





1



MINNEAPOLIS  
HEART  
INSTITUTE



ABBOTT  
NORTHWESTERN  
HOSPITAL

## Cardiology Grand Rounds

### *Valvular Heart Disease in Resource-Limited Settings*

Owais Shakir Abdul-Kafi, MD  
Structural & Adult Congenital Interventional Cardiology Fellow, '24-25  
Minneapolis Heart Institute at Abbott Northwestern Hospital

2

## Disclosures

- None
- Patient information & images used with permission

3



3

## Objectives

- Review unique aspects of invasive cardiovascular care delivery in resource-limited settings
- Describe challenges for the diagnosis and management of cardiovascular and valvular heart disease in resource-limited settings
- Understand basic anatomy and technique including complications for percutaneous balloon mitral valvuloplasty

4

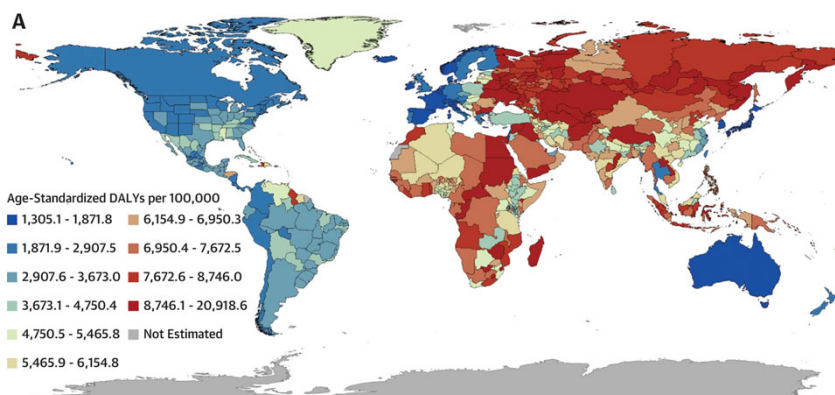


4

## Introduction

- Lower and Middle-Income countries bear 80% of cardiovascular disease burden
- smoking, smoke/particulate exposure, climate change, access to medications for chronic conditions, dietary contributions
- Less diagnostic equipment

### CENTRAL ILLUSTRATION: Global Burden of Cardiovascular Diseases and Risks



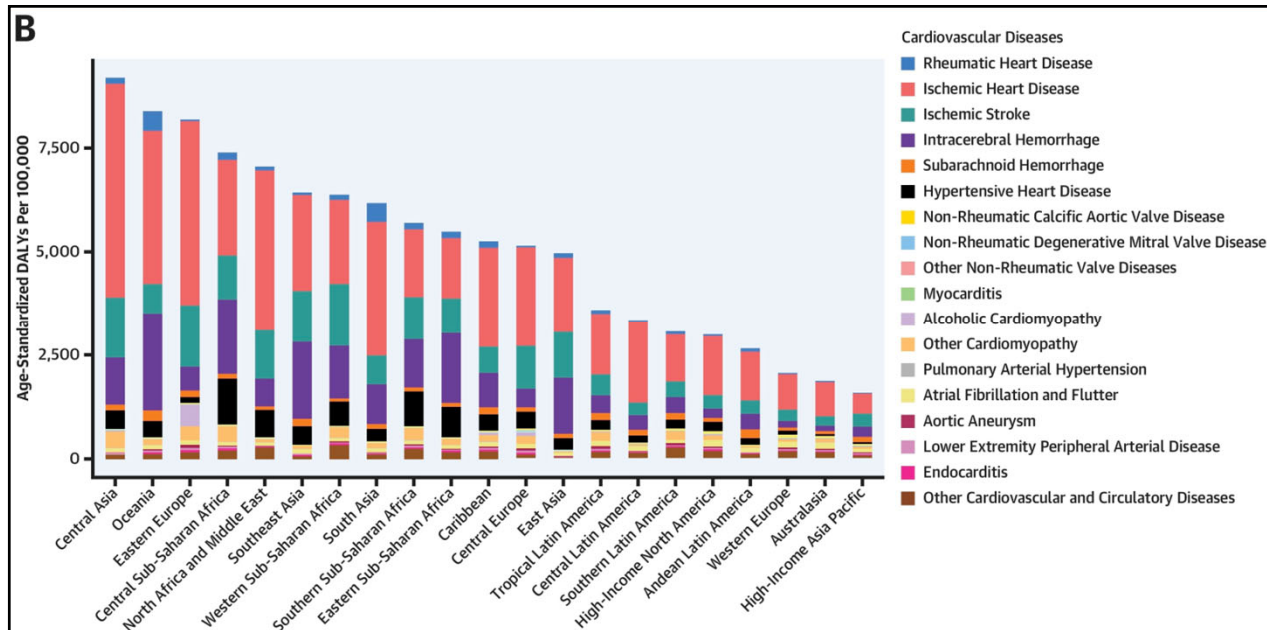
Vaduganathan, M, *et al.* JACC. 2022 Dec, 80 (25) 2361–2371



MINNEAPOLIS  
HEART  
INSTITUTE

AlinaHealth  
ABBOTT  
NORTHWESTERN  
HOSPITAL

5



Vaduganathan, M, *et al.* JACC. 2022 Dec, 80 (25) 2361–2371



MINNEAPOLIS  
HEART  
INSTITUTE

AlinaHealth  
ABBOTT  
NORTHWESTERN  
HOSPITAL

6

## Cardiac Catheterization Laboratory

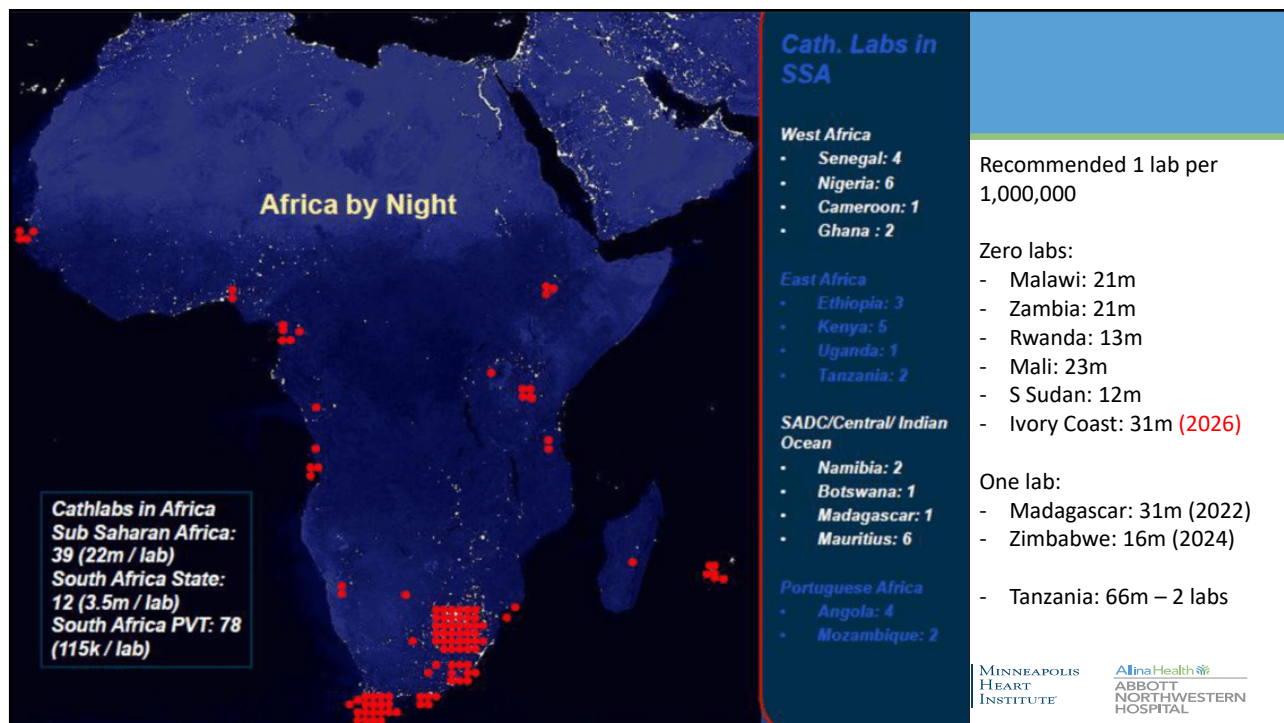
- Central role in workup, diagnosis, management of cardiovascular disease for CAD, valvular heart disease, cardiomyopathies, congenital heart disease, peripheral vascular disease
- Critical shortage of labs in many parts of world.
- Wide variety of outcomes:
  - 59% of South Africa STEMI pts received PCI, 13% in Kenya
  - Median distance to PCI capable center: 123 km
- Cath labs are expensive, and maintenance, consumable supplies are expensive
- Local expertise limited, some centers relay on supplies & expertise brought by treatment camps.



MINNEAPOLIS  
HEART  
INSTITUTE

AlinaHealth  
ABBOTT  
NORTHWESTERN  
HOSPITAL

7



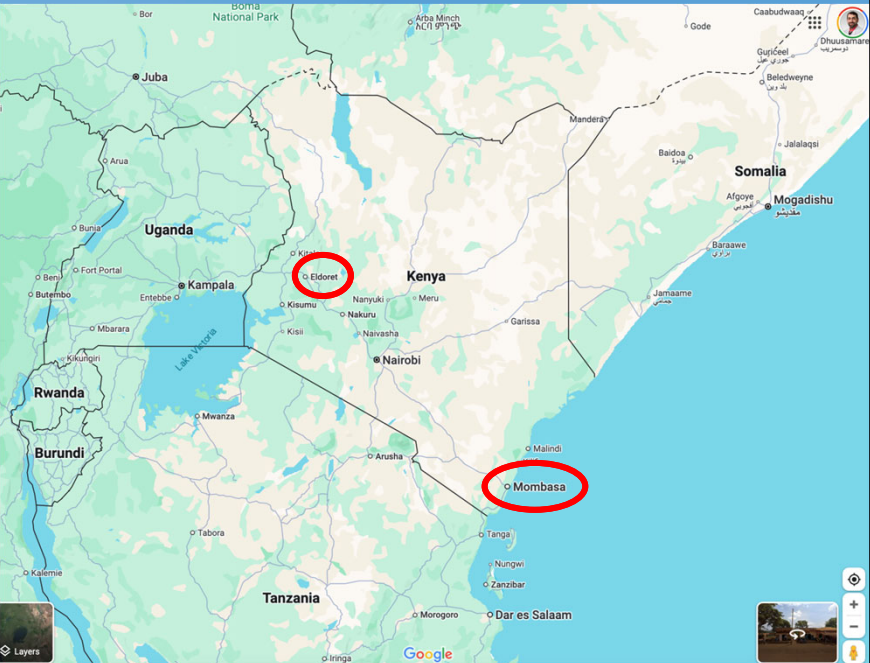
8



## Kenya, Dec 2024

- CGTRH – Mombassa
- MTRH – Eldoret

Ron Johannsen  
Micaela Iantorno  
Ross Goodfellow  
Eileen Nemec  
Nancy Martin  
Constantine Akwanalo  
Kieran Mwazo



A map of Kenya and surrounding regions (Uganda, Rwanda, Burundi, Tanzania, Somalia) with Eldoret and Mombassa circled in red. The map shows major cities, roads, and geographical features like Lake Victoria. Eldoret is located in the central-north part of Kenya, and Mombassa is on the coast in the southeast.

