.	IIa	C	[147, 168, 169, 171, 179]
Early RVAD implantation in case of right heart failure to decrease morbidity and mortality should be considered.	IIa	C	[147, 168, 169, 171, 179, 186]

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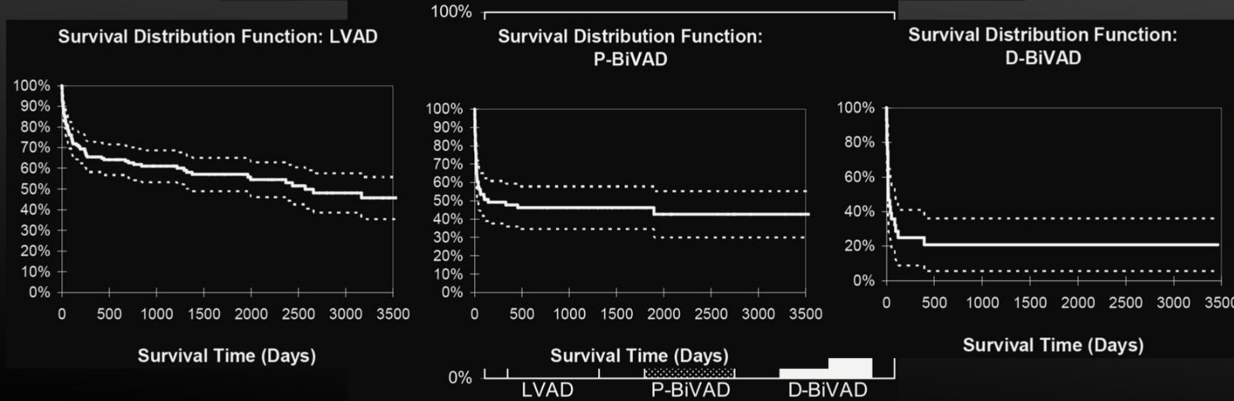
Early, Planned Institution of Biventricular Mechanical Circulatory Support Results in Improved Outcomes Compared to Delayed Conversion of LVAD to BiVAD

J. Raymond Fitzpatrick III, M.D., John R. Frederick, M.D., William Hiesinger, M.D., Vivian M. Hsu, M.D., Ryan C. McCormick, B.S., Elliott D. Kozin, B.A., Carine M. Laporte, B.A., Mary Lou O'Hara, M.S.N., Elan Howell, B.S.N., Deborah Dougherty, B.S.N., Jeffrey E. Cohen, B.A., Kevin W. Southerland, B.S., Jessica L. Howard, B.S., E. Carter Paulson, M.D., M.S.C.E., Michael A. Acker, M.D., Rohinton J. Morris, M.D., and Y. Joseph Woo, M.D.
Division of Cardiovascular Surgery, Department of Surgery, University of Pennsylvania, Philadelphia, PA 19104.



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Outcome of unplanned right ventricular assist device support for severe right heart failure after implantable left ventricular assist device insertion

The Journal of Heart and Lung Transplantation
http://www.jhltonline.org

Koji Takeda, MD, PhD,[a] Yoshifumi Naka, MD, PhD,[a] Jonathan A. Yang, MD, MPH,[a]
Nir Uriel, MD,[b] Paolo C. Colombo, MD,[b] Ulrich P. Jorde, MD,[b] and Hiroo Takayama, MD, PhD[a]

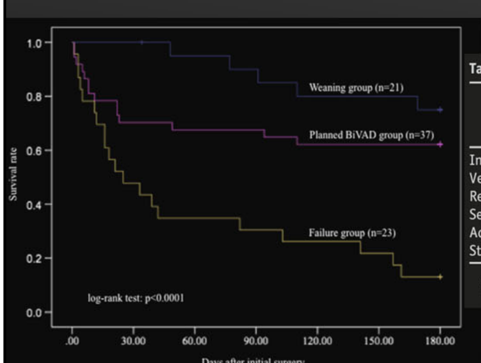

Table 4 In-hospital Mortality and Morbidity

	Unplanned RVAD ($N = 44$)			
	Weaning group ($n = 21$)	Failure group ($n = 23$)	Planned BiVAD ($N = 37$)	*p*-value[b]
In-hospital mortality, *n* (%)	5 (24)	17 (74)[a]	11 (30)	0.0009
Ventricular arrhythmia, *n* (%)	9 (43)	7 (30)	3 (8.1)	0.0047
Reoperation for bleeding, *n* (%)	13 (62)	14 (61)	16 (43)	0.16
Sepsis, *n* (%)	6 (29)	6 (26)	6 (16)	0.39
Acute renal failure requiring dialysis, *n* (%)	9 (43)	17 (74)[a]	17 (46)	0.033
Stroke, *n* (%)	3 (14)	5 (22)	4 (11)	0.46

[a]$p < 0.05$ vs weaning group.
[b]*p*-value for differences between the 3 subgroups.

