Exercise echo in CHD: complex questions and analytics

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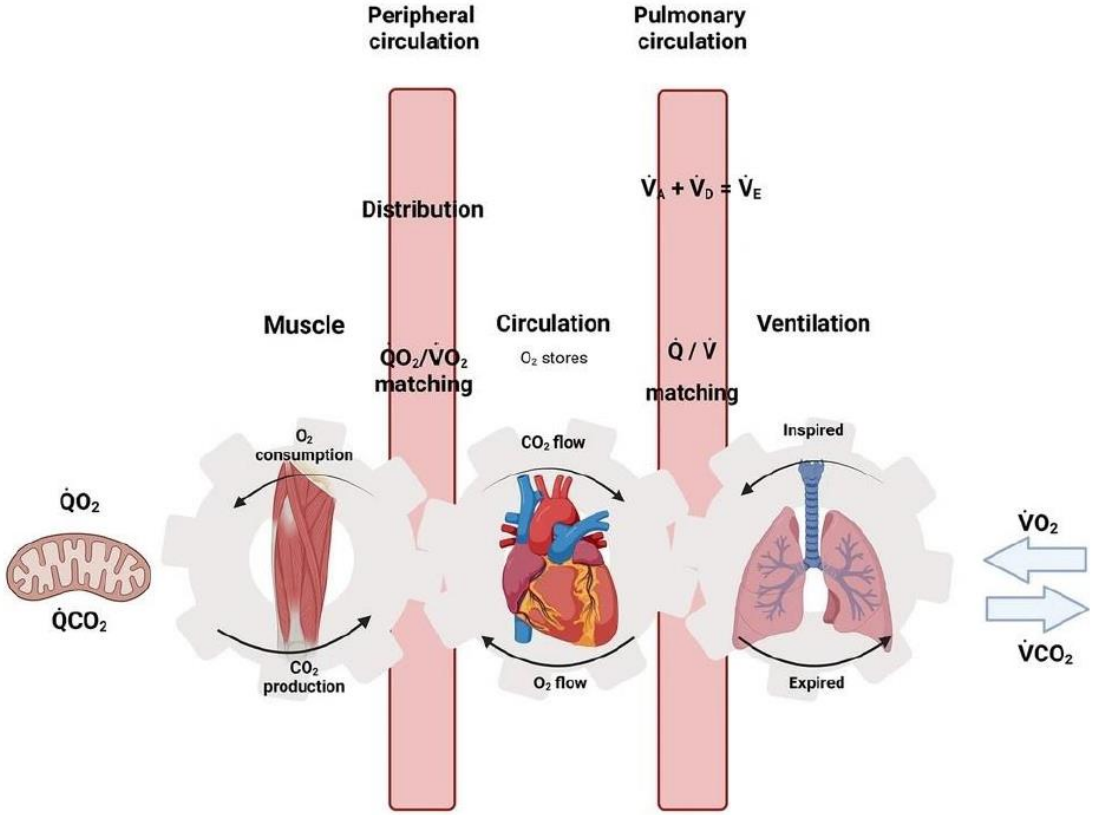
Exercise is complex



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Exercise and CHD

- Exercise → intrinsic to symptoms and QoL
- CHD → on average lower fitness
- ESC/ACC guidelines → interventions based on symptoms, less so on fitness
- Multiple factors dictating fitness and exercise capacity

- **Key is to narrow down disease specific mechanisms**

CHD prognostics

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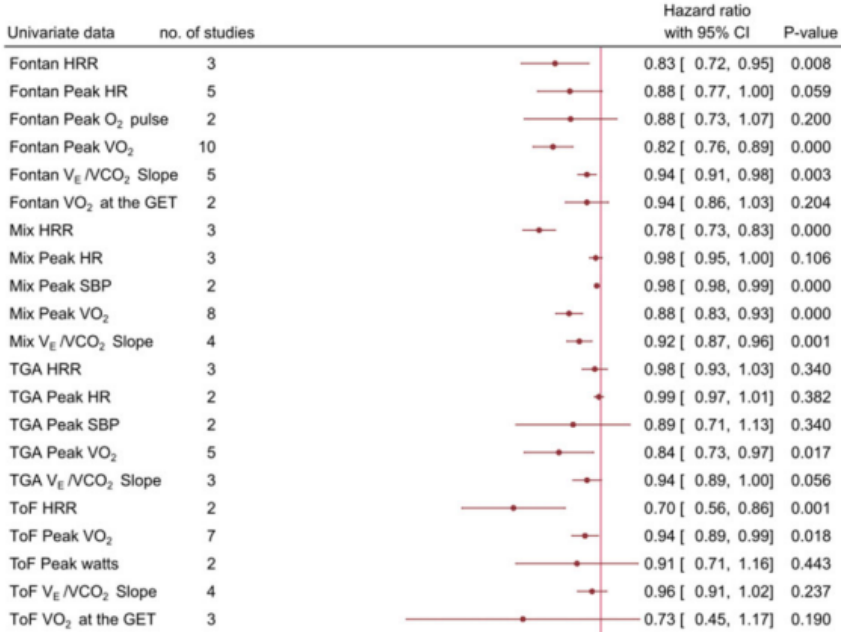
The role of cardiopulmonary exercise testing in predicting mortality and morbidity in people with congenital heart disease: a systematic review and meta-analysis