9



10



11



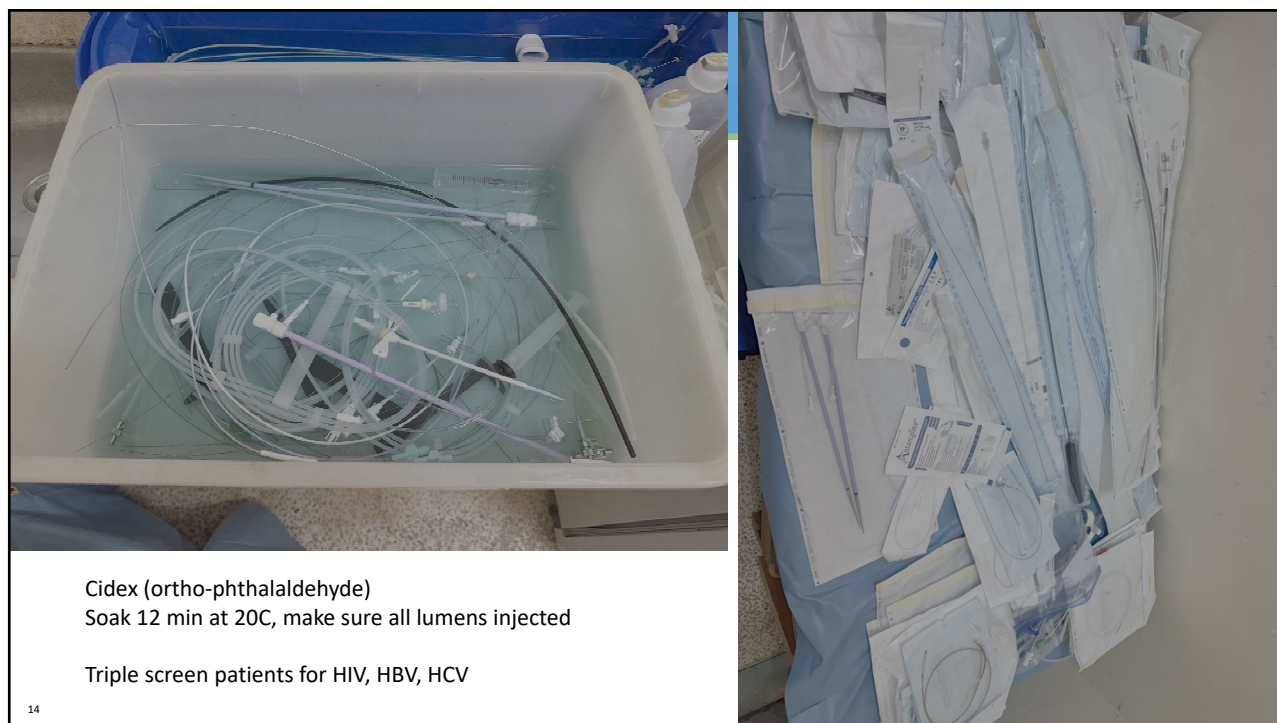
12





13

13



Cidex (ortho-phthalaldehyde)  
Soak 12 min at 20C, make sure all lumens injected

Triple screen patients for HIV, HBV, HCV

14

14

## Rheumatic Heart Disease

- Most common acquired heart disease in children and young adults (<25) in world
  - 360,000 deaths per year
  - 50-80 million people living with RHD
  - 15-20% of heart failure in endemic countries
  - 3.4/100k cases in nonendemic countries, 444/100k in endemic countries
- Leading cause of maternal cardiac complications / death during pregnancy
- Predominantly affects those living in poverty with inadequate access to healthcare.
- Usually diagnosed late after significant lesions develop.

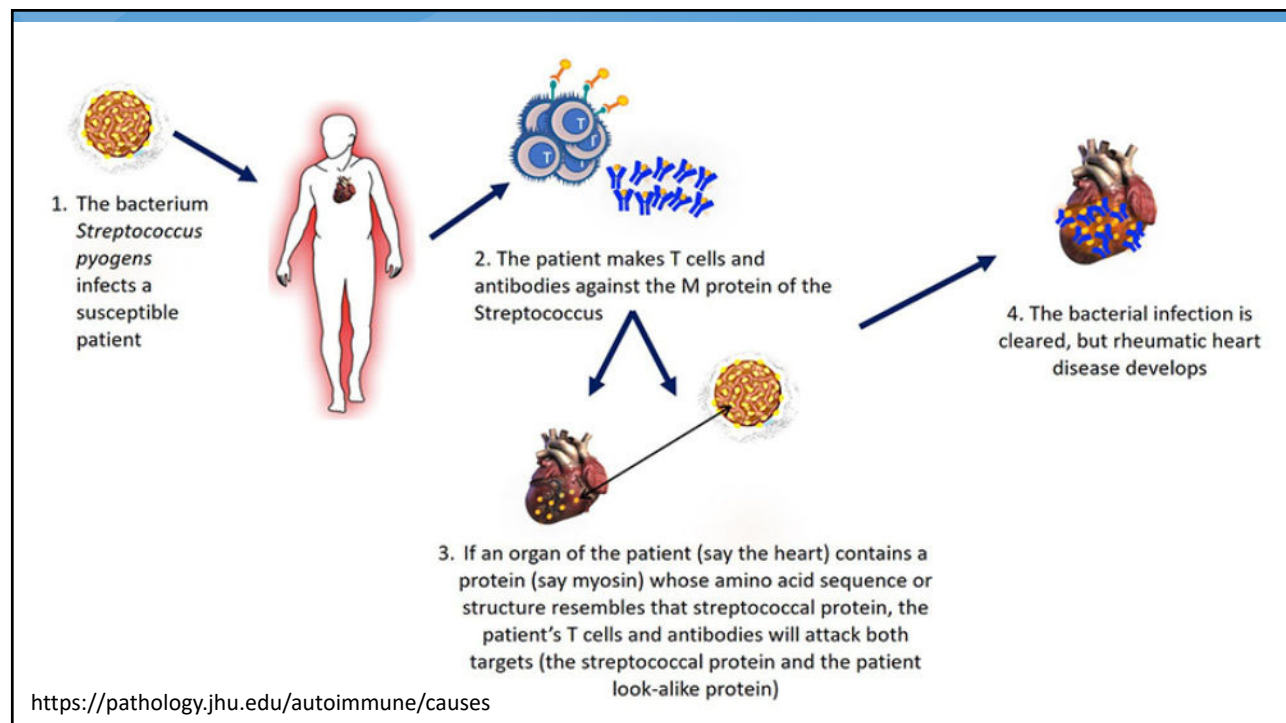
15



MINNEAPOLIS  
HEART  
INSTITUTE

AlinaHealth  
ABBOTT  
NORTHWESTERN  
HOSPITAL

15



16

## RHD Phases

- **Acute Rheumatic Fever**: 2 major or 1 major + 2 minor criteria:
  - Major**: Carditis (MR/AR murmur), Polyarthritits (large joints, migratory), Chorea (diagnostic, but delayed), erythema marginatum, subcutaneous nodules
  - Minor**: arthralgias, fever, acute phase reactants (CRP, ESR), prolonged PRAdditionally: +strep throat culture, +rapid strep, + strep antibody titer
- Most common initial cardiac manifestation is MR
- Repeat attacks or untreated can lead to **Rheumatic Heart Disease**, MS

17

17



18

18

## Rheumatic Mitral Stenosis

- If left untreated:
  - Heart Failure
  - Pulmonary Hypertension
  - Afib → LA thrombus → stroke
- Vast majority of world's young people who need valve replacement or ballooning for RHD do not receive it and die young in 20's – 30's.
- Pregnancy can unmask undiagnosed MS due to increased blood volume
  - Most commonly 2<sup>nd</sup> trimester
  - PBMV indicated if severe MS to improve symptoms, reduce maternal/fetal mortality

19



19

## Rheumatic Fever Treatment

- Limit Activity
- Penicillin
  - 10 days for acute rheumatic fever
  - IM benzathine PCN G q28 days for secondary prophylaxis
- NSAIDS for arthritis
- Steroids maybe for chorea
- How long to treat for secondary prophylaxis?
  - RF with/without carditis but no valve damage → 10 yrs or till age 21
  - RF with residual valve damage → till 40

20



20



## MS Classification

- European Guidelines

Mild:  $MVA > 1.5 \text{ cm}^2$ ,  **$MG < 5 \text{ mmHg}$** ,  $PASP < 30 \text{ mmHg}$

Moderate:  $MVA 1.0 - 1.5 \text{ cm}^2$ ,  $MG 5 - 10 \text{ mmHg}$ ,  $PASP 30 - 50 \text{ mmHg}$

Severe:  $MVA < 1.0 \text{ cm}^2$ ,  **$MG > 10 \text{ mmHg}$** ,  $PASP > 50 \text{ mmHg}$

- AHA

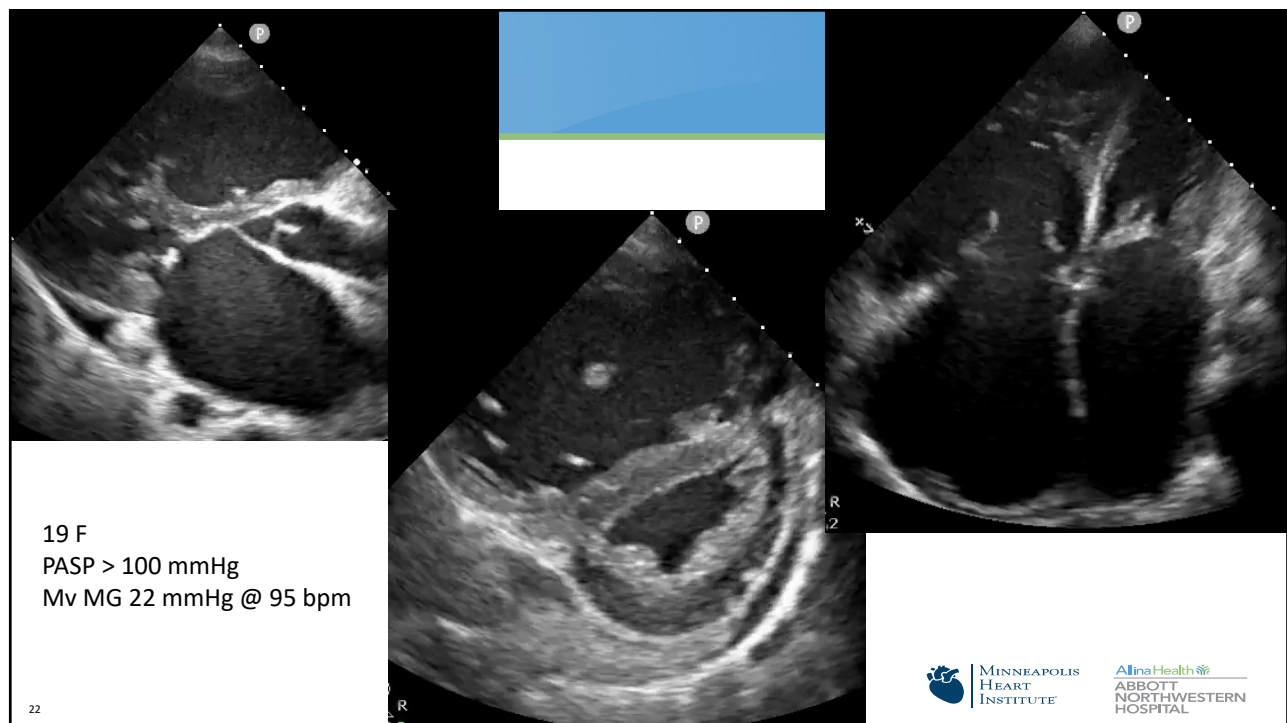
Progressive:  $MVA > 1.5 \text{ cm}^2$ , diastolic PHT  $< 150 \text{ msec}$

Severe MS:  **$MVA \leq 1.5 \text{ cm}^2$** , diastolic PHT  $\geq 150 \text{ msec}$

Very severe MS:  $MVA \leq 1.0 \text{ cm}^2$ , diastolic PHT  $\geq 220 \text{ msec}$

