

# Complexities in Decision Making in Aortic Surgery (or how to improve an aortic program)



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# Author Disclosures

- None for this talk
- But my firm belief is we operate on more people than we need to (and I LOVE doing cardiac surgery)

# Question for the Back of the Mind—Answer at the End of Talk

- Which current NFL head coach has more rushing yards than Bo Jackson?



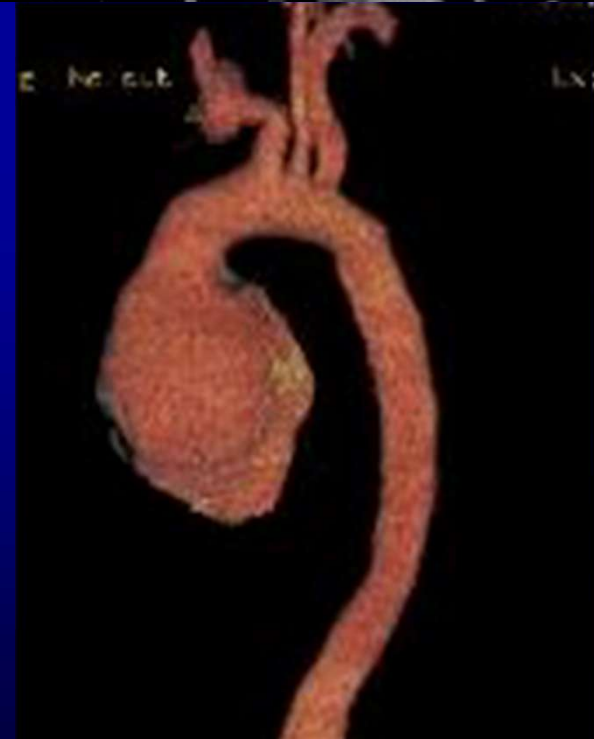
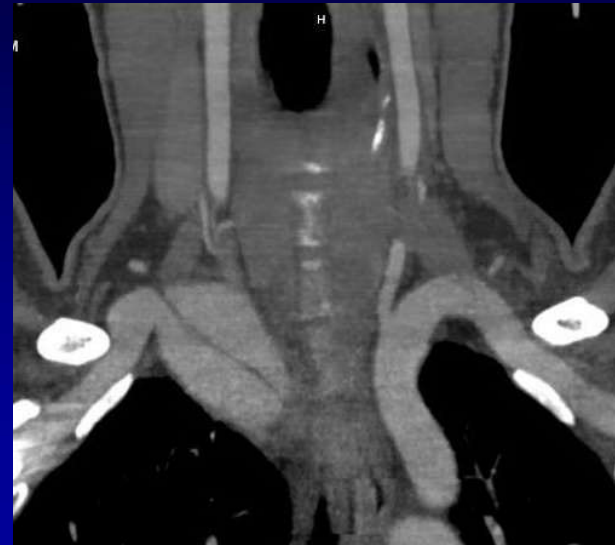
# First Patient Case

- 75 yr old male
- Well controlled HTN
- CT scan for prior smoking history led to incidental 4.2 cm asc Ao
- No FH, normal AoV



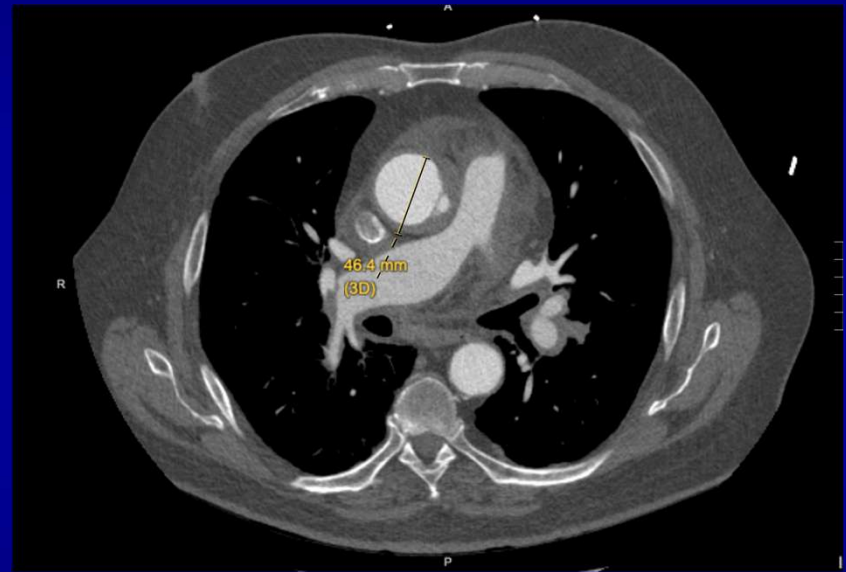
# Another Patient Case

- 45 yr male—6 ft 10 inches tall
- Mother with P2 prolapse and severe MR, CHF
- Father with aberrant LSCA and limited vessel dissection
- Incidental finding of severe asx AI, nl EF and LVEDV
- 11cm root/ascending Ao and limited RSCA dissection