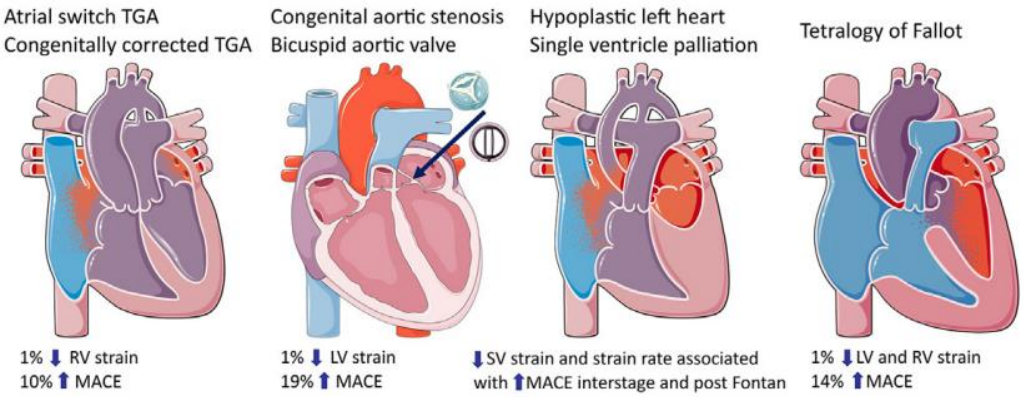
Curtis A. Wadey [1], Max E. Weston [1,2†], Dan Mihai Dorobantu [1,3†], Guido E. Pieles [4,5,6], Graham Stuart [4,5], Alan R. Barker [1], Rod S. Taylor [7], and Craig A. Williams [1*]

CPET → prognostic of long-term outcomes
Unspecific to disease mechanisms
Loss of functionality → irreversible?



Univariate data	no. of studies	Hazard ratio with 95% CI	P-value
Fontan HRR	3	0.83 [0.72, 0.95]	0.008
Fontan Peak HR	5	0.88 [0.77, 1.00]	0.059
Fontan Peak O_2 pulse	2	0.88 [0.73, 1.07]	0.200
Fontan Peak VO_2	10	0.82 [0.76, 0.89]	0.000
Fontan V_E/VCO_2 Slope	5	0.94 [0.91, 0.98]	0.003
Fontan VO_2 at the GET	2	0.94 [0.86, 1.03]	0.204
Mix HRR	3	0.78 [0.73, 0.83]	0.000
Mix Peak HR	3	0.98 [0.95, 1.00]	0.106
Mix Peak SBP	2	0.98 [0.98, 0.99]	0.000
Mix Peak VO_2	8	0.88 [0.83, 0.93]	0.000
Mix V_E/VCO_2 Slope	4	0.92 [0.87, 0.96]	0.001
TGA HRR	3	0.98 [0.93, 1.03]	0.340
TGA Peak HR	2	0.99 [0.97, 1.01]	0.382
TGA Peak SBP	2	0.89 [0.71, 1.13]	0.340
TGA Peak VO_2	5	0.84 [0.73, 0.97]	0.017
TGA V_E/VCO_2 Slope	3	0.94 [0.89, 1.00]	0.056
ToF HRR	2	0.70 [0.56, 0.86]	0.001
ToF Peak VO_2	7	0.94 [0.89, 0.99]	0.018
ToF Peak watts	2	0.91 [0.71, 1.16]	0.443
ToF V_E/VCO_2 Slope	4	0.96 [0.91, 1.02]	0.237
ToF VO_2 at the GET	3	0.73 [0.45, 1.17]	0.190