21

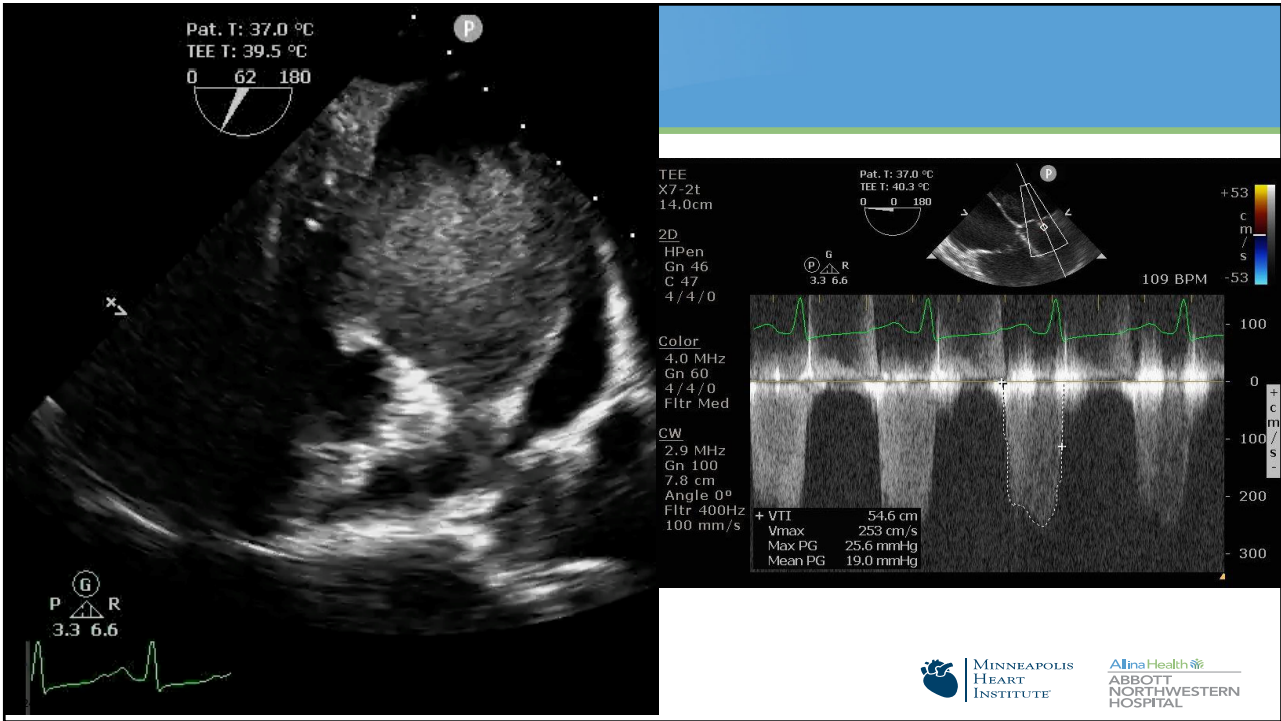
21



22



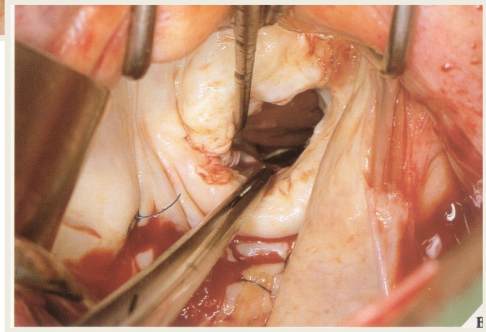
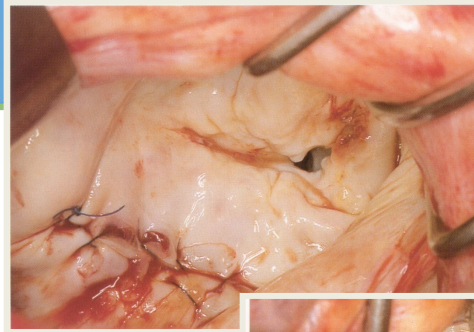
23



24

## Treatment of MS-RHD

- Closed Commissurotomy
- Open Commissurotomy
- Percutaneous Balloon Mitral Valvuloplasty



## Indications for MV Commissurotomy / Valvuloplasty

- **Symptomatic MS:** NYHA II-IV, typically MVA < 1.5 cm<sup>2</sup>
- **Pulmonary Hypertension:** PASP > 50 mmHg at rest
- **Atrial fibrillation**
- PBMV preferred in patients at high risk for surgery, or to delay surgery to future.

Very long term follow up: >1500 pts, mean **15.6 yrs follow-up**  
**overall mortality 0.6%, need for MV surgery 8%, repeat PBMV 10%**  
79.1% without need for repeat intervention, NYHA I-II symptoms  
predictors of acute success: LA size, Wilkin score ≤ 8, age  
predictors of primary endpoint: NYHA III/IV, age, MVA < 1.75 cm<sup>2</sup>

## Contraindications to PBMV (and Commissurotomy)

- **Severe MR**
- **MVA > 1.5 cm<sup>2</sup>**
- **Extensive valve calcification**
- **LA , LAA thrombus**
- **Active endocarditis**
- **Severe fixed pulmonary hypertension**
- **Congenital valve abnormalities:** parachute mitral valve
- **Unfavorable anatomy:** PBMV best in pliable, noncalcified valves, noncalcified subvalvular apparatus. Avoid chordal thickening or fusion, severe MAC.

27



MINNEAPOLIS  
HEART  
INSTITUTE

AlinaHealth  
ABBOTT  
NORTHWESTERN  
HOSPITAL

27

## Wilkin Score

Grade	Mobility	Thickening	Calcification	Subvalvular Thickening
1	Highly mobile valve with only leaflet tips restricted	Leaflets near normal in thickness (4-5 mm)	A single area of increased echo brightness	Minimal thickening just below the mitral leaflets
2	Leaflet mid and base portions have normal mobility	Midleaflets normal, considerable thickening of margins (5-8 mm)	Scattered areas of brightness confined to leaflet margins	Thickening of chordal structures extending to one-third of the chordal length
3	Valve continues to move forward in diastole, mainly from the base	Thickening extending through the entire leaflet (5-8mm)	Brightness extending into the mid-portions of the leaflets	Thickening extended to distal third of the chords
4	No or minimal forward movement of the leaflets in diastole	Considerable thickening of all leaflet tissue (>8-10mm)	Extensive brightness throughout much of the leaflet tissue	Extensive thickening and shortening of all chordal structures extending down to the papillary muscles

• The total score is the sum of the four items and ranges between 4 and 16.