# 3rd Patient Case

- 75 yr male
- Acute onset chest pain
- Acute DeBakey 2 IMH with ulcer
- Normal renal and LV function



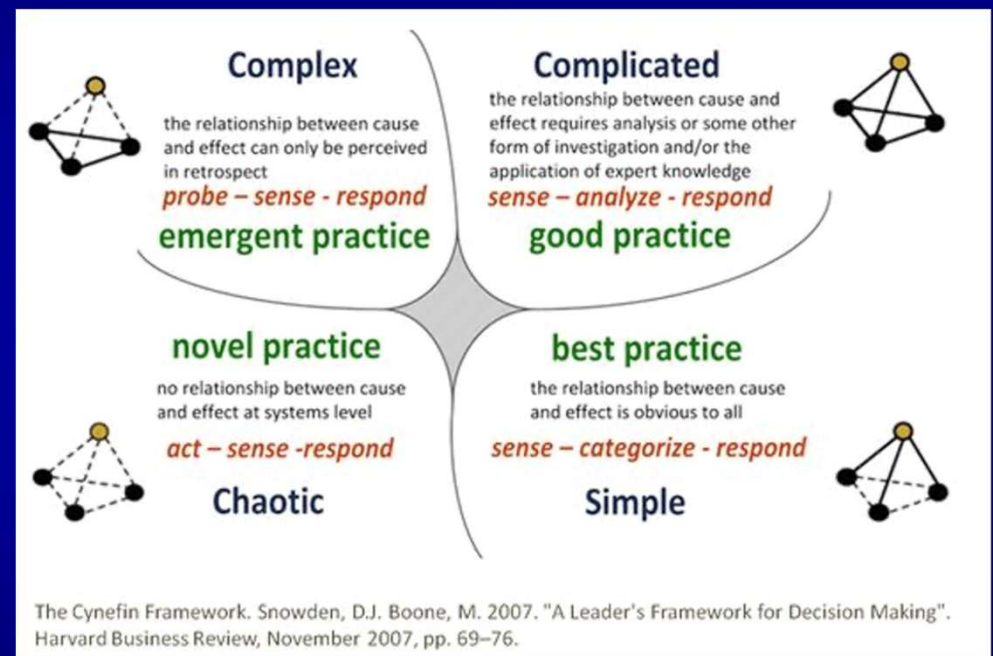
# 4th Patient Case

- 76 yr old male
- EF 40%, hx of PCI to LAD after MI
- HTN poorly controlled
- Cr 2.1mg/dL
- Arrives to small rural hospital without cardiac surgery
- Acute type A IMH with ulcer with tamponade for 2 hours



# Similarities in Patients

- Indication for surgery is improvement in life expectancy
- NOT quality of life
- Makes the decision more complicated
- Each case represents progressive complexity for achieving the goal



