Outline

General overview of prenatal development

Embryonic period phase 1
- Formation of bilaminar disk
- Formation of trilaminar disk (gastrulation)

Embryonic period phase 2
- Formation of neural tube
- Differentiation of mesoderm
- Folding of embryo
- Formation of pharyngeal arches

Development of head, face and oral cavity
- Face (bones and muscles)
- Pituitary gland
- Palate
- Tongue
- Thyroid
- Jaw bones
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Part 3
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Part 2
  • Formation of pharyngeal arches

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  • Face (bones and muscles)
  • Pituitary gland
  • Palate
  • Tongue
  • Thyroid
  • Jaw bones
Embryology Lecture part 1 Objectives

• In general, what happens in the first and second phases of the embryonic period?

• What happens during weeks 1 and 2?

• Describe the main events in gastrulation.

• How does the neural tube form, and what happens to it?

• How does lateral folding occur (what meets up with what?)

• What is the fate of the endoderm, mesoderm and ectoderm?
Outline

General overview of prenatal development
This YouTube video is awesome at explaining early embryonic development:

http://www.youtube.com/watch?v=rN3lep6roRI
Prenatal Development

Phase 1
- Cellular proliferation and migration

Phase 2
- Differentiation of internal & external structures

Phase 3
- Growth and maturation

0 1 2 3 4 5 6 7 8

Fertilization

Delivery
Outline

General overview of prenatal development

Embryonic period phase 1
  • Formation of bilaminar disk
Week 1: Differentiation of Morula into Blastocyst

Morula

Blastocyst
Week 2: Formation of Bilaminar Germ Disk

- Epiblast
- Hypoblast
- Amniotic cavity
- Secondary yolk sac
Outline

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  • Formation of bilaminar disk
  • Formation of trilaminar disk (gastrulation)
Gastrulation: formation of primitive streak

- primitive streak
- primitive node
- epiblast
Gastrulation: movement and differentiation of epiblast cells

Epiblast cells give rise to all three germ cell layers!
(the hypoblast does NOT turn into endoderm; it is displaced by endoderm)
Gastrulation: formation of notochord

The notochord is super important because it tells the three layers what to do next.
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Prenatal Development

Embryo

Phase 1
Cellular proliferation and migration

Phase 2
Differentiation of internal & external structures

Phase 3
Growth and maturation

Fetus

Fertilization

Delivery

0 1 2 3 4 5 6 7 8 40
Formation of the Neural Tube
Formation of the Neural Tube

Diagram showing the formation of the neural tube with labels for Notochord, Epidermis, Neural tube, Spinal ganglion, and Somites (mesoderm-derived).
How does the neural tube turn into the brain?

At about week 3-4, there are three brain vesicles.
THE MAJOR DIVISIONS OF THE BRAIN

FOREBRAIN
Processes sensory information, helps with reasoning and problem-solving, and regulates autonomic, endocrine, and motor functions

HINDBRAIN
Helps to regulate autonomic functions, relay sensory information, coordinate movement, and maintain balance and equilibrium

MIDBRAIN
Helps to regulate movement and process auditory and visual information
How does the neural tube turn into the brain?

By week 5, there are five brain vesicles!
Both the telencephalon and diencephalon must divide into two halves in order to form the two cerebral hemispheres and eyes.
Failure of these parts to divide properly results in a malformation called **holoprosencephaly**.
Holoprosencephaly is often associated with facial defects, which range from mild to severe.

Single incisor

Cyclopia
What about the rest of the neural tube?

The neural tube closes like a zipper, starting at the middle and moving towards the head and tail.
Embryo, day 23-26

- Neural tube still open
- Neural tube closing
- Somites
- Neural tube still open
If the neural tube doesn’t “zip up” properly, this can result in a malformation called spina bifida.
The posterior portions of the vertebrae remain open...
...and sometimes things protrude through the gap.

- Spina bifida occulta
- Meningocele
- Meningomyelocele

meninges and spinal cord
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Differentiation of mesoderm

- Forming neural tube
- Paraxial mesoderm
- Intermediate mesoderm
- Lateral plate mesoderm
Each somite has three subdivisions

- dermis
- muscle
- vertebral body
Cranial and sensory ganglia and nerves
  Adrenal medulla
  Bones of the head
  Pharyngeal arches
  Dentin
  Periodontal ligament
  Alveolar bone

Know this!

Posterior pituitary
  Pineal body
  Retina
  Central nervous system

Neuroectoderm

Neural crest

Surface ectoderm

Epidermis
  Hair
  Nails
  Mammary glands
  Anterior pituitary
  Lens of eye
  Inner ear
  Tooth enamel

Paraxial mesoderm

Bones of most of the body
  (everything except the head)
  Muscles of the body and head
  Dermis
  Pharyngeal arches
  Connective tissue

Intermediate plate mesoderm

Heart
  Hematopoietic system
  Lymphoid system
  Spleen
  Adrenal cortex
  Serous membranes of pleura, pericardium and peritoneum
  Pharyngeal arches
  Connective tissue

Lateral plate mesoderm

Endoderm

Lining of GI tract
  Lungs
  Liver, pancreas and gallbladder
  Bladder
  Thyroid follicular cells
  Tympanic cavity
  Tonsils
  Parathyroids

Know this!
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Lateral plate mesoderm splits in two. One part remains near the ectoderm. The other part follows the endoderm.
Folding of the Embryo

- Head fold
- Lateral fold
- Tail fold
Lateral Folding of the Embryo

Endodermal layer (lined by mesoderm) bends, the edges reaching towards each other, meeting in front to form the gut.

Ectodermal layer (lined by mesoderm) grows forward, reaches around the gut, and zips up the front to form the anterior body wall.
Lateral Folding of the Embryo

- Amnion (and amniotic cavity) comes along for the ride, eventually surrounding entire embryo.
- Back, with ectoderm overlying neural tube
- Gut (lined by endoderm, surrounded by mesoderm)
- Anterior thoracic wall (mesoderm covered with ectoderm)
- Paraxial mesoderm
- Intermediate mesoderm
- Lateral plate mesoderm
Head-Tail Folding of the Embryo
Head-Tail Folding of the Embryo

Before folding

Day 24

Day 26

Stomatodeum

Day 28