28

MR 2+ or less, evaluate commissures in PSSA view

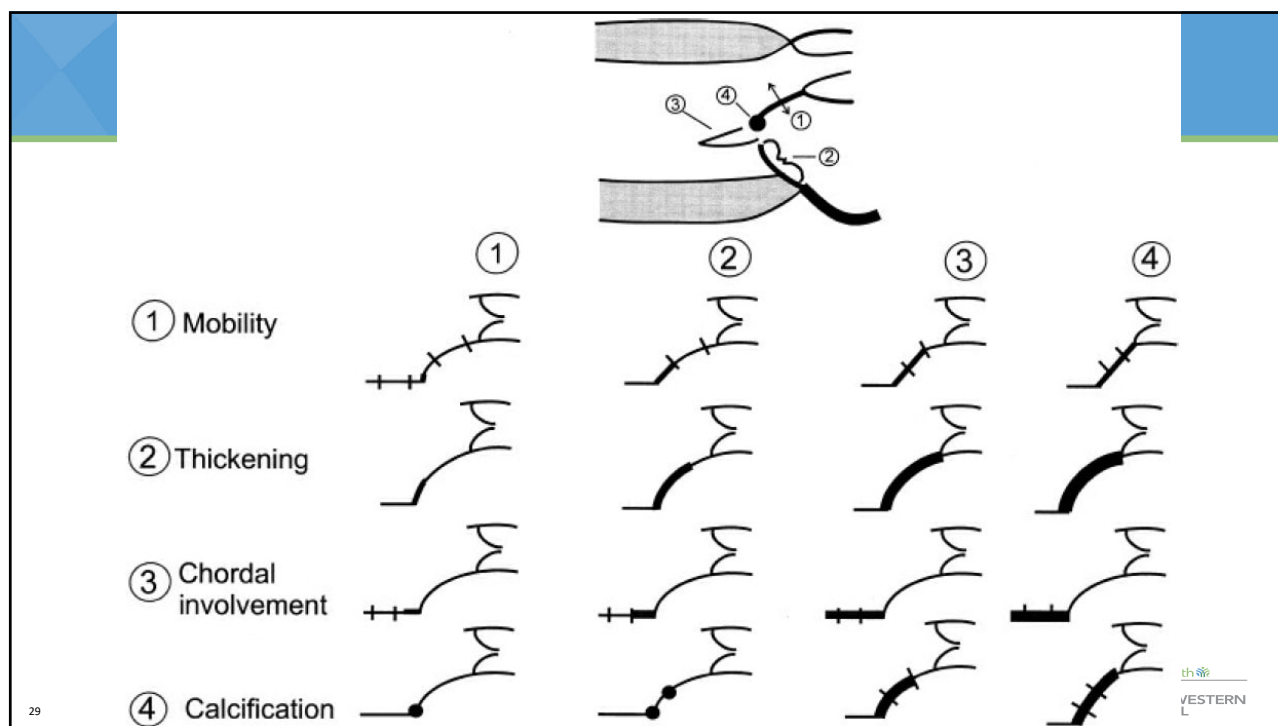


MINNEAPOLIS  
HEART  
INSTITUTE

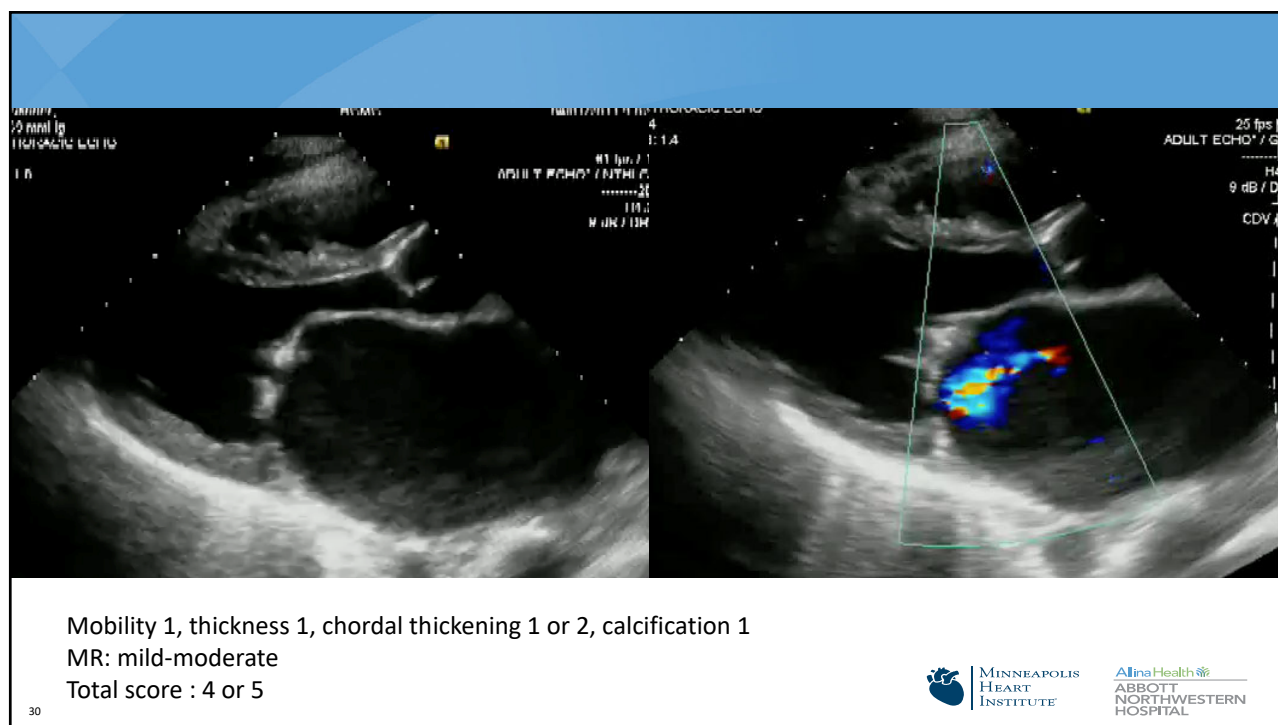
ABBOTT  
NORTHWESTERN  
HOSPITAL

28





29



30

## PBMV Procedure

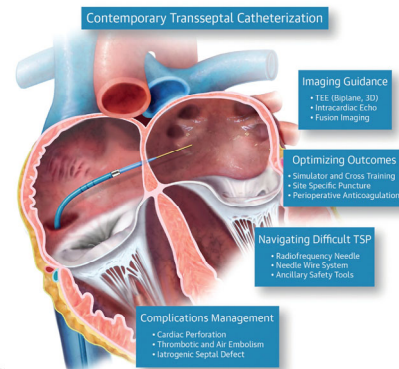
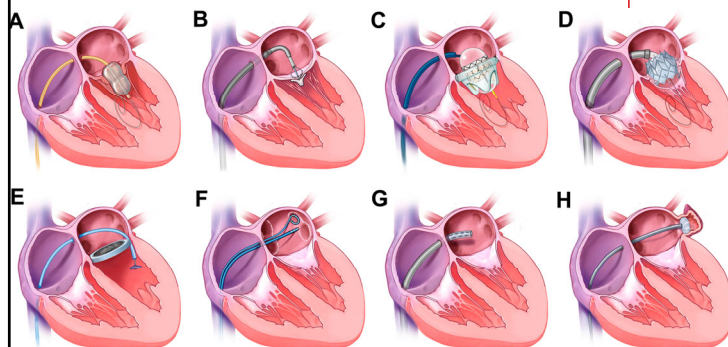
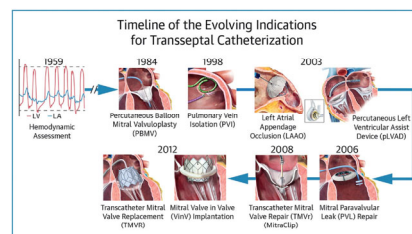
- Femoral Vein Access
- Systemic Anticoagulation
- Trans-Septal Puncture
- Possible septostomy
- Crossing Mitral Valve
- Balloon Dilation
- Re-assessment
- Closure

32

32

## Trans-Septal Puncture

### CENTRAL ILLUSTRATION: Evolving Indications and Contemporary Techniques of Transseptal Catheterization



33

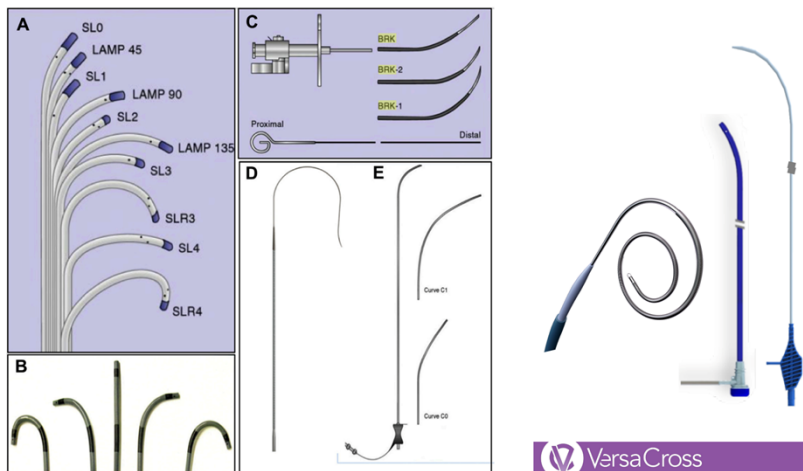
Alkhouli, M. et al. J Am Coll Cardiol Interv. 2016;9(24):2465-80.

33



## Tools for TSP

- Sheath
  - Fixed-curve (A)
  - Steerable (B)
- Trans-Septal Needle
  - BRK (C)
  - NRG RF (Baylis - E)
- SafeSept wire (D)
- VersaCross



*J Am Coll Cardiol Interv* 2016;9:2465–80.