# Cynefin Framework for Decision-Making

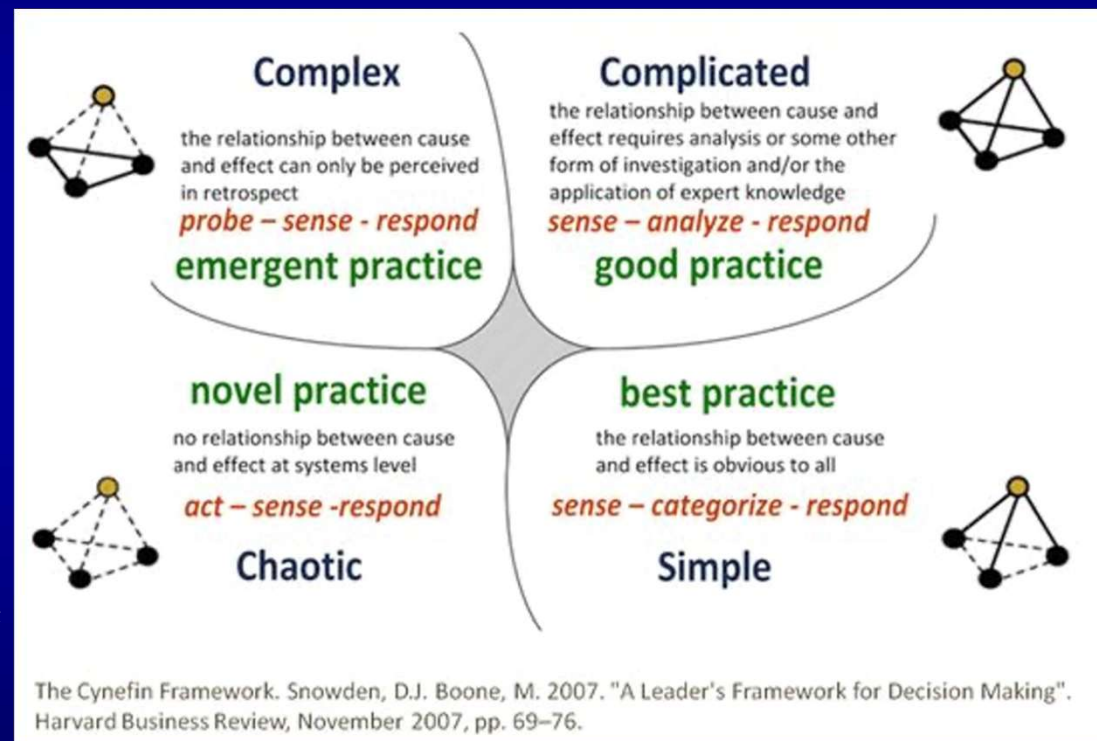
*Nonlinear*

*Side.*

irreducible

uncontrollable

not predictable



*Linear*

*Side.*

stable

controllable

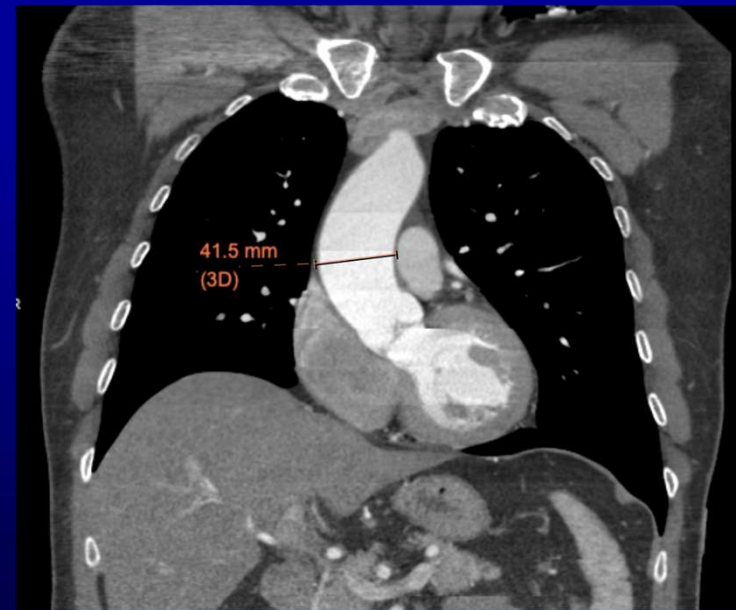
predictable

# The 4 items to discern the type of problem

- Number of elements in decision
- Is interaction linear or nonlinear
- How does the element interact with the requirement—limited or many?
- Is the boundary between element limited or fuzzy?

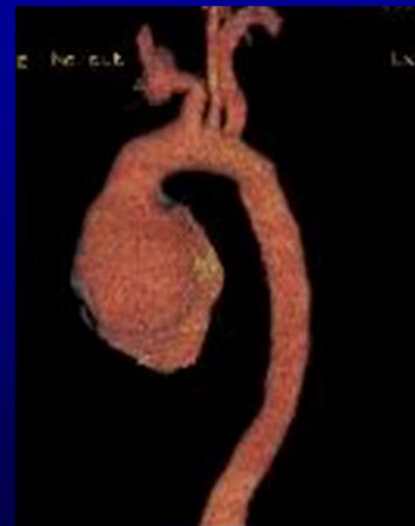
# Let's Take the First Case— Simple

- Not much of a decision
- Medical management
- Excellent aortic prognosis
- Few interconnecting parts—linear interdependence