CHD prognostics



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The Role of Speckle-Tracking Echocardiography in Predicting Mortality and Morbidity in Patients With Congenital Heart Disease: A Systematic Review and Meta-analysis

Dan M. Dorobantu, MBBS [a,b] · Nurul H. Amir, MSc [b,c] · Curtis A. Wadey, MSc [a] · Chetanya Sharma, MBBS [d] · A. Graham Stuart, MBChB, MSc [b,d] · Craig A. Williams, PhD [a] · Guido E. Pieles, PhD [d,e,f] Show less

Cardiac function (strain) → more specific to disease type

Measured at rest → not reflective of exercise capacity

Most sensitive prognostic factor now → is it enough?

Gaps in knowledge

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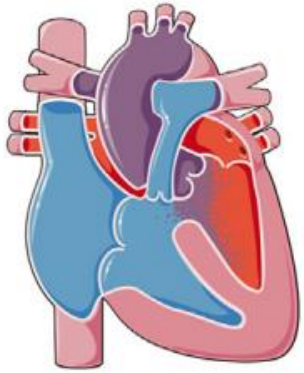
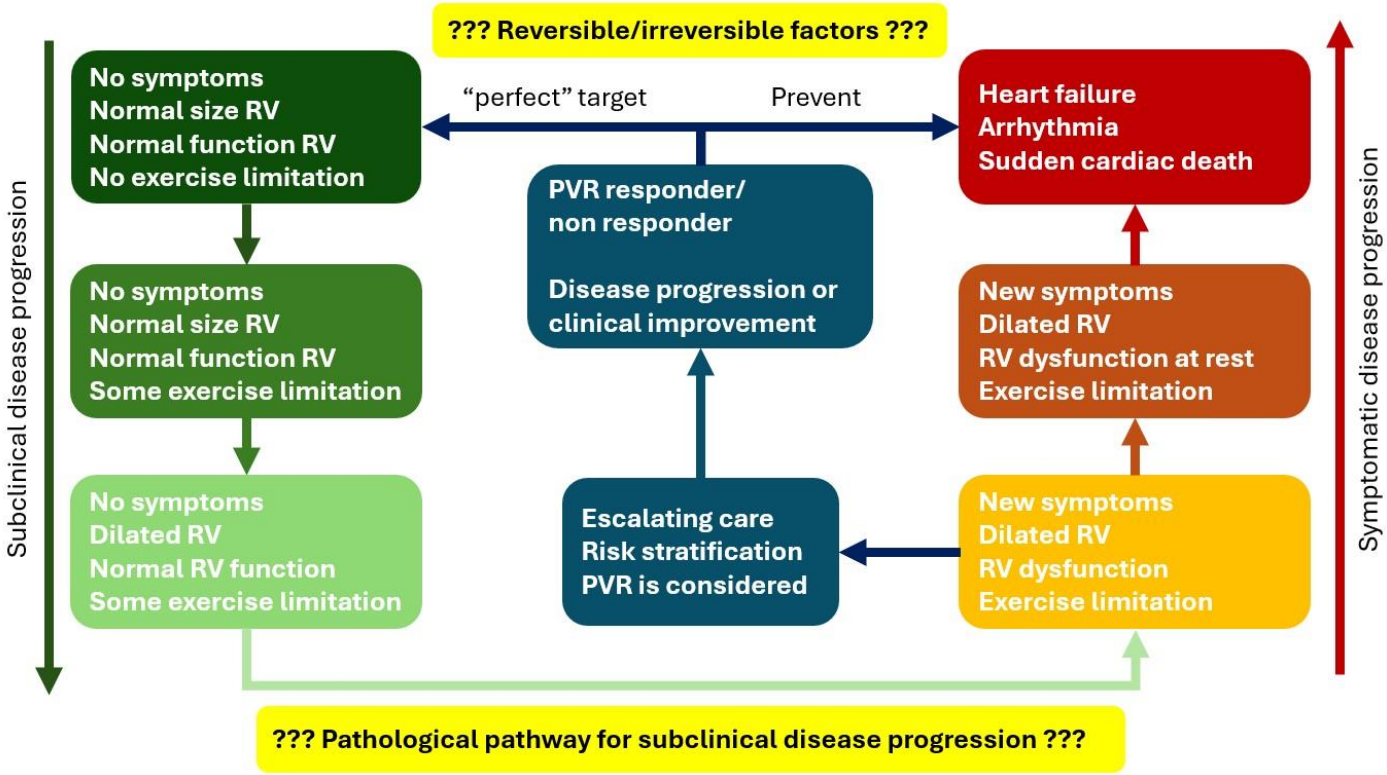
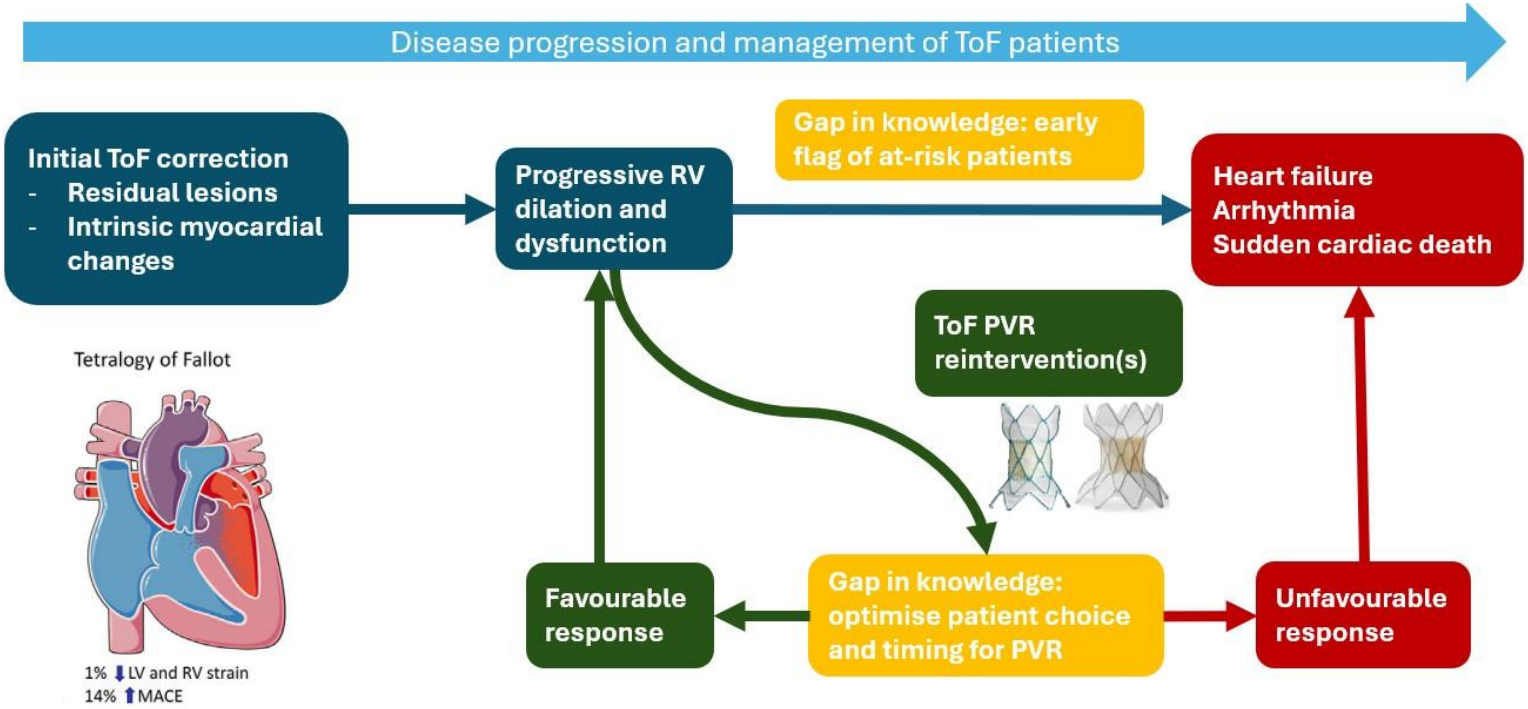
Tetralogy of Fallot



