INTRODUCTION TO HUMAN HEART DEVELOPMENT
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POSTNATAL CIRCULATION

HUMAN HEART DEVELOPMENT

CONGENITAL HEART DISEASE

LONGITUDINAL FOLDING
POSITIONS CARDIAC CELLS
LATERAL FOLDING FACILITATES TUBE FORMATION

TUBE FORMATION BEGINS ROSTRALLY

PRIMITIVE HEART TUBE

CARDIAC LOOPING

CARDIAC LOOPING

DEXTROCARDIA AND SITUS INVERSUS
GENETIC BASIS FOR HETEROTAXY

- NODAL FAMILY OF GROWTH FACTORS REQUIRED FOR ESTABLISHMENT OF LEFT-RIGHT AXIS
- CFC1 GENE ENCODES A COMPONENT OF THE RECEPTOR FOR NODAL FACTORS
- MUTATIONS IN CFC1 CAUSE HETEROTAXY

PARTITIONING THE HEART

- ATRIAL SEPTATION
- VENTRICULAR SEPTATION
- ATRIOVENTRICULAR VALVE FORMATION
- DIVISION OF THE OUTFLOW TRACT

ATRIAL SEPTATION I: SEPTUM PRIMUM

ATRIAL SEPTATION II: FORAMEN SECUNDUM

FROM FETAL TO POSTNATAL CIRCULATION

SAGITTAL SECTIONS

CORONAL SECTIONS
ATRIAL SEPTATION III: SEPTUM SECUNDUM

ATRIAL SEPTATION IV: COMPLETION

ATRIAL SEPTAL DEFECTS

GENETIC CAUSES OF ASD
HETEROZYGOSITY OF MUTATIONS IN GENES LIKE:
- \( Nkx2-5 \), ENCODING A HOMEODOMAIN TRANSCRIPTION FACTOR
- \( TBX5 \), ENCODING A T-BOX TRANSCRIPTION FACTOR (HOLT-ORAM SYNDROME)

BEGINNING OF VENTRICULAR SEPTATION

PROGRESSION OF VENTRICULAR SEPTATION
COMPLETION OF VENTRICULAR SEPTATION

- MUSCULAR SEPTUM
- MEMBRANOUS SEPTUM
- CONOTRUNCAL SEPTUM

MEMBRANOUS VSD

NORMAL VSD

ENDOCARDIAL CUSHION FORMATION

VALVE FORMATION

Cusps of mitral valve
Chordae tendineae
Papillary muscle

Cusps of tricuspid valve
Developing mitral valve
Membranous part of interventricular septum

OUTFLOW SEPTATION

Aorta
Pulmonary trunk
DEFECTS IN OUTFLOW SEPTATION

NORMAL

NO SEPTUM: PERSISTENT TRUNCUS ARTERIOSUS

STRAIGHT SEPTUM: TRANPOSITION OF GREAT VESSELS

ASYMMETRIC SEPTUM: PULMONARY STENOSIS; TETRALOGY OF FALLOT

NEURAL CREST AND OUTFLOW TRACT SEPTATION

NORMAL

NO SEPTUM: PERSISTENT TRUNCUS ARTERIOSUS

STRAIGHT SEPTUM: TRANPOSITION OF GREAT VESSELS

ASYMMETRIC SEPTUM: PULMONARY STENOSIS; TETRALOGY OF FALLOT

GENETIC BASIS FOR OUTFLOW DEFECTS

• TBX1 ENCODES A TRANSCRIPTION FACTOR EXPRESSED NEAR MIGRATING NEURAL CREST CELLS

• TBX1 MUTATION IN MICE CAUSES DEFECTS RESEMBLING DIGEORGE SYNDROME

• DELETION OF TBX1 FOUND IN MANY DIGEORGE SYNDROME PATIENTS

HUMAN HEART DEVELOPMENT

• HEART TUBE FORMATION

• CARDIAC LOOPING

• CHAMBER SEPTATION

• VALVE AND OUTFLOW FORMATION

SINUS VENOSUS AND RIGHT ATRIUM

NORMAL

NO SEPTUM: PERSISTENT TRUNCUS ARTERIOSUS

STRAIGHT SEPTUM: TRANPOSITION OF GREAT VESSELS

ASYMMETRIC SEPTUM: PULMONARY STENOSIS; TETRALOGY OF FALLOT
PULMONARY VEINS AND LA

Pulmonary veins
Pulmonary vein
Right and left pulmonary veins
Primordial pulmonary vein
Primordial atrium
Entrance of four pulmonary veins
Primordial left atrium
Part of left atrium formed from absorbed pulmonary vein blebs
Smooth-walled part of left atrium

ATRIAL SEPTAL DEFECTS

• OSTIUM PRIMUM (LOW) ASD
• OSTIUM SECUNDUM (HIGH) ASD
• SINUS VENOSUS ASD