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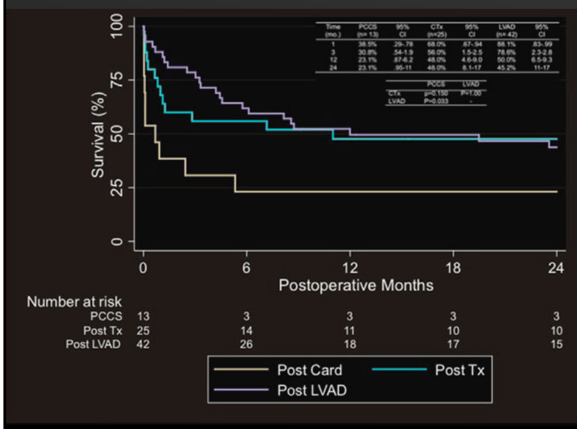
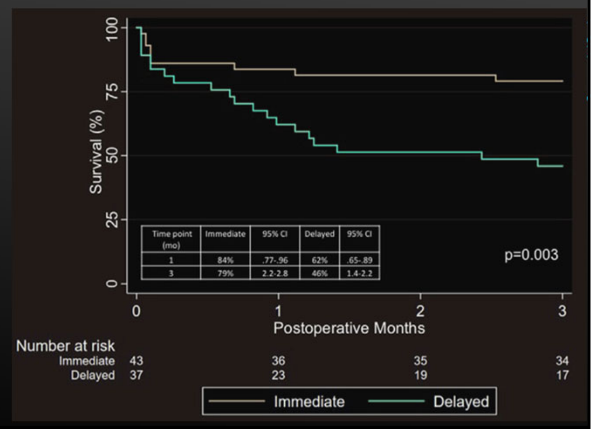
Clinical experience with temporary right ventricular mechanical circulatory support

Jay K. Bhama, MD,[a] Utsav Bansal, BS,[b] Daniel G. Winger, MS,[c] Jeffrey J. Teuteberg, MD,[d] Christian Bermudez, MD,[e] Robert L. Kormos, MD,[d] and Aditya Bansal, MD[f]





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Inhaled nitric oxide after left ventricular assist device implantation: A prospective, randomized, double-blind, multicenter, placebo-controlled trial

105 patients randomized to receive 40ppm NO vs placebo at time of weaning from bypass

Use of iNO at 40 ppm given before separation from CPB did not reach statistical significance for the primary end point of reduction in RVD incidence. No statistically significant difference was found for secondary variables, including time on mechanical ventilation, ICU or hospital stay, and the need for RVAD after LVAD placement.

Table 5 Primary and Secondary Outcome Measures in the Intent-to-Treat Population

Outcome Measure	iNO	Placebo	*p*-value
Patients meeting RVD criteria ≤48 hours			0.330
No. of total (%)	7/73 (9.6)	12/77 (15.6)	
95% CI	2.8–16.3	7.5–23.7	
Males, No. (%)	7/64 (10.9)	7/65 (10.8)	>0.99
Females, No. (%)	0/9 (0.0)	5/12 (41.7)	0.045
PVRI <270.5 dyne/sec/cm^{-5}	6/51 (11.8)	6/48 (12.5)	>0.99
PVRI ≥270.5 dyne/sec/cm^{-5}	1/7 (14.3)	5/7 (71.4)	0.103
Days on mechanical ventilation[a]	70	67	0.077
Mean (SD)	5.37 (7.72)	11.10 (24.81)	
Median (range)	2.0 (1–30)	3.0 (0–160)	
No. of ICU days[b]	60	58	0.630
Mean (SD)	20.52 (32.31)	19.90 (24.38)	
Median (range)	11.0 (3–194)	9.0 (3–115)	
No. of total hospital days[c]	58	58	0.979
Mean (SD)	40.57 (32.19)	40.76 (29.41)	
Median (range)	32.0 (11–194)	31.5 (10–156)	
Quantity of blood products used	73	77	
Mean, ml (SD)	4,232 (4675)	4,885 (7760)	0.226
Patients requiring RRT, No. (%)[d]	10/71 (14.1)	8/70 (11.4)	0.637
Non-survival at Day 28, No. (%)	8/71 (11.3)	8/70 (11.4)	0.924
Patients needing RVAD by Day 28, No. (%)	4/71 (5.6)	7/70 (10.0)	0.468

J Heart Lung Transplant 2011;30:870–8

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OUR CENTER DATA

- Retrospectively evaluated 75 adult patients underwent LVAD and temporary RVAD insertion
- RVAD was either a planned procedure during LVAD surgery or a bailout strategy after LVAD placement (patient left the OR)
- Evaluated several factors such as: presence of temporary mechanical support (MCS) prior to LVAD insertion, echocardiography-based RV function and invasive hemodynamic data
- Patient demographics and clinical characteristics were compared along with 3-month, 6-month and 1-year survival.

