CARDIOVASCULAR SYSTEM:
EARLY DEVELOPMENT - I
BLOOD VESSELS OF THE EMBRYO
(at 26 days)
NORMAL: Loop to the RIGHT: Levocardia!
ABNORMAL: Loop to the LEFT: Dextrocardia!
FROM TUBE TO FOUR CHAMBERS
INTERNAL VIEW
FOUR CHAMBERS- ULTRASOUND VIEW
@ 20 wks
ATRIAL SEPTUM FORMATION - I

RA, right atrium
RV, right ventricle
LA, left atrium
LV, left ventricle

Septum primum
Foramen primum
Dorsal endocardial cushions

Perforations represent the developing foramen secundum
Fused endocardial cushions

Red arrows—well oxygenated blood  Blue arrows—poorly oxygenated blood
ATRIAL SEPTUM FORMATION- II

Red arrows—well oxygenated blood  Blue arrows—poorly oxygenated blood

Foramen secundum
Foramen primum

Developing septum secundum
Foramen secundum
Septum primum
Foramen primum closed
Primordial AV septum

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ATRIAL SEPTUM FORMATION- III

- Septum secundum (upper limb)
- Foramen secundum
- Oval foramen
- Valve of oval foramen (derived from septum primum)
- Septum secundum (lower limb)

E

E1

F

F1
ATRIAL SEPTUM FORMATION- V

BEFORE BIRTH

RIGHT ATRIUM
HIGHER PRESSURE

LEFT ATRIUM
LOWER PRESSURE

Septum secundum

Shunt

Oval foramen

Septum primum (valve of oval foramen)

AFTER BIRTH

RIGHT ATRIUM
LOWER PRESSURE

LEFT ATRIUM
HIGHER PRESSURE

Septum secundum

Oval fossa

Septum primum

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**NOTE: In 25% of normal population, the foramen ovale remains ‘probe patent’.
THE DEFINITIVE LEFT ATRIUM

A. Pulmonary veins
   Primordial pulmonary vein
   Primordial left atrium

B. Part of left atrium formed from absorbed pulmonary vein tissue
   Primordial left atrium

C. Right and left pulmonary veins
   Primordial left atrium

D. Entrance of four pulmonary veins
   Smooth-walled part of left atrium
   Left auricle

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ATRIAL SEPTAL DEFECTS- “Fossa Ovalis” type
ATRIAL SEPTAL DEFECTS- Unrelated to Foramen Ovale

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AORTIC ARCHES AND DERIVATIVES - II

Diagram showing the relationships between various arterial structures, including:
- 3rd aortic arch
- 4th aortic arch
- 6th aortic arch
- Truncus arteriosus
- Aortic sac
- Dorsal aortae
- Internal carotid arteries
- External carotid arteries
- Brachiocephalic artery
- Subclavian arteries
- Ascending aorta
- Ductus arteriosus
- Left pulmonary artery
- Right pulmonary artery
- Ascending aorta
- Descending aorta
- Left subclavian artery
- Arch of aorta
- Ligamentum arteriosum
- Pulmonary trunk
RECURRENT LARYNGEAL NERVES
Right vs Left
PATENT DUCTUS ARTERIOSUS

Prostaglandin: Keeps the duct Patent
Indomethacin: Closes the duct.
RIGHT AORTIC ARCH: Mirror image branching

A

Ductus arteriosus
Left dorsal aorta
Left subclavian artery
Area of involution

B

Right subclavian artery
Trachea
Esophagus
Left subclavian artery
Ligamentum arteriosum
Right arch of aorta
Descending aorta
ABERRANT RIGHT SUBCLAVIAN ARTERY:

Occurs in 0.5% of people. Usually asymptomatic.
DOUBLE AORTIC ARCH: “Vascular ring”
Causes airway obstruction, stridor in infancy.
COARCTATION OF THE AORTA
THE CARDINAL VEINS AND THE VENAE CAVAE

Anterior cardinal v.
Sinus venosus
Common cardinal v.
Vitelline and umbilical vv.
Posterior cardinal v.
Subcardinal v.
Subcardinal anastomosis
Anastomosis through mesonephros (early kidney)
Iliac venous anastomosis of postcardinal vv.

Anterior cardinal v.
Common cardinal v.
Caudal extension of hepatic segment of IVC
Supracardinal v.
Subcardinal v.
Subcardinal anastomosis
Subsupracardinal anastomosis
Posterior cardinal v.
Iliac venous anastomosis of posterior cardinal vv.
THE CARDINAL VEINS AND THE VENAE CAVAE

Subclavian v.
Hepatic segment of inferior vena cava (IVC)
Prerenal segment of IVC (subcardinal v.)
Renal segment of IVC (subsupracardinal anastomosis)
Postrenal segment of IVC (supracardinal v.)
External iliac v.
Hypogastric v.
Common cardinal v.
Posterior cardinal v.
Subcardinal v.
Subcardinal anastomosis
Renal v.
Stern of internal spermatic v.
Internal spermatic v.
Iliac venous anastomosis of posterior cardinal vv.
R. internal jugular v.
R. external jugular v.
Superior vena cava
Azygos v.
IVC (inferior vena cava)
Hepatic v.
Hemiazygos v.
L. brachiocephalic v.
Oblique v.
I. subclavian v.
R. suprarenal v.
R. renal v.
R. internal spermatic v. or ovarian v.
L. suprarenal v.
L. renal v.
L. internal spermatic v. or ovarian v.
IVC
External iliac v.
Internal iliac v.
L. common iliac v.
Median sacral v.

Cardinal, umbilical, and vitelline veins
Subcardinal veins
Supracardinal veins
Hepatic segment
v. - vein
v. v. - veins

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SINUS VENOSUS AND THE CORONARY SINUS

A

- Left thymic and thyroid veins
- Truncus arteriosus
- Orifice of initial pulmonary vein
- Presumptive left ventricle
- Left horn of sinus venosus
- Left posterior cardinal vein
- Left umbilical vein
- Vitelline veins

B

- Anterior cardinal veins
- Presumptive right ventricle
- Right horn of sinus venosus
- Orifices of pulmonary veins
- Right subclavian vein
- Oblique vein on the left atrium

C

- Jugular veins
- Left pulmonary artery
- Superior vena cava
- Coronary sinus
- Right brachiocephalic vein
- Right subclavian vein
- Inferior vena cava

24 days

50 days

56 days
PERSISTENT LEFT SVC

0.3% of general population.
4% of patients with Cong. Ht Dis.

Usually drains to Coronary sinus.
Usually asymptomatic.

Enlarged coronary sinus is a clue.
Left SVC to coronary sinus
UMBILICAL AND VITELLINE VEINS- I: Liver, portal vein and ductus venosus.
UMBILICAL AND VITELLINE VEINS- II:
Liver, portal vein and ductus venosus.
LYMPHATIC SYSTEM - II

Right lymphatic duct
Internal jugular vein
Subclavian vein
Superior vena cava
Anastomosis
Thoracic duct
Thoracic ducts
Chyle cistern
Retroperitoneal lymph sac
Iliac lymph sac
Lymph node

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FETAL CIRCULATION

Oxygen saturation of blood:
- Red: High oxygen content
- Purple: Medium oxygen content
- Blue: Poor oxygen content

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