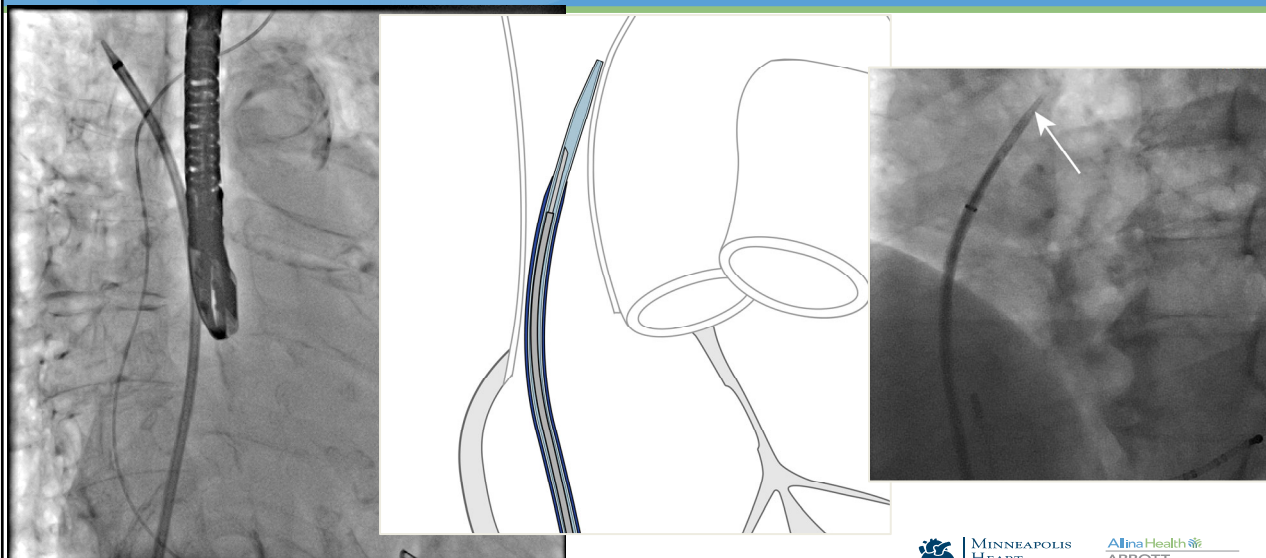
MINNEAPOLIS  
HEART  
INSTITUTE

AlinaHealth  
ABBOTT  
NORTHWESTERN  
HOSPITAL

34

34

## Wire & Sheath into SVC



35

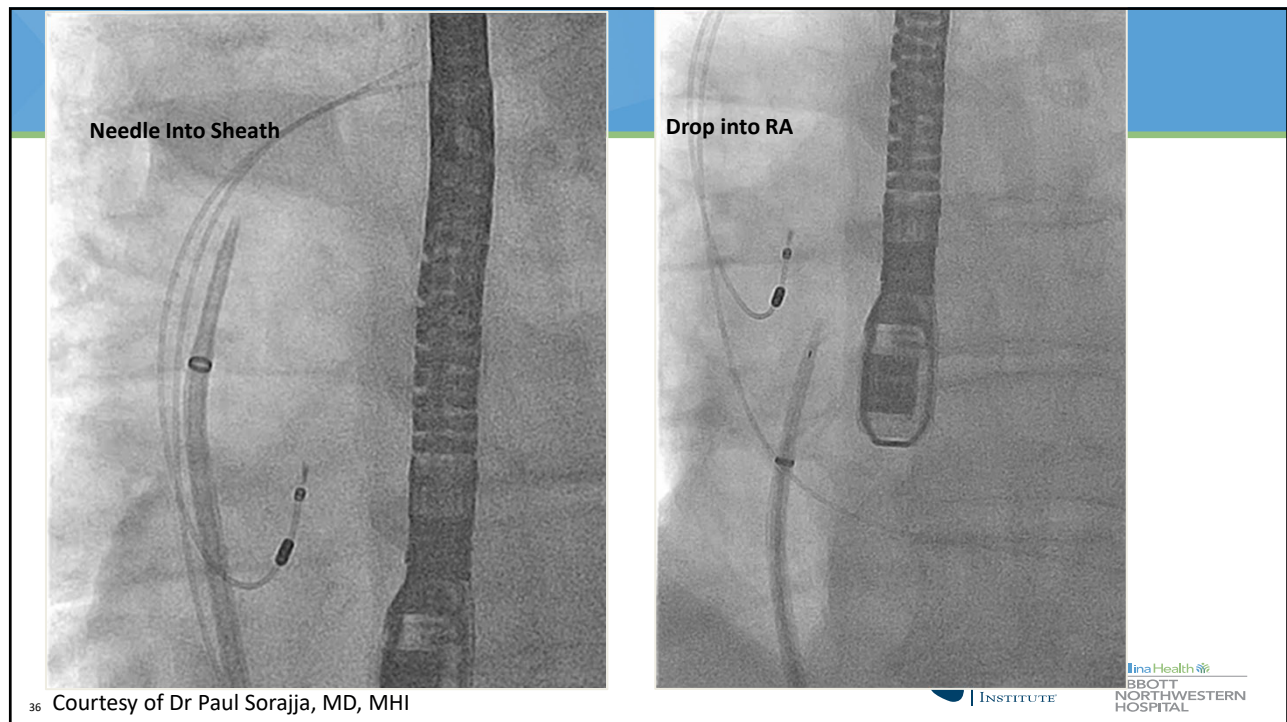
Courtesy of Dr Paul Sorajja, MD, MHI



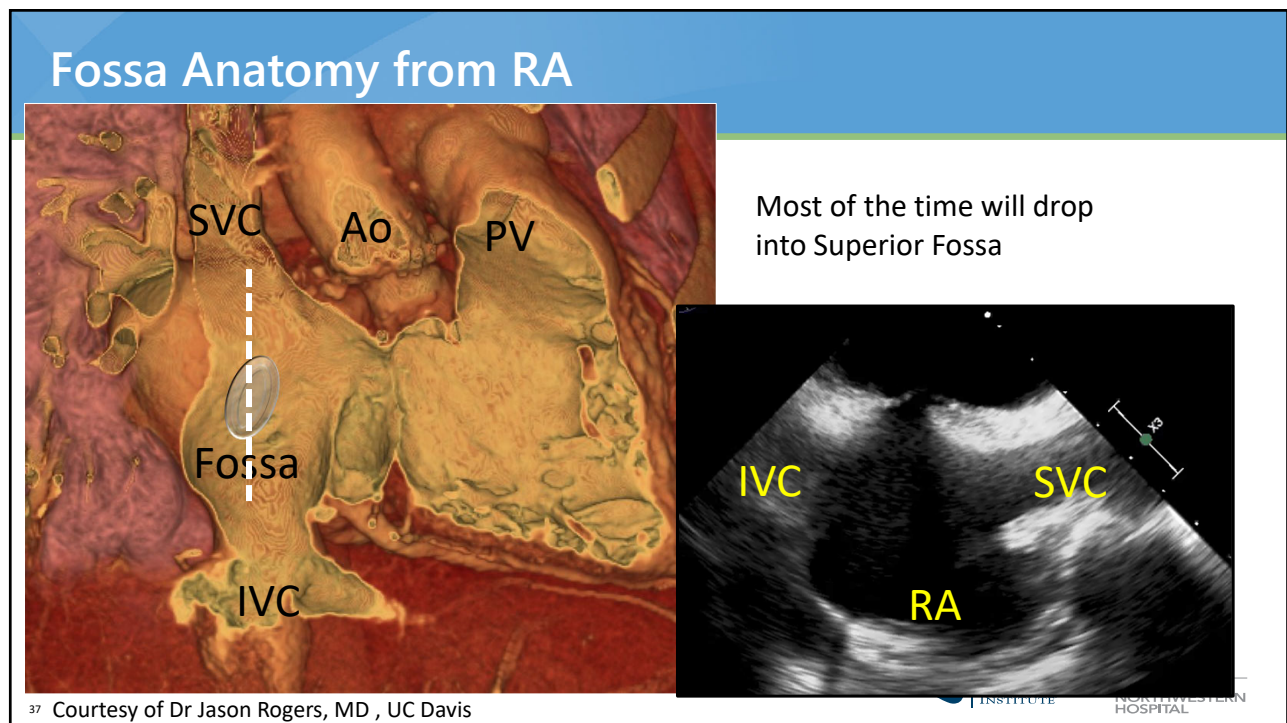
MINNEAPOLIS  
HEART  
INSTITUTE

AlinaHealth  
ABBOTT  
NORTHWESTERN  
HOSPITAL

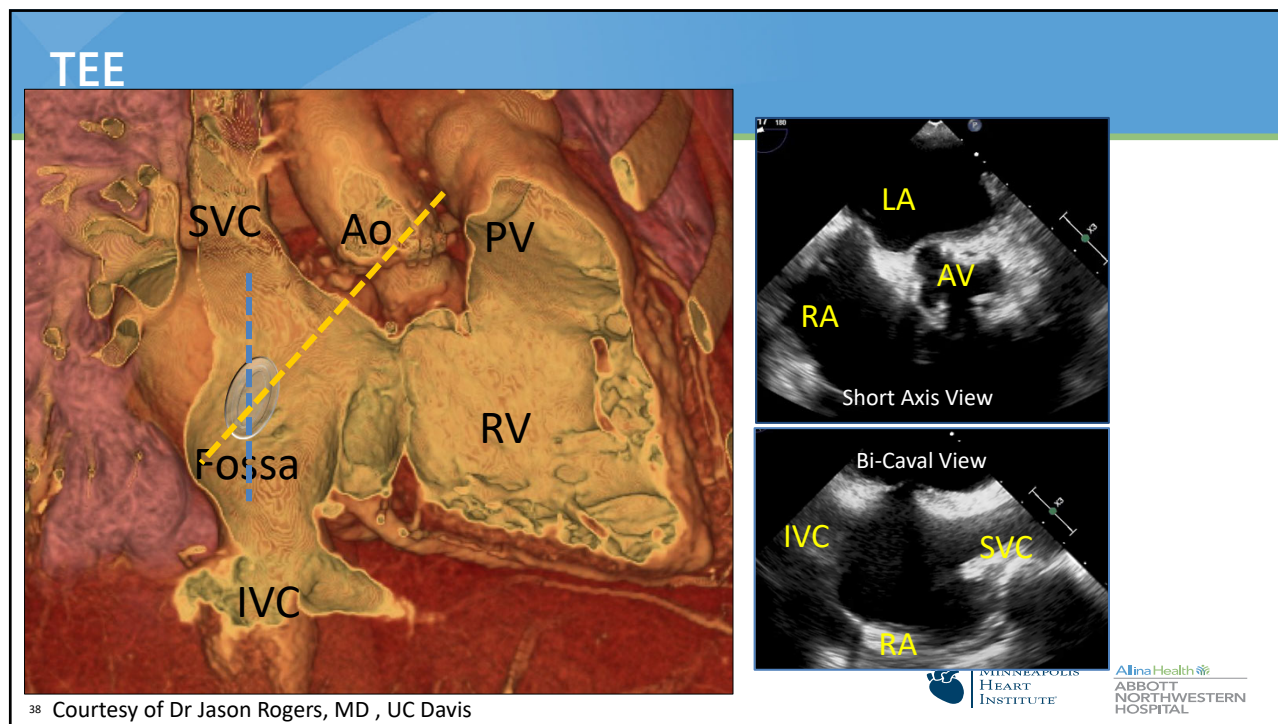
35



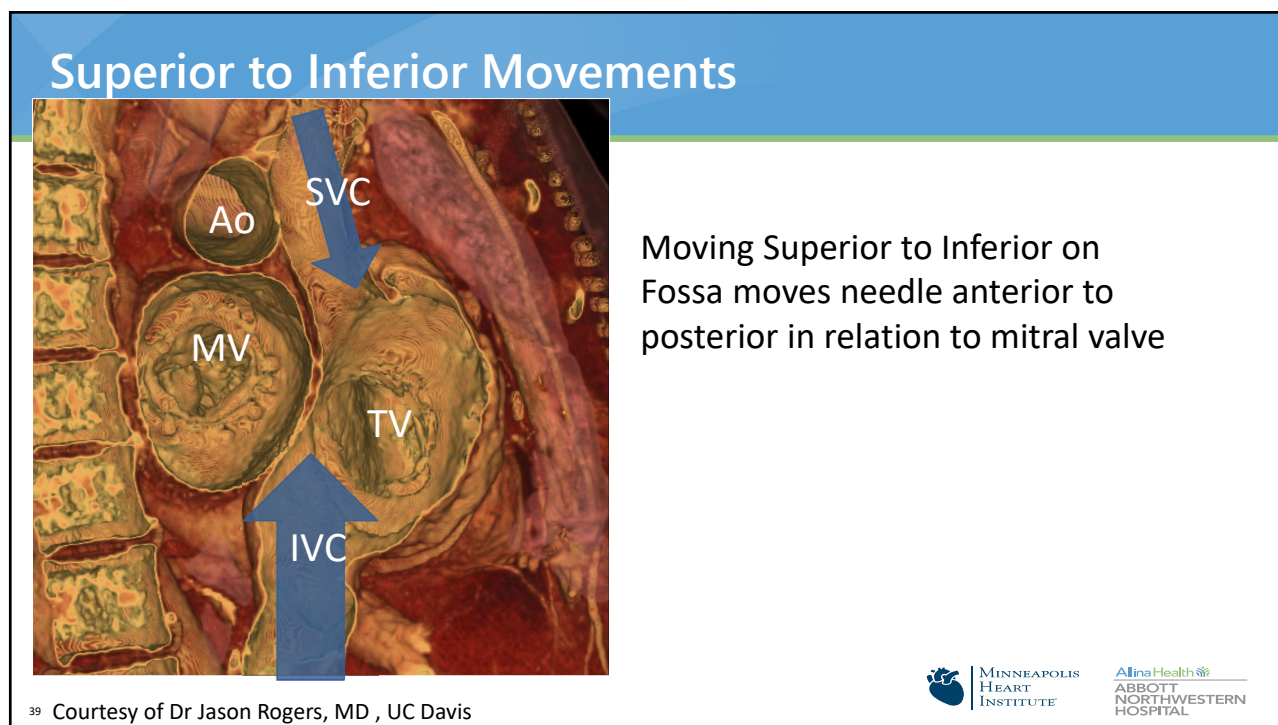
36



37



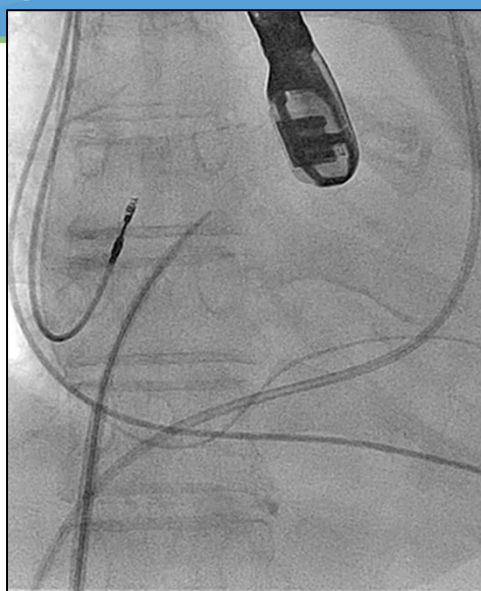
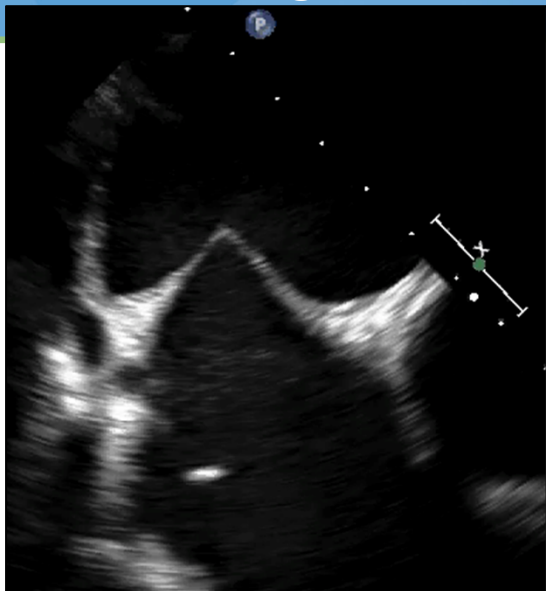
38



39



## Gentle Tenting and forward pressure



BRK needle vs RF

40

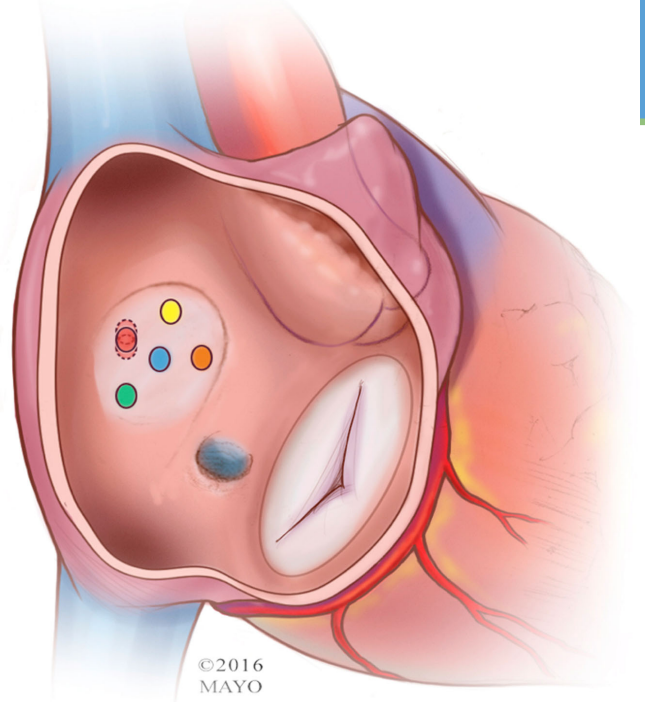
cautery on BRK  
needle



41

## Location Matters

- **most mitral procedures**
  - Posterior / superior-mid
- PFO closure : more anterior (yellow)
- LAVA ECMO, LA pressure : mid-mid
- LAAO closure: posterior / inferior-mid
- PV interventions: anterior / mid

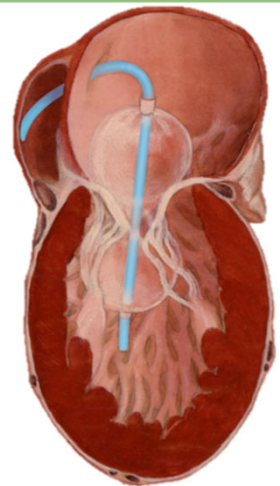
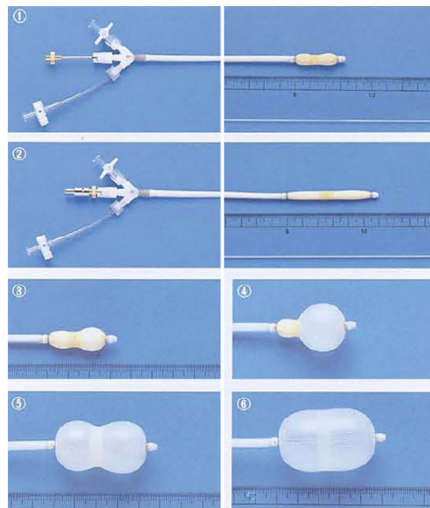


42

42

## Inoue Balloon

- 12F sheath with balloon at tip
- 14F septal dilator
- 2 latex layers, double balloon
- Two ports – inflation, venting
- Stainless steel tube to stretch balloon
- Stainless steel stylet to shape and guide into mitral valve
- 3 balloon sizes: 26, 28, 30, can be inflated to achieve 22 – 30mm diameter
- Ideally  $(\text{height} / 10) + 10$



43

43

## Post-dilation evaluation

- Ideally gradient cut in half without increase of > 1 grade MR
- If gradient still not at goal, can add 1-2 cc contrast and dilate again
- Evaluate IAS – usually small and heals on own, most L → R
- Evaluate for effusion