1% ⬇ LV and RV strain
14% ⬆ MACE



Gaps in knowledge

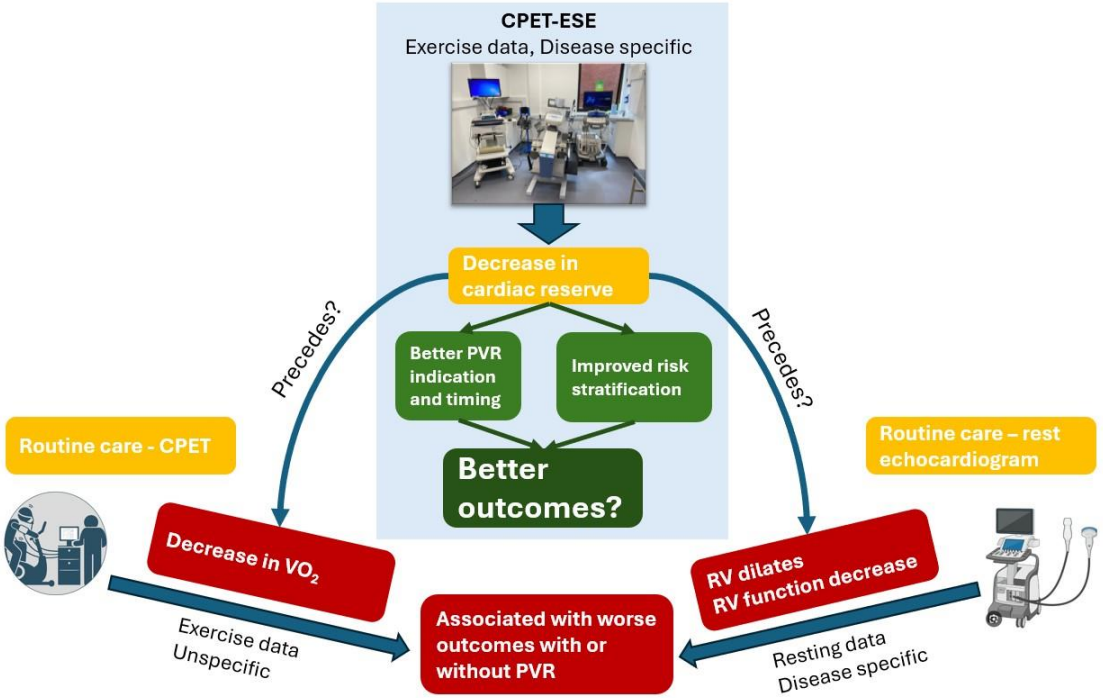


Exercise echo - potential

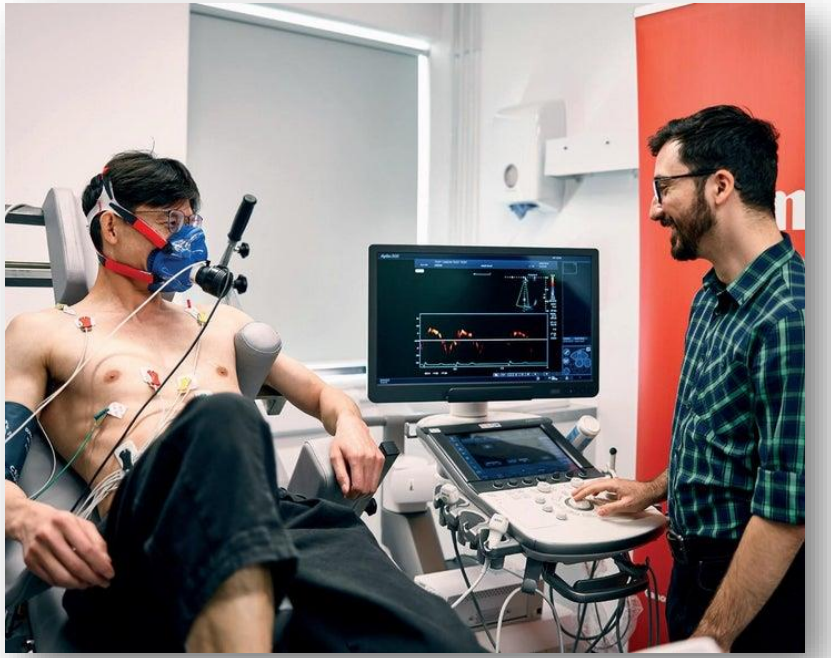
Exercise cardiac reserve → changes before resting function

Exercise cardiac reserve → changes before functional capacity

Is cardiac reserve the missing link in prognosis and intervention timing decisions?



