Sequential Segmental Analysis

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Sequential Segmental Approach

- The need for a system

- Logical approach to each patient

- Accounts for all anatomies

- Does not rely on embryology or surgical trends
Sequential Segmental Approach

Richard and Stella Van Praagh

Bob Anderson Anton Becker + many others

International Agreement

ISNPCHD

ICD-11

www.ipccc-awg.net
Sequential Segmental Approach

- The approach to analysis
  - Work out which components of the heart are present
  - Work out how they are connected
  - Document any associated lesions
How do we start the analysis?
Segmental Analysis of the Heart
Sequential Segmental Approach

- **The approach to analysis**
  - Analyse in 3 segments
  - Limited variation within each segment
  - Limited number of segmental connections
  - Any number of associated lesions
How can we recognise the morphology of the segments?
The Morphologic Method (Lev 1954)

- "Cardiac chambers are identified in terms of their gross myocardial (morphologic) characteristics"
- "They are not identified according to the vessel or valve of entry, nor relative position, nor in terms of the blood conveyed by the chamber, because these are variables in heart disease"
Sequential Segmental Approach

- **The Morphologic Method (Anderson)**
  - Segments are sub-divided into **component parts**
  - The **part** that is **most constant** is used to define the **segment**
    - “**a feature that is always present (or almost always) in the normal heart and in hearts with congenital malformations**”
The Atriums
How many Components?

Atrial Chambers
How many Components?

1. Venous

Atrial Chambers

Pulm. Veins
How many Components?

1. Venous

Atrial Chambers
How many Components?

1. Venous
2. Septal

Atrial Chambers
How many Components?

1. Venous
2. Septal
3. Body
How many Components?

1. Venous
2. Septal
3. Body

Atrial Chambers
How many Components?

1. Venous
2. Septal
3. Body
4. Vestibule
How many Components?

1. Venous
2. Septal
3. Body
4. Vestibule

Atrial Chambers
How many Components?

1. Venous
2. Septal
3. Body
4. Vestibule
5. Appendage

Atrial Chambers
How many Components?
1. Venous
2. Septal
3. Body
4. Vestibule
5. Appendage

Atrial Chambers
Normal Right Atrial Appendage
FOUR patterns of atrial arrangement

- Usual Atrial Arrangement
- Mirror-imaged Arrangement
- Right isomerism
- Left isomerism
Is that what you see on echo?
**Correlation with Ultrasound**

Usual arrangement (Situs Solitus) or \{S, , \}

Mirror-imagery (Situs Inversus) or \{I, , \}
**Correlation with Ultrasound**

**Right Isomerism**
- Asplenia (Asplenia) or \{A, \}
- Mid-line Liver
- Malrotated gut
- Desc Ao
- IVC

**Left Isomerism**
- Polysplenia (Polysplenia) or \{A, \}
- Mid-line Liver
- Malrotated gut
- Absent IVC
- Azygous
- Desc Ao
- Polysplenia
The Ventricles
How many Components?

Right Ventricle
- Outlet
- Inlet
- Apical Trabecular (Course)

Left Ventricle
- Outlet
- Inlet
- Apical Trabecular (Smooth)
Rare case - Solitary / ‘indeterminate’ Ventricle
The Great Arteries
How many Components?

Pulmonary Trunk

Aorta

Branching Pattern

Right Pulmonary Artery

Left Pulmonary Artery

Pulmonary Trunk

Brachiocephalic artery

Left common carotid artery

Left sub-clavian artery

Coronary arteries
The Four Types of Arterial Trunk

- **Aortic Trunk**
- **Pulmonary Trunk**
- **Common Arterial Trunk**
  - Central PA’s (within pericardial sac)
- **Solitary Arterial Trunk**
  - No Central PA’s (but collaterals)
Limited Variability in the Segments