45

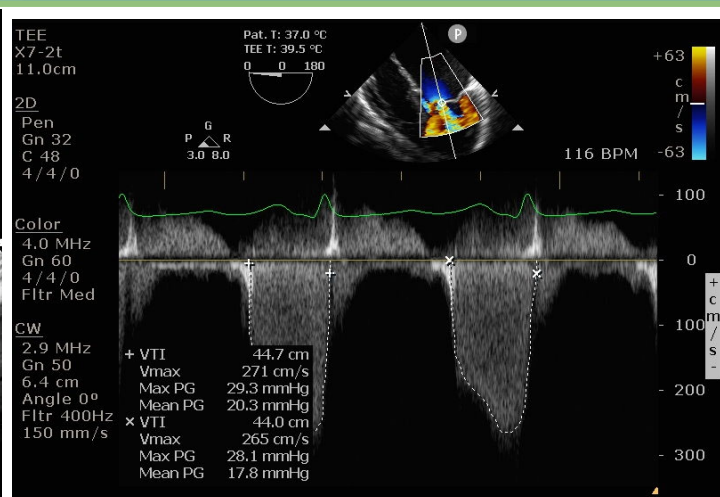
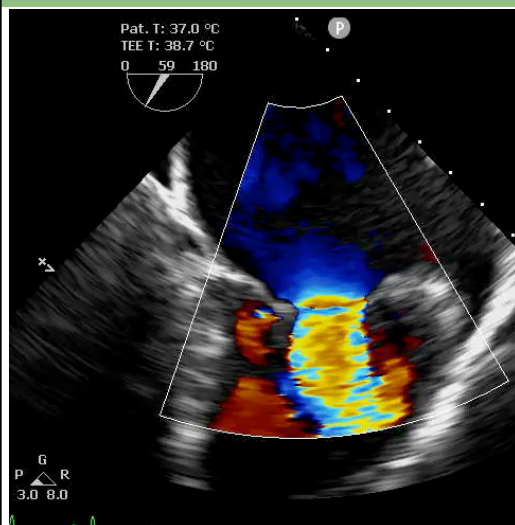