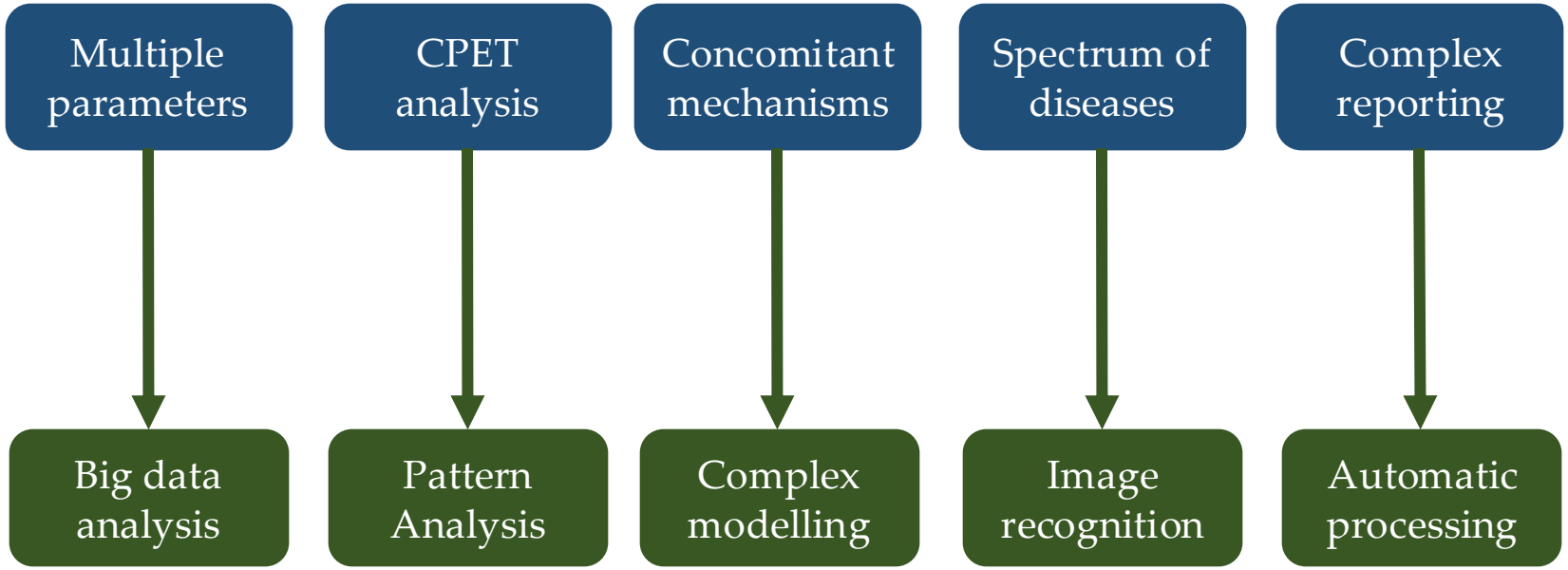
What is exercise echo?



Exercise echo in CHD – complex problems

- 100 parameters can be measured and derived
- CPET analysis is only semi-structured
- Reporting and measurements are time consuming
- Multiple concomitant disease modifying factors
- CHD are spectrums of diseases, not single entities

Using data analysis in ESE



The CHD ESE research workflow of my dreams

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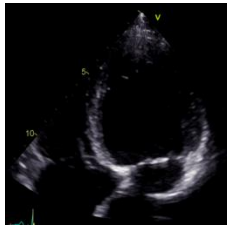

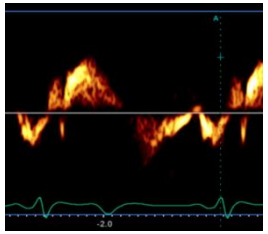

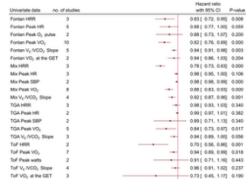

- Semi-automatic CPET core report
- Automatic view recognition
- Hands-off core measurements
- Variables of interest identification
- Key mechanisms for prognostic

Current work and future pipeline

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- N=120 healthy standardised CPET-ESE studies
- 10 to 65 years old
- Full assessments:
  - Resting ECG
  - Resting echo
  - CPET data (raw, detailed)
  - Exercise ECG continuous strip
  - Stress echo @moderate and @high intensity
- Stress echo
  - >330 GB of raw DICOM data
  - Each study uses 2D moving images, Doppler, Tissue Doppler
  - >100 variables measured by experts
- Grant applications for use in CHD → underway

Future

Train new/existing algorithms on this data
Implement and translate into CHD
Generate clinical tools
Generate new IP

Thank you!