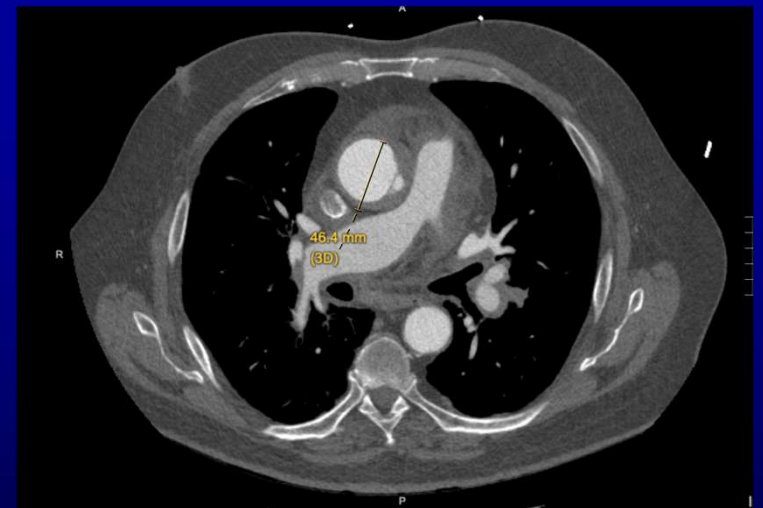
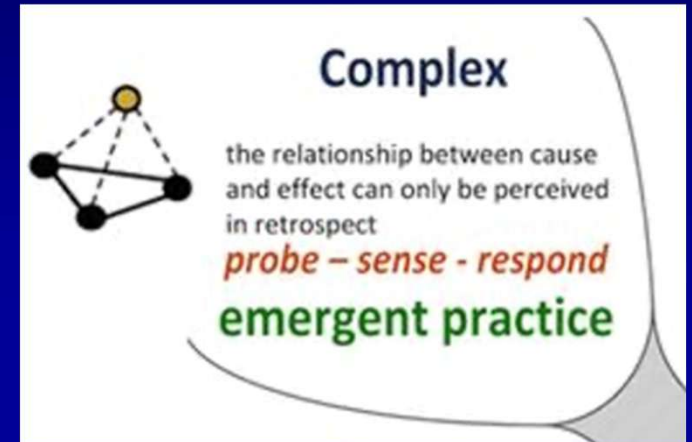
# Take the 2<sup>nd</sup> Case—Complicated

- More interconnecting parts
- Generally, can get this patient through operative repair
  - what to do about RSCA?
  - What about the valve?
  - Most places straight forward linear response



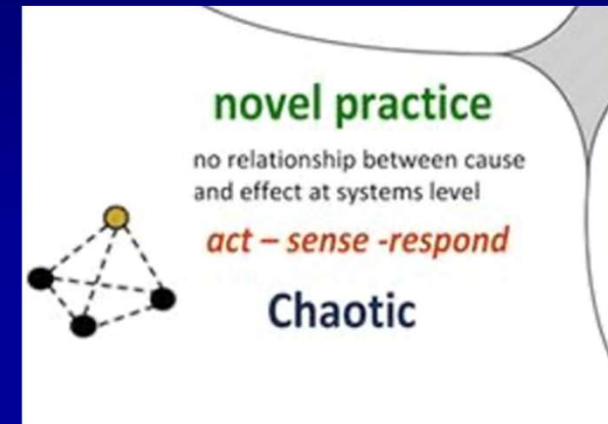
# Take the 3<sup>rd</sup> Case-Complex

- Lots of interconnecting parts
  - Requires surgeon, ER, ICU, anesthesia, etc but emergently
- Nonlinear response if one of them is not optimized
- Emergence phenomenon



