Practical 1: Embryology of the Gastrointestinal Tract

