Week 3: gastrulation

Resources:
http://php.med.unsw.edu.au/embryology/
Larsen’s Human Embryology
The Developing Human: Clinically Oriented Embryology

Dr Annemiek Beverdam – School of Medical Sciences, UNSW
Wallace Wurth Building Room 234 – A.Beverdam@unsw.edu.au
Week 1/2 Lecture overview

Fertilization
Cleavage stages
Morula formation
Blastocyst formation
Implantation
Generation of bilaminar embryo

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Week 3 Lecture overview

- Placentation
- Body axes
- Gastrulation
- Notochord formation
- Embryo folding

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Implantation

Week 2

Extra-embryonic mesoderm of the second week is probably generated by hypoblast cells.
Placentation

1st week: Nutrients through diffusion
Later: uteroplacental circulation

Day 11-13
Trophoblastic lacunae
Fusion with maternal circulation

Primary chorionic stem villi formation: Cytotrophoblast projections into lacunae
Placentation

Day 16
Secondary stem villus
Cytotrophoblast projections

Day 21
Tertiary stem villus
Blood vessel development
Placentation

Placental barrier

No mixing of embryonic and maternal blood

4 separating tissue layers:
- Endothelium
- Connective tissue (EEM)
- Cytotrophoblast
- Syncytiotrophoblast
Body axes
Anatomical orientation
Implantation

Week 2

- Week 1, Day 1: Trophoblast differentiates into cytotrophoblast and syncytiotrophoblast and begins to implant into the uterine endometrium; embryonic disc becomes bilaminar.

- Week 1, Day 8: Amniotic cavity forms; syncytiotrophoblast expands.

- Week 1, Day 9: Cells migrate from hypoblast to form primary yolk sac; lacunae form within the syncytiotrophoblast; implantation is complete; syncytiotrophoblast surrounds embryo.

- Week 2, Day 10: Extraembryonic mesoderm forms and splits to form chorionic cavity: trophoblastic lacunae anastomose with maternal blood sinusoids.

- Week 2, Day 11: Cells migrate from hypoblast to form secondary yolk sac; primary yolk sac pushed aside and begins to degenerate.

- Week 2, Day 12: Primary yolk sac is reduced to a remnant at the embryonic pole of the chorionic cavity.

- Week 3, Day 15: Embryo proper is attached to the chorion by the connecting stalk.
Gastrulation
Day 15

Formation of the 3 germ layers
Formation of body axes
Gastrulation
Day 16

Ingression of epiblast cells: EMT transition
Generation of definitive endoderm
Generation of intra-embryonic mesoderm
Oropharyngeal and cloacal membrane
Embryonic ectoderm
Gastrulation
Day 16

- Ingression of epiblast cells: EMT transition
- Generation of definitive endoderm
- Generation of intra-embryonic mesoderm
- Oropharyngeal and cloacal membrane
- Embryonic ectoderm

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http://php.med.unsw.edu.au/embryology/images/5/55/Mesoderm_001.mp4
Gastrulation

Ingression of epiblast cells: EMT transition
Gastrulation

DV axis generation: Nodal cilia, Lefty/Nodal signalling

http://php.med.unsw.edu.au/embryology/images/a/a9/Nodal_cilia_001.mp4
Gastrulation

**Epiblast** forms 3 germ layers:
- Ectoderm: epithelium (previous epiblast)
- Mesoderm: mesenchymal layer (embryonic connective tissue)
  - Endoderm: epithelium

**Hypoblast:**
- replaced by definitive endoderm
End product gastrulation:

Trilaminar embryo

**Ectoderm (Neural crest)**
- brain, spinal cord, eyes, *peripheral nervous system*
- epidermis of skin and associated structures,
  *melanocytes, cranial connective tissues (dermis)*

**Mesoderm**
- musculo-skeletal system, limbs
- connective tissue of skin and organs
- urogenital system, heart, blood cells

**Endoderm**
- epithelial linings of gastrointestinal, liver, pancreas,
  thyroid and respiratory tracts
Embryonic development:

3 weeks

37 weeks
Embryonic development:
Notochord

- Axial mesoderm
- Transient
- Crucial signalling centre
- Mechanical role in embryonic folding
Notochord

- Axial mesoderm
- Transient
- Crucial signalling centre
- Mechanical role in embryonic folding
Embryo folding

Generation of primitive gut
Neural plate and neural tube

http://php.med.unsw.edu.au/embryology/images/2/27/Week3_folding.mp4
≈ 3 week old embryo
≈ 4 week old embryo
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