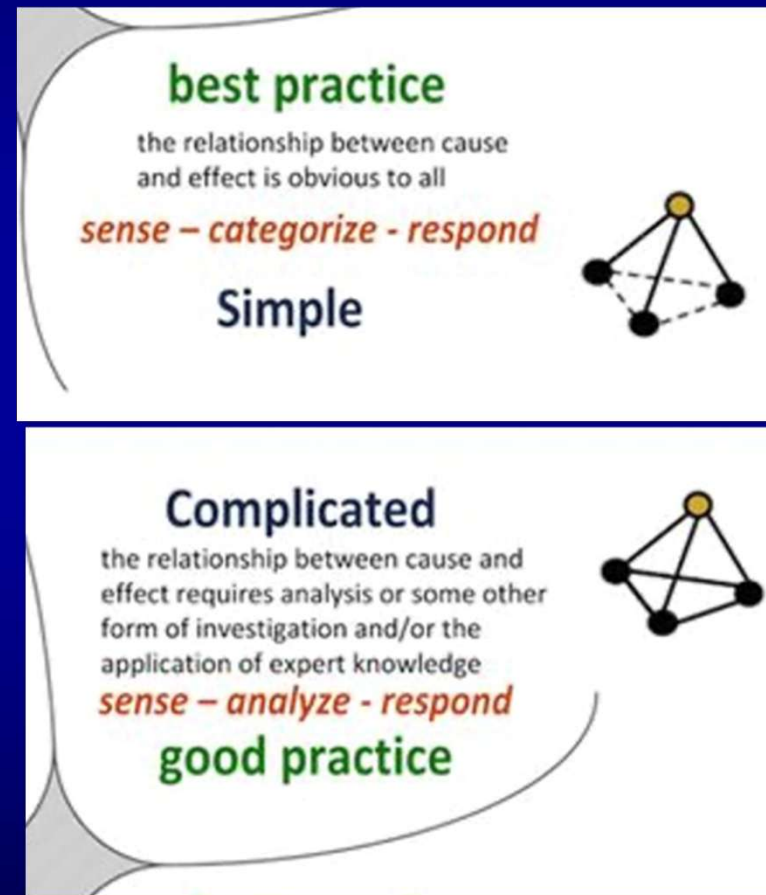
# Take the 4<sup>th</sup> Case—Chaotic

- Lots of interconnecting parts
- Highly dependent on initial conditions
  - How quick is the transfer, is OR ready, etc
- Nonlinear response—if one part is “off”—all bets are off



# If Something Goes Wrong...

- We do the following:
  - Reductionist evaluation
  - Root cause analysis
  - Best for simple and complicated problems where parts act predictably with each other



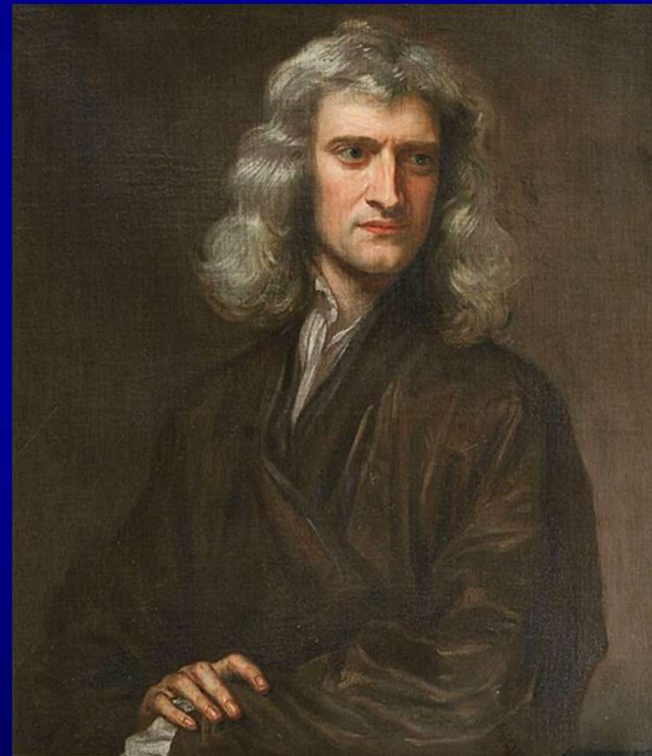
# Our Brains Struggle With Complexity

- We think deterministically
- Laplace's Demon—we often assume knowledge
- Complexity arises because many interdependent parts act unpredictably



# Determinism

- Influence of Sir Isaac Newton
- Figured out how earth and sun revolve around each other
- But even he struggled with the 3 body system



# Determinism and Complexity

- Even determinism leads to complexity
- Things that follow in sequence can be pieced together to appear random
- 3 body system is the basic element of chaos theory—”butterfly effect”

Predictable World				Unpredictable World							
→		→		Decreasing Order				→		→	
Simple Systems		Complicated Systems		Complex Systems		Chaotic Systems					
Examples <sup>1</sup>											
Teeter Totter	Light Switch	Toaster	Car	Healthcare <sup>2</sup>	Rainforest	Pandemic	Weather				

# Random Events That Ultimately Contribute to Poor Decisions in Complexity

- Uncertainty types:
  - Different possible outcomes—*stochastic uncertainty*
  - Unknown information—*epistemic uncertainty*
  - Inherent variability—*aleatoric uncertainty*
  - Our biases caused by our worldview—*ontologic uncertainty*