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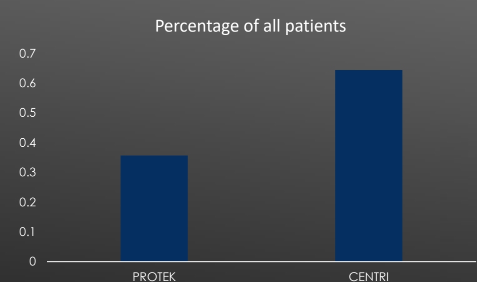
Characteristic	Bailout (n=35)	Planned (n=40)	p
Age, (years)	57.5 ± 21.2	59.8 ± 19.4	0.67
Male, (%)	67.7	75	0.50
Female,(%)	32.3	25	
BMI, (kg/m^2)	31.0 ± 9.46	30.4 ± 10.6	0.34
CKD, (%)	58.9	52.5	0.44
DM, (%)	32.4	42.5	0.37
CAD, (%)	61.8	70.0	0.46
INTERMACS, (%)			0.02*
1-2	64.7	90.0	
3-5	32.4	10	
6-7	2.94	0	
Pre-LVAD MCS, (%)	58.2	80.0	0.047*
ICM, (%)	38.2	40.0	0.37
NICM, (%)	52.9	42.5	
Mixed, (%)	8.82	17.5	
LVEF, (%)	18.1 ± 8.7	14.4 ± 8.7	0.03*
LVIDd, (cm)	6.90 ± 1.17	6.29 ± 1.47	0.13
Visual RV function, (%)			0.007*
Normal	34.4	10.3	
Mildly reduced	40.6	23.1	
Moderately reduced	18.8	33.3	
Severely reduced	6.20	33.3	
TAPSE, (cm)	1.52 ± 0.58	1.44 ± 0.67	0.38
PAPi score	1.29 ± 1.46	1.7 ± 1.32	0.68
RVAD duration, (days)	10.0 ± 9.50	10.0 ± 10.0	0.72
Days of intubation	19.8 ± 16.2	16.8 ± 14.4	0.53
ICU stay, (days)	28.4 ± 17.1	25.5 ± 12.5	0.69



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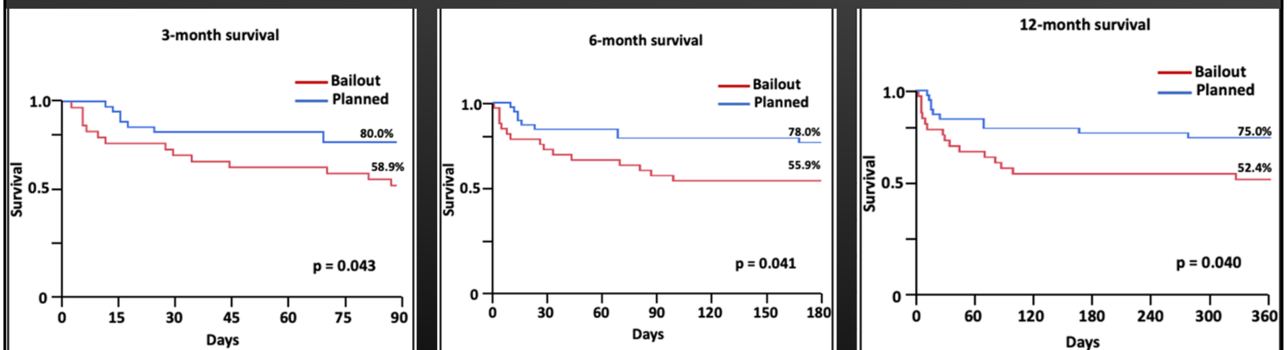
OUTCOMES



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RESULTS

- Baseline characteristics were not significantly different between bailout versus planned RVAD strategy
- Patients with a planned RVAD had lower INTERMACS score and a higher proportion of temporary MCS preoperatively
- Although the Tricuspid Annular Plane Systolic Excursion (TAPSE), there was an increased percentage of patients with visually moderate to severe RV dysfunction in the planned RVAD group
- Invasive hemodynamic comparison between the groups were not statistically significant
- Length of RVAD duration, Intensive Care Unit (ICU) stay and intubation time were also not different
- Survival was greater at 3-month, 6-month and 12-months when RVAD placement was planned instead of bailout (right panel).

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Percutaneous RVAD to Preemptively Treat Right Heart Failure Post-LVAD

Protocol 2020P000422 / NCT04458103

MGH 1811 MASSACHUSETTS GENERAL HOSPITAL

III. SPECIFIC AIMS

The purpose of this study is to compare clinical outcomes of standard of care treatment versus preemptive percutaneous right ventricular assist device (RVAD) placement surrounding left ventricular assist device (LVAD) implantation. We hypothesize that the use of the RVAD will mitigate need for inotropic support, reducing the vasoactive-inotrope score (VIS) by 50%, and will improve end organ function in patients compared to standard of care.

IV. SUBJECT SELECTION

This trial will include both a prospective interventional cohort and a retrospective control cohort. The prospective interventional cohort will consist of patients undergoing LVAD implantation at Massachusetts General Hospital. These patients will receive an RVAD (either the ProtekDuo or Impella RP) prior to or during LVAD implantation. The historical control cohort will consist of retrospective data collection on patients who have undergone LVAD implantation in the past. This group will be age and sex matched with the enrolled prospective interventional patients.

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THANK YOU

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