cardiac imaging for structural heart disease

Imaging modalities.

Procedure specific modalities.

Multi modality imaging.

Interventional Imaging.

Future developments.
# Wellington Structural Heart

**Interventional Cardiologist**  
[Image of Phillip Matis]

**Interventional Imaging Cardiologist**  
[Image of Alexander Sasse]

## Table 1: Overview of Congenital and Structural Heart Disease Interventions

<table>
<thead>
<tr>
<th>Category</th>
<th>Procedures</th>
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</thead>
</table>
| **Valvular** | - Valve repair techniques  
- Balloon valvuloplasty  
- Paravalvular leak closure  
- Transcatheter valve replacement |
| **Congenital** | - Atrial septal defect closure  
- Ventricular septal defect closure  
- Closure of patent ductus arteriosus  
- Interventional treatment of coarctation  
- Closure of fistulae |
| **Structural** | - Patent foramen ovale closure  
- Left atrial appendage closure  
- Closure of post-myocardial infarction ventricular septal defects  
- Interventional techniques to treat heart failure |
cardiac imaging for structural heart disease

Imaging modalities.

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Tools in Interventional Imaging

- **Echo:**
  - Transthoracic - TTE
  - Contrast (saline contrast and left heart contrast)
  - 3D
  - TOE
  - ICE

- **CT:**
  - CTCA and cardiac CT
  - Post-processing

- **Angiography** and invasive hemodynamic assessment:
  - Left heart cath
  - Right heart cath
  - Complex haemodynamics and shunt calculation

- **MRI:**
  - Complex and congenital heart disease
  - Non-invasive haemodynamics
cardiac imaging for structural heart disease

Imaging modalities.

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**Multi modality imaging.**

Interventional Imaging.

Future developments.

1. Using multiple sequential modalities to come to a unifying understanding of diagnosis and anatomy.
2. Using multiple modalities simultaneously.

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**Multimodality Imaging in Structural Heart Disease**

**Costs of Medical Imaging**


Computed tomography (CT) and positron-emission tomography (PET) expose patients to radiation; magnetic resonance imaging (MRI) does not. Data are from a 2007 analysis conducted by the Office of Inspector General, Department of Health and Human Services.
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Atrial Septal Defect - ASD

**Diagnosis and Work-Up**

- TTE – initial diagnosis
- TOE – fundamental imaging to define structure, 3 D for spatial orientation
- MRI - Shunt (Qp:Qs) and RV function
- Right Heart Cath – Shunt and pulmonary pressures

**Intra Procedural**

- TOE – guidance, sizing
- Fluoroscopy – catheter motion
- [ICE – intra cardiac ultrasound]
Patent Foramen Ovale - PFO

Diagnosis and Work-Up

- TTE with saline contrast – initial diagnosis
- TOE – fundamental imaging to define structure and rule out ASD
- [TCD – trans cranial doppler]

Intra Procedural

- TOE – guidance, sizing
- Fluoroscopy – catheter motion
- [ICE – intra cardiac ultrasound]
Left Atrial Appendage Closure - LAAC

(1) Biase et al. JACC 2012, 60: 531-538
Left Atrial Appendage Closure - LAAC

Diagnosis and Work-Up

- TOE – fundamental imaging to define structure, 3 D for spatial orientation, rule out current LAA thrombus
- [CT – ECG gated, high resolution scan]

Intra Procedural

- TOE – trans-septal puncture, guidance, sizing.
- Fluoroscopy – catheter motion
- [ICE – intra cardiac ultrasound]

Ventricular Septal Defect - VSD

Diagnosis and Work-Up

- TTE including 3D
- TOE –define structure
- CT – angle independent analysis and planning
- [MRI – functional relevance, tissue characterization]

Intra Procedural

- TOE – guidance, sizing.
- Fluoroscopy – catheter and device motion
- [Echo and Fluoroscopy simultaneous multimodality imaging]
- [ICE – intra cardiac ultrasound]
Transcatheter Aortic Valve Implantation - TAVI

**Diagnosis and Work-Up**
- TTE for valve characterisation and general work up
- CT – high resolution ECG gated, allows multi angle post processing

**Intra Procedural**
- Fluoroscopy – catheter and device motion
- TTE for general imaging including AR
- [TOE – for specific questions]

Percutaneous Mitral Valve Repair - Mitraclip

**Diagnosis and Work-Up**
- TTE initial diagnosis and valve characterisation
- TOE – define structure, including 3D
- [CT – angle independent analysis and planning]

**Intra Procedural**
- TOE – trans septal puncture. 3D and multi plane.
- Fluoroscopy – catheter and device motion
- [Echo and Fluoroscopy simultaneous multimodality imaging]
- [ICE – intra cardiac ultrasound]
Paravalvular Leak - PVL

**Diagnosis and Work-Up**

- TTE initial diagnosis and valve characterisation
- TOE – define structure, including TOE
- CT – angle independent analysis and planning

**Intra Procedural**

- TOE – guidance, sizing, trans septal puncture. 3D and multi plane.
- Fluoroscopy – catheter and device motion
- [Echo and Fluoroscopy simultaneous multimodality imaging]
- [ICE – intra cardiac ultrasound]

**cardiac imaging for structural heart disease**

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Hand to Eye Coordination

Team SHD

SHD Training

**Focus Intervention**
- Angiography incl. right heart cath
- [coronary artery disease intervention]
- Echo and TOE – [Operational Knowledge]
- Cardiac CT and post-processing
- Interventional SHD Portfolio:
  - ASD, PFO, LAAC, VSD
  - Aortic Valve – BAV, TAVI
  - Mitral Valve – PTMC, Mitraclip …, PVL

**Focus Imaging**
- Angiography incl. right heart cath
- Echo in all modalities
- Cardiac CT – acquisition and post-processing
- [Cardiac MRI]

Interventional SHD Portfolio
[and Operational Knowledge]:
SHD intervention is a burgeoning field. The sub-specialty of interventional imaging will likely develop out of an increased need for high-quality imaging. Imaging expertise constitutes a key factor in the decision-making process and in the management of patients with SHD in order to offer patients optimal outcomes from transcatheter interventions.

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Interventional Cardiovascular MRI - iCMR

3D Printing in SHD
Hybrid Cath Lab

Sabbatical Experience: 9 countries

Depends entirely on local infrastructure and organization.

**Hurdles**

Little incentive for cardiologists.
Few surgeons able to do percutaneous interventions.
Who owns the lab?
Reimbursement.

cardiac imaging for structural heart disease

**The Future is here.**

Team work.

Multiple modalities.

Interventional Imaging Cardiologist.

Alexander Sasse