# How can we overcome this challenge to decision making in complex environments

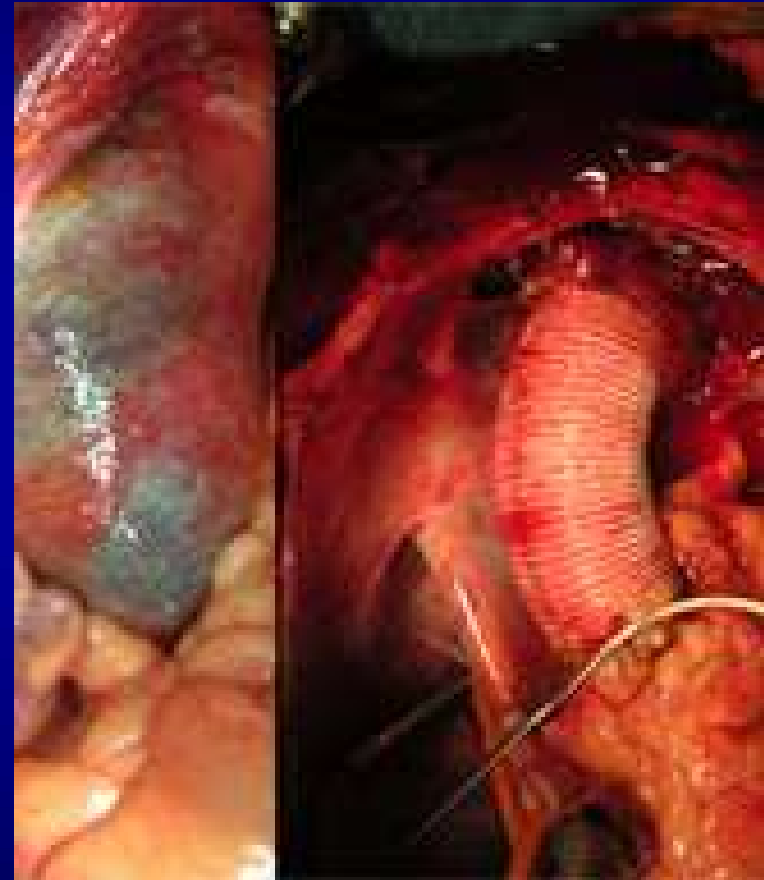
- Where possible,
  - reduce complexity
  - understand the interplay between the patient and the system
  - reduce rigidity to ask questions
  - release control to observe and learn the adaptability of the system

# Complexity requires Probabilities

- It is the dissection not the aneurysm that most frequently concerns us
- *Fundamental Aortic Inequality*

$$P_{r/d} > P_c$$

- THEREFORE: We cannot continue to succumb to the *Fundamental Aortic Heuristic*:
  - If  $> X$  cm —then operate

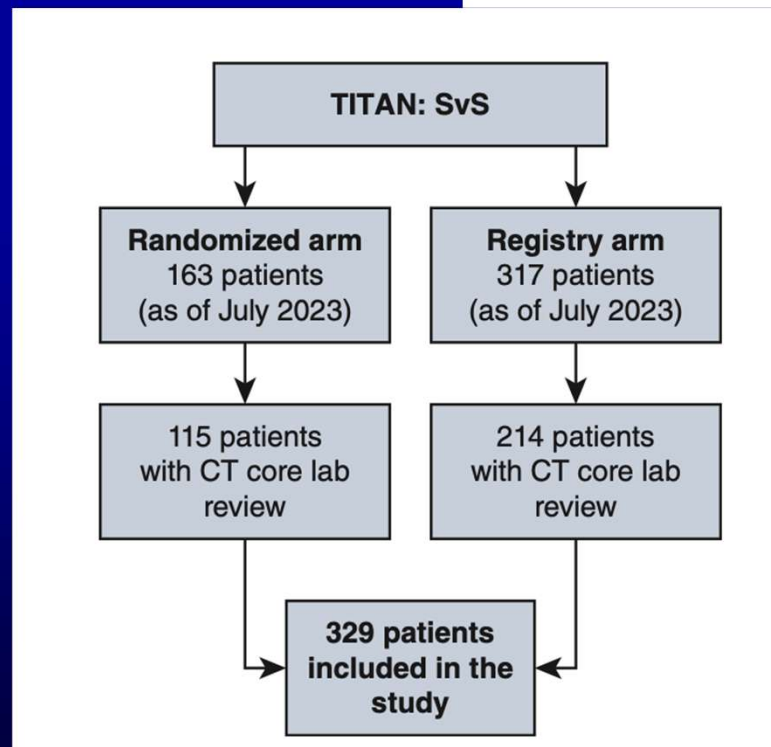


# Therefore in order to deal with complexity in aortic decision making

- We need more good data

**Impact of nondiameter aortic indices on surgical eligibility: Results from the Treatment in Thoracic Aortic Aneurysm: Surgery Versus Surveillance (TITAN: SvS) randomized controlled trial** Check for updates

Olina Dagher, MD,<sup>a,b</sup> Jehangir J. Appoo, MDCM,<sup>a</sup> Eric Herget, MD,<sup>c</sup> Rony Atoui, MD, MSc,<sup>d</sup> Cristian Baeza, MD,<sup>e</sup> William Brinkman, MD,<sup>f</sup> John Bozinovski, MD, MSc,<sup>g</sup> Michael W. A. Chu, MD, MEd,<sup>h</sup> Francois Dagenais, MD,<sup>i</sup> Philippe Demers, MD,<sup>j</sup> Nimesh Desai, MD,<sup>k</sup> Ismail El-Hamamsy, MD, PhD,<sup>l</sup> Anthony Estrera, MD,<sup>m</sup> Juan B. Grau, MD,<sup>n</sup> G. Chad Hughes, MD,<sup>o</sup> Armand Jassar, MBBS,<sup>p</sup> Puja Kachroo, MD,<sup>q</sup> Kevin Lachapelle, MD, MSc,<sup>r</sup> Maral Ouzounian, MD, PhD,<sup>s</sup> Himanshu J. Patel, MD,<sup>t</sup> Zlatko Pozeg, MD,<sup>u</sup> Elaine Tseng, MD,<sup>v</sup> Richard Whitlock, MD,<sup>w</sup> Ming Hao Guo, MD, MSc,<sup>x</sup> and Munir Boodhwani, MD, MMSc<sup>x</sup>