MINNEAPOLIS  
HEART  
INSTITUTE

AlinaHealth  
ABBOTT  
NORTHWESTERN  
HOSPITAL

45

## K,B – 12 yr old M



46

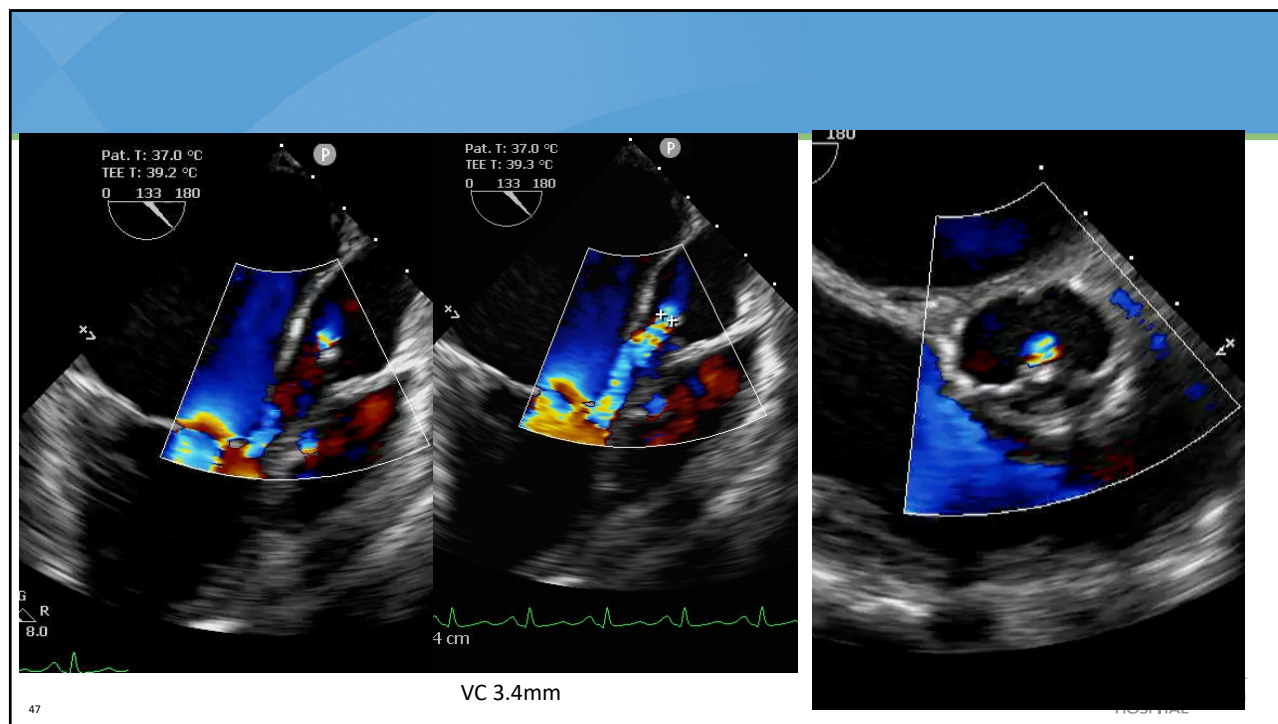


MINNEAPOLIS  
HEART  
INSTITUTE

AlinaHealth  
ABBOTT  
NORTHWESTERN  
HOSPITAL

46





47



48

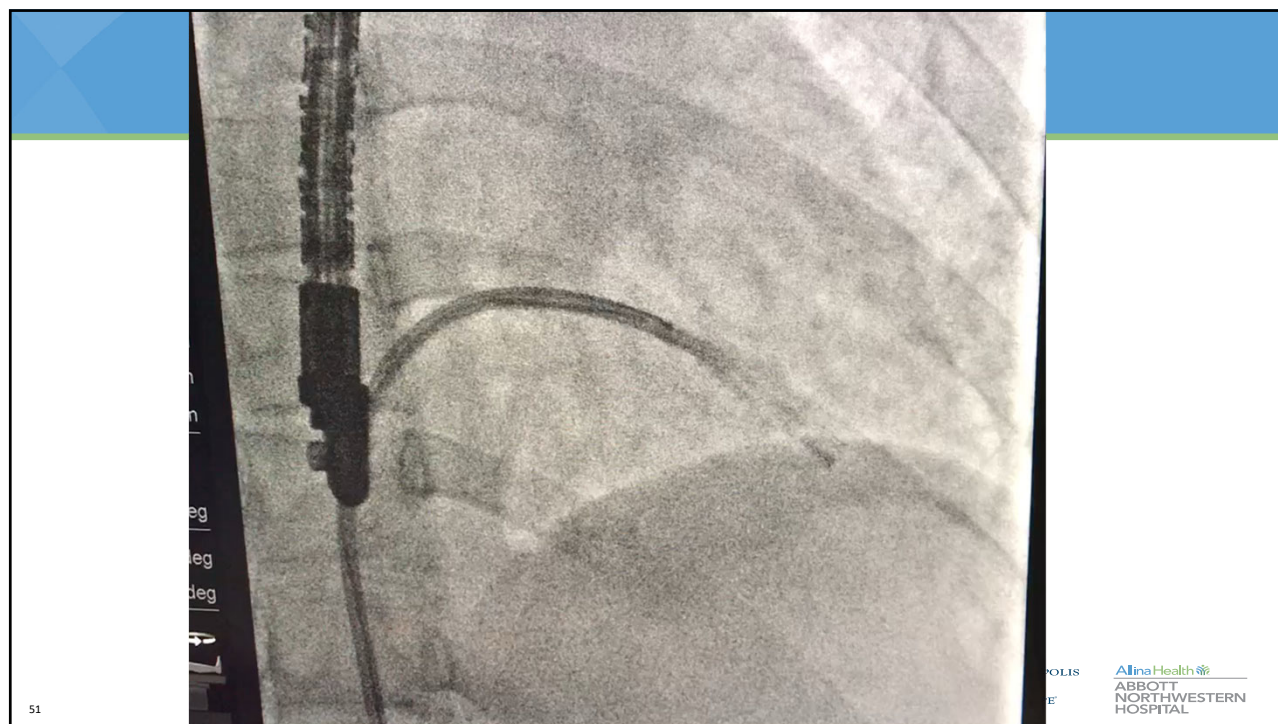


49

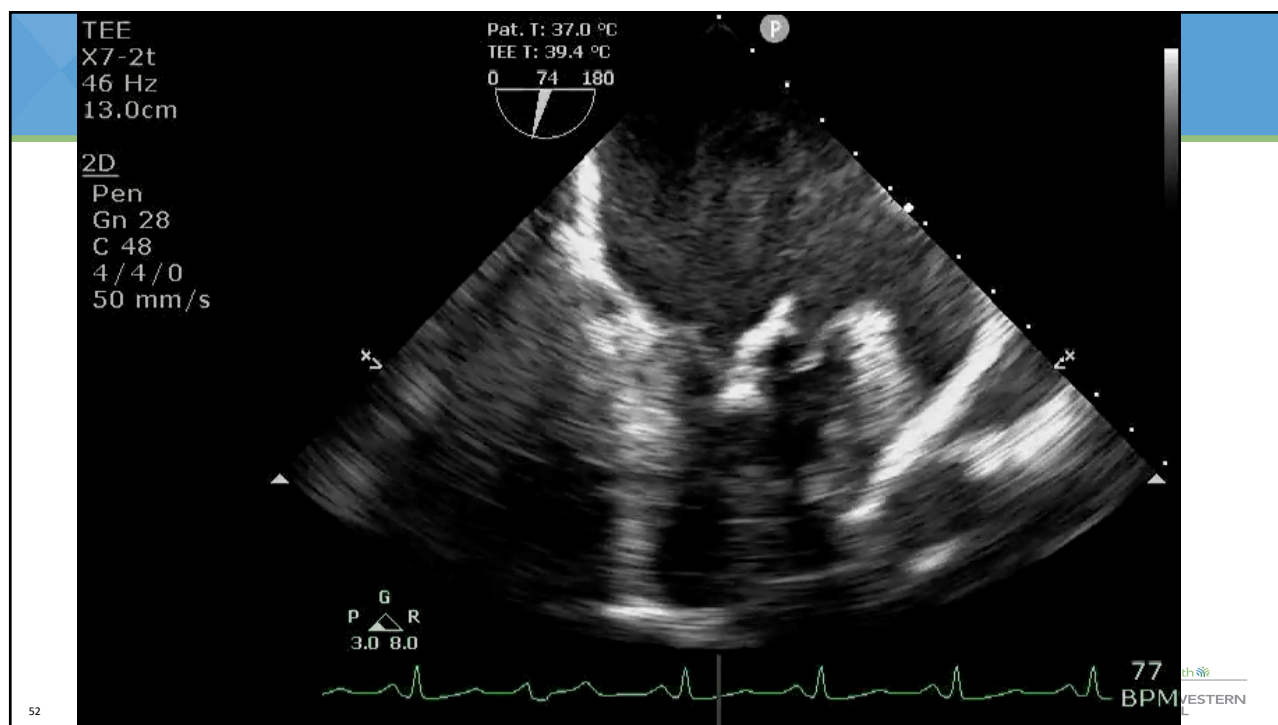


50

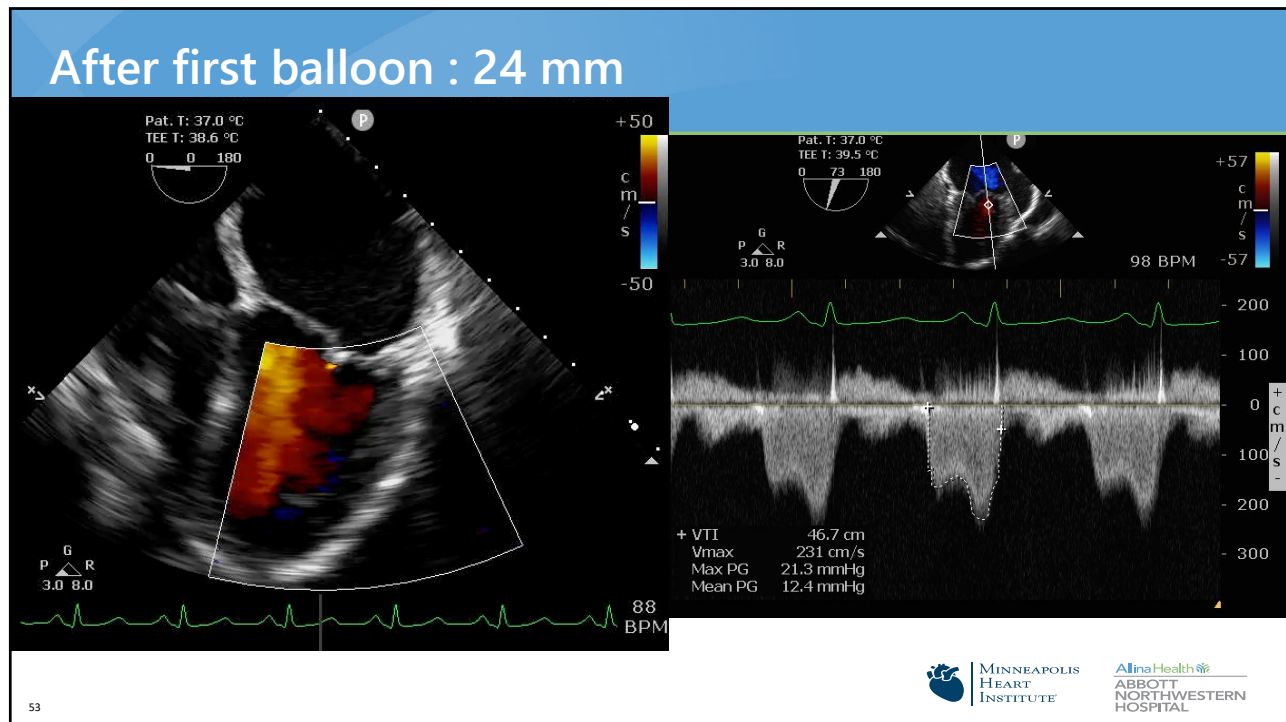




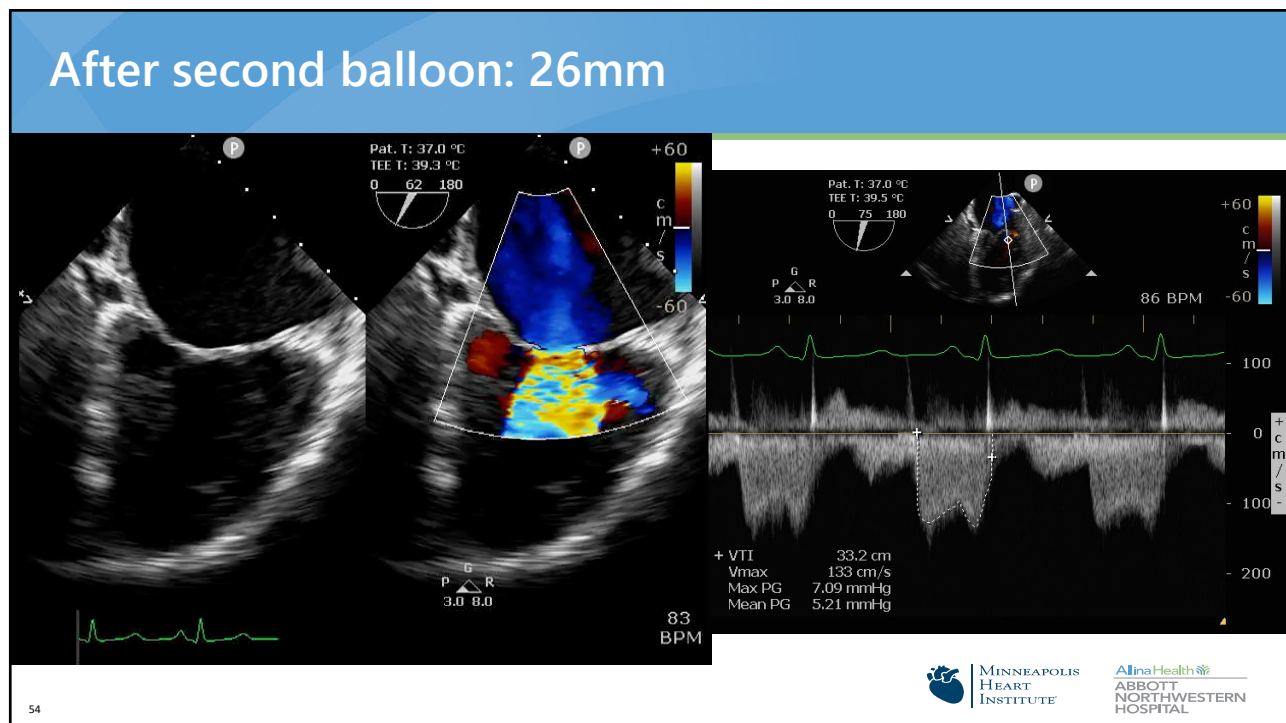
51



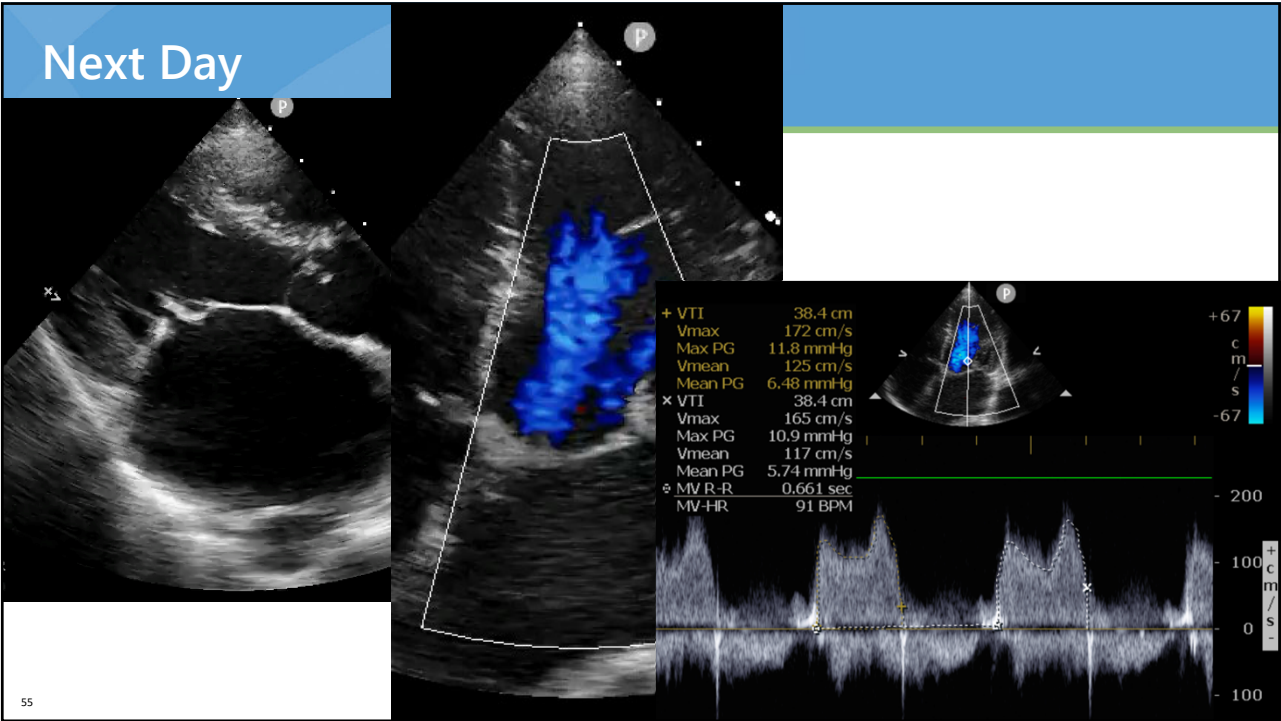
52



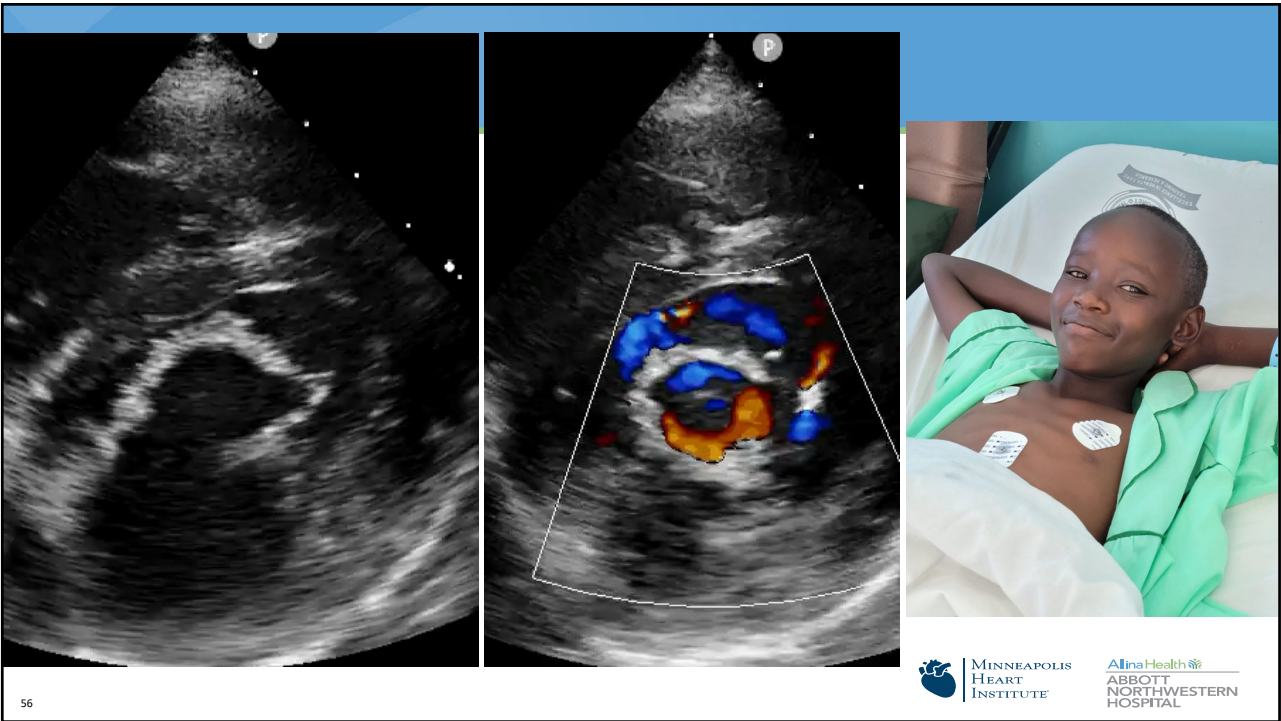
53



54



55

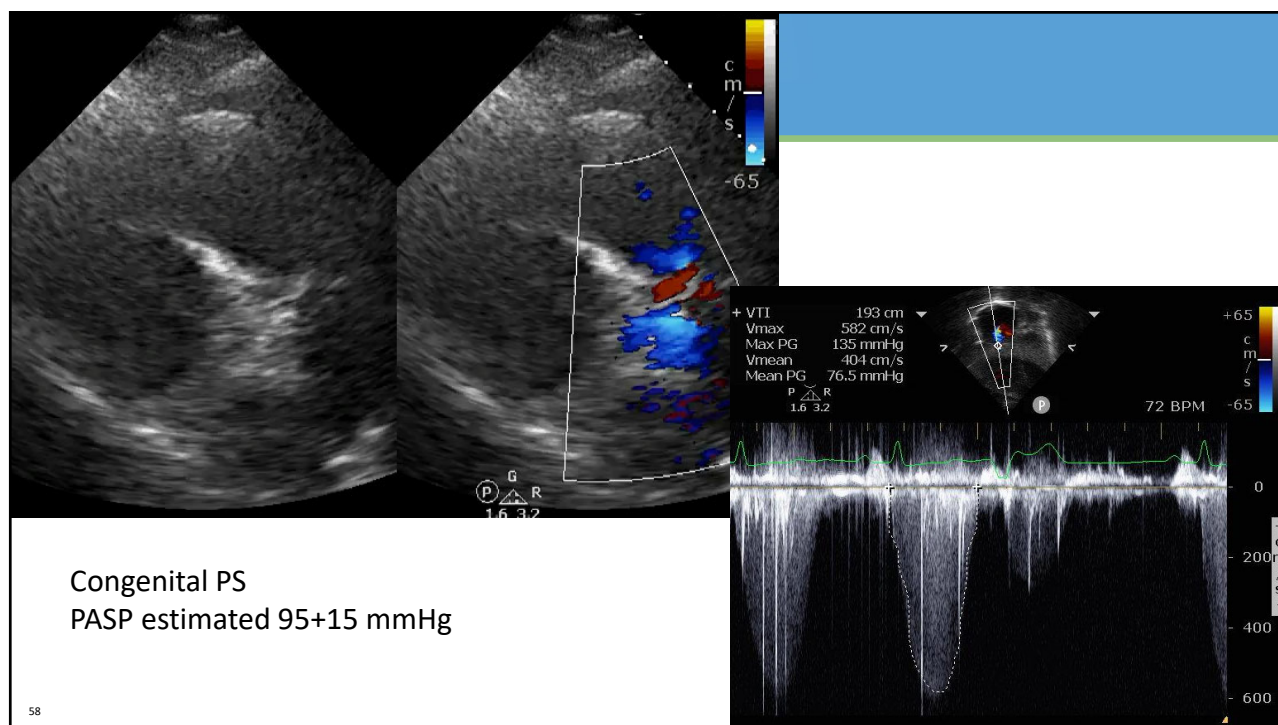


56



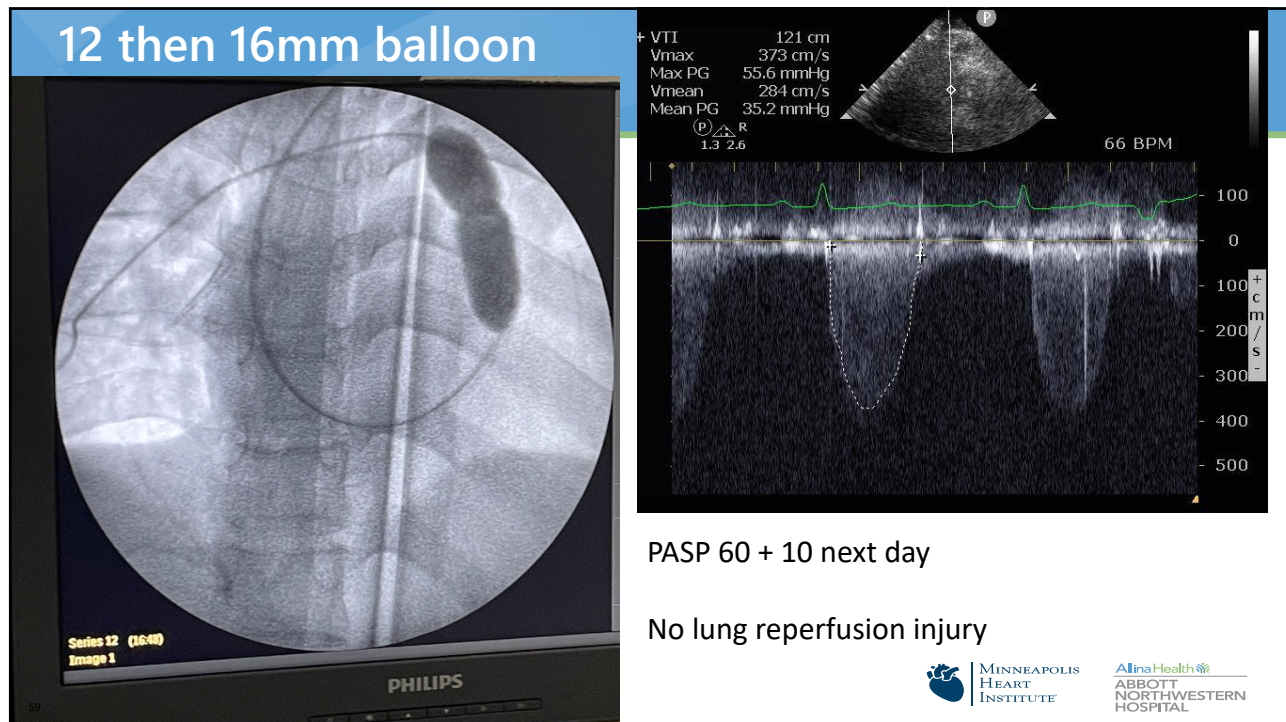


57



58





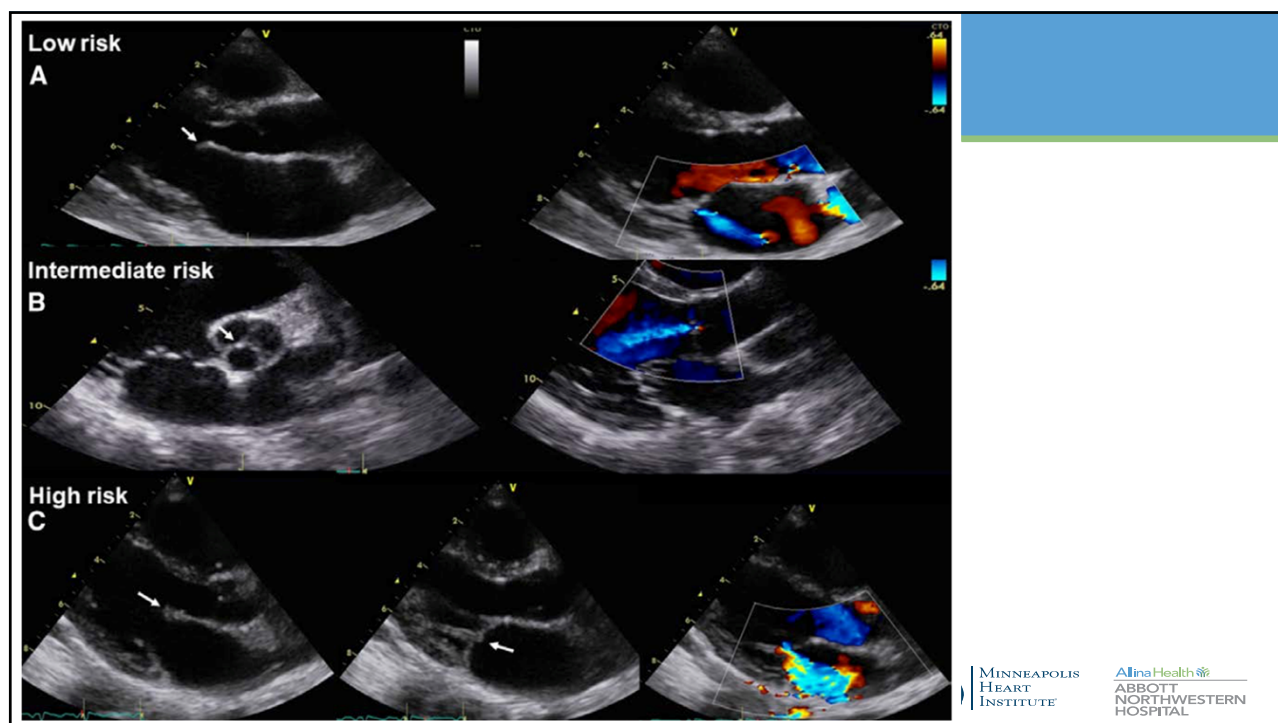
59

## Screening Programs for RHD


- World Health Federation criteria 2012, modified in 2019 for easier screening
  - Mitral valve:** >3mm thickness of anterior leaflet, overriding anterior leaflet, tethered anterior leaflet
  - MR** throughout systole
  - Aortic valve:** any AR, any thickening
- 2023 update: at least one of
  - MR:** all of (1) MR jet > 1.5cm if <30kg, > 2cm if >30kg, observed at least one view and at least 2 consecutive frames
  - AR:** any AR, at least one view, at least 2 consecutive frames
  - MS:** restricted leaflet motion with reduced valve opening

60

60



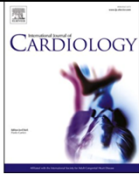
61



Contents lists available at [ScienceDirect](https://www.sciencedirect.com)

## International Journal of Cardiology

journal homepage: [www.elsevier.com/locate/ijcard](http://www.elsevier.com/locate/ijcard)



---




Short communication

### Saving time saves lives! A time focused evaluation of a single-view echocardiographic screening protocol for subclinical rheumatic heart disease

Ronald A. Johannsen<sup>a</sup>, Zachary P. Kaltenborn<sup>b,\*</sup>, Gautam R. Shroff<sup>a,c</sup>

<sup>a</sup> Division of Cardiology, Department of Internal Medicine, Hennepin County Medical Center, 716 S 7th St, Minneapolis, MN 55415, United States of America  
<sup>b</sup> Division of General Internal Medicine and Hospital Pediatrics, Department of Internal Medicine and Pediatrics, University of Minnesota Medical School, Division Mailbox - MMC 741, 420 Delaware Street SE, Minneapolis, MN 55455, United States of America  