**Atrial**
- Two morphological types of atrium:
  - Morph. Right
  - Morph. Left

**Ventricular**
- Three morphological types of ventricle:
  - Morph. Right
  - Morph. Left
  - Indeterminate

**Arterial**
- Four anatomic types of arterial trunk:
  - Aorta
  - Pulmonary Trunk
  - Common Arterial Trunk
  - Solitary Arterial Trunk
Sequential Segmental Approach

- The approach to analysis
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Topology of the ventricles

Defined from the morphologic Right Ventricle

Right-hand ventricular topology
(usual arrangement)
(D-loop), { ,D, }

Left-hand ventricular topology
(mirror-image arrangement)
(L-loop) , { ,L, }

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Sequential Segmental Analysis
Atrioventricular connections - Biventricular

CONCORDANT

CONCORDANT
Sequential Segmental Analysis
Atrioventricular connections - Biventricular

DISCORDANT

DISCORDANT
Sequential Segmental Analysis

Atrioventricular connections - Biventricular

ISOMERISM
RIGHT-HAND TOPOLOGY

ISOMERISM
LEFT-HAND TOPOLOGY

MIXED

Ambiguous?
3 types of Biventricular AV Connection

1. Right Hand Topology
   - Usual Atrial Arrangement
   - Mirror-imagery
   - CONCORDANT

2. Left Hand Topology
   - Usual Atrial Arrangement
   - Mirror-imagery
   - DISCORDANT

3. MIXED
   - Right Hand Topology
   - Left hand topology

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3 types of Univentricular AV Connection

USUAL ARRANGEMENT

RIGHT ISOMERISM

LEFT ISOMERISM

MIRROR-IMAGE ARRANGEMENT

ABSENT LEFT CONNECTION

DOUBLE INLET

ABSENT RIGHT CONNECTION

DOMINANT LV WITH RUDIMENTARY RV

INDETERMINATE

SOLITARY INDETERMINATE VENTRICLE

DOMINANT RV WITH RUDIMENTARY LV

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3 types of Univentricular AV Connection

- Usual Arrangement
- Right Isomerism
- Left Isomerism
- Mirror-Image Arrangement

- Absent Right Connection
- Double Inlet
- Absent Left Connection

- Dominant LV with Rudimentary RV
- Indeterminate
- Solitary Indeterminate Ventricle

- Dominant RV with Rudimentary LV

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Double Inlet Indeterminate (Solitary) Ventricle
3 types of Ventriculo-Arterial Connection with two arterial trunks

1. CONCORDANT

2. DISCORDANT

3. DOUBLE OUTLET
4 types of Ventriculo-arterial Connection with single outlet

4. Pulmonary Trunk (Aortic atresia)

5. Aorta (Pulm. atresia)

6. Common Trunk

7. Solitary Trunk
How do we deal with overriding valves?
How do we deal with overriding valves?

50% Rule

When a valve overrides we assign it to the ventricle to which the majority of it is connected! (cut off is 50%)

Overriding (and straddling) Tricuspid Valve

CONCORDANT AV connections
How do we deal with overriding valves?

50% Rule

When a valve overrides we assign it to the ventricle to which the majority of it is connected! (cut off is 50%)

Overriding (and straddling) Tricuspid Valve

Double Inlet Left Ventricle
Overriding valves - 50% Rule

Transposition or DORV?
Overriding valves - 50% Rule

Double Outlet Right Ventricle
The approach to analysis

- Work out which components of the heart are present
- Work out how they are connected
- Document any associated lesions
Associated Lesions - Mode of Connection

Concordant AV connections - imperfect right AV valve
Sequential Segmental Approach

- **Document associated malformations**
  - Imperforate, straddling or common valve
  - Septal defects - ASD, VSD, AVSD
  - Position of heart / great arteries
  - Infundibular anatomy...
  - etc, etc....
Sequential Segmental Approach

- A logical approach to analysis
- A common language
- Accounts for all cases
- Describes what you see!!

Summary