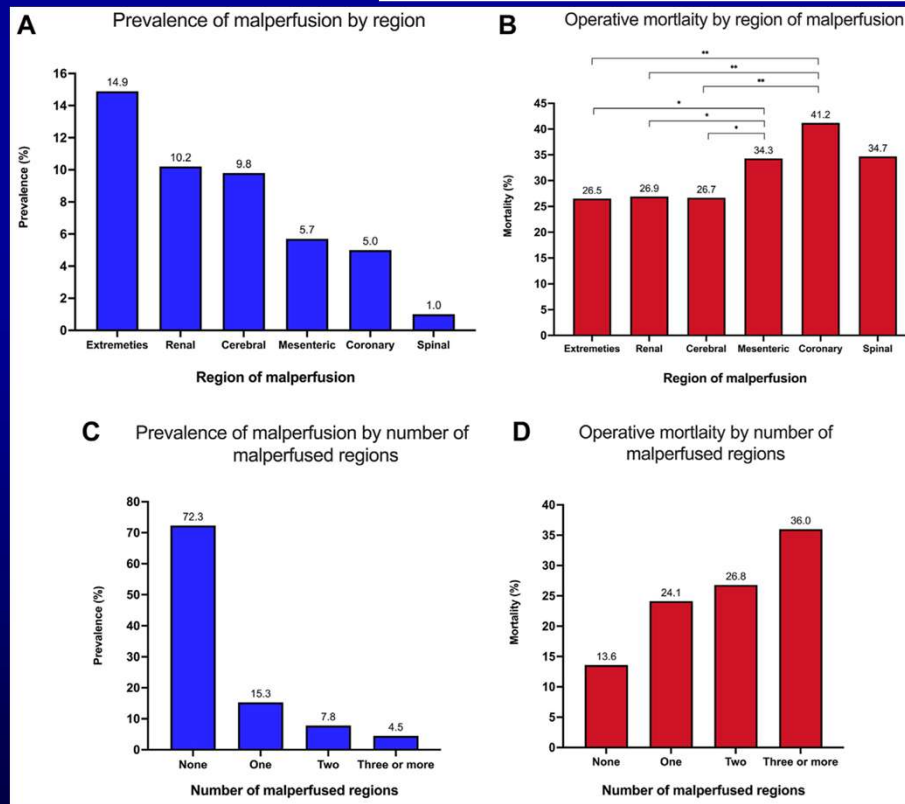
# To Deal with Complexity

- We need more big data

## Malperfusion in Patients With Acute Type A Aortic Dissection: A Nationwide Analysis

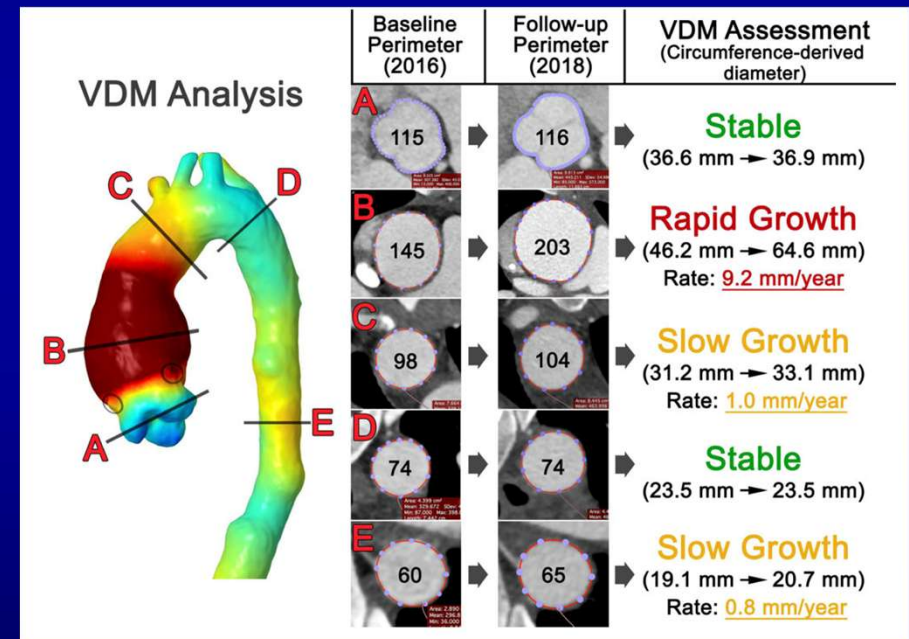
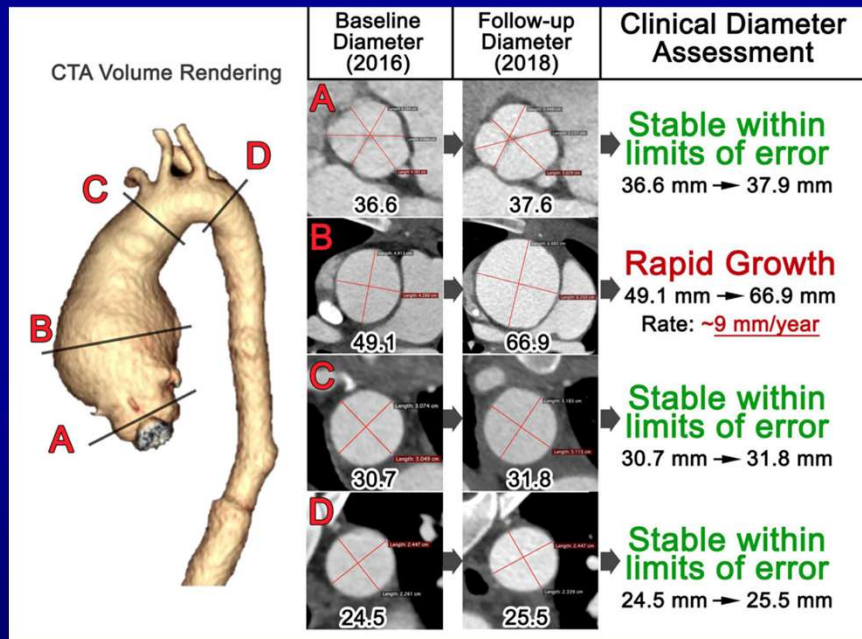
Check for updates

Nicholas J. Goel, MD,<sup>1,2,3</sup> John J. Kelly, MD,<sup>1,2,3</sup> William L. Patrick, MD,<sup>1,2,3</sup> Yu Zhao, MS,<sup>1,2</sup> Joseph E. Bavaria, MD,<sup>1</sup> Maral Ouzounian, MD, PhD,<sup>4</sup> Anthony L. Estrera, MD,<sup>5</sup> Hiroo Takayama, MD, PhD,<sup>6</sup> Edward P. Chen, MD,<sup>7</sup> T. Brett Reece, MD,<sup>8</sup> G. Chad Hughes, MD,<sup>7</sup> Eric E. Roselli, MD,<sup>9</sup> Karen M. Kim, MD,<sup>10</sup> Himanshu J. Patel, MD,<sup>11</sup> Michael E. Bowditch, MD, MS,<sup>12</sup> Jason S. Sperling, MD,<sup>13</sup> Bradley G. Leshnouer, MD,<sup>14</sup> Ourania Preventza, MD,<sup>15</sup> William T. Brinkman, MD,<sup>16</sup> and Nimesh D. Desai, MD, PhD<sup>1,2,3</sup>



# To Deal With Complexity

- We need more patient specific data



23 year old Jehovah's witness with Takayasu aortitis

## Three-dimensional Growth Analysis of Thoracic Aortic Aneurysm with Vascular Deformation Mapping (VDM)

Nicholas S. Burris, MD<sup>1</sup>, Benjamin A. Hoff, PhD<sup>2</sup>, Himanshu J. Patel, MD<sup>3</sup>, Ella A. Kazerooni, MD, MS<sup>1</sup>, and Brian D. Ross, PhD<sup>2,4</sup>

# My suggestions

- We need a different framework with guidelines to help decision making and reduce NNT—in its absence however...
- Look at the CT scan
- But listen to the patient!!

Recommendations for Shared Decision-Making		
COR	LOE	Recommendations
1	C-LD	1. In patients with aortic disease, shared decision-making is recommended when determining the appropriate thresholds for intervention, deciding on the type of surgical repair, choosing between open surgical versus endovascular approaches; and in medical management and surveillance. <sup>1-6</sup>

# Who Got This One?

- Which current NFL head coach has more rushing yards than Bo Jackson?
- “some people woke up on 3<sup>rd</sup> base and think they hit a triple”
  - *Jim Harbaugh*



# Thank you Houston colleagues!!!