<sup>c</sup> Department of Medicine, University of Minnesota Medical School, 420 Delaware Street SE, Minneapolis, MN 55455, United States of America

<p>Single-view echo 1.2 min / child</p> <p>Two-view 2.1 min / child</p> <p>Multi-view 5 min / child</p>	<p>No significant RHD missed</p> <p><b>100k children can be screened in 1 year (5 days/week)</b></p>
---	--

62

62



63



64



## References

- Rwebembera, J, et al. “Starting and Operating a Public Cardiac Catheterization Laboratory in a Low Resource Setting: The Eight-Year Story of the Uganda Heart Institute Catheter Laboratory”. *Global Heart*, vol. 16, no. 1, 2021, p. 11, doi:10.5334/gh.859.
- Marijon, E, et al. “Rheumatic Heart Disease”. *The Lancet*, vol 379, iss 9819, 10–16 March 2012, Pages 953-964. [https://doi.org/10.1016/S0140-6736\(11\)61171-9](https://doi.org/10.1016/S0140-6736(11)61171-9)
- Dass C, Kanmanthareddy A. “Rheumatic Heart Disease”. Updated 2023 Jul 25 : StatPearls Publishing; 2025 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK538286/>
- Johannsen, Ronald A et al. “Saving time saves lives! A time focused evaluation of a single-view echocardiographic screening protocol for subclinical rheumatic heart disease.” *International journal of cardiology* vol. 351 (2022): 111-114. doi:10.1016/j.ijcard.2021.12.031
- Rwebembera, J., Marangou, J., Mwita, J.C. et al. 2023 **World Heart Federation guidelines for the echocardiographic diagnosis of rheumatic heart disease.** *Nat Rev Cardiol* **21**, 250–263 (2024). <https://doi.org/10.1038/s41569-023-00940-9>
- Meneguz-Moreno, Rafael A et al. “Very Long Term Follow-Up After Percutaneous Balloon Mitral Valvuloplasty.” *JACC. Cardiovascular interventions* vol. 11,19 (2018): 1945-1952. doi:10.1016/j.jcin.2018.05.039

65



65

## Special Thanks To My Mentors & Family This Year

- Ron Johansen, MD
- Paul Sorajja, MD
- Mario Göessl, MD
- Anil Poullose, MD
- Ivan Chavez, MD
- Voudris Konstantinos, MD
- Michael Mooney, MD
- Vinayak Bapat, MD
- Rizwan Attia, MBBS
- Erik Beckmann, MD
- Carly Lodewyks, MD
- Sarah Palmer, MD
- Sebastian Ittura, MD
- Nadira Hamid, MD
- João Cavalcante, MD
- Marcus Burns, DNP
- Caitlin Kronenwetter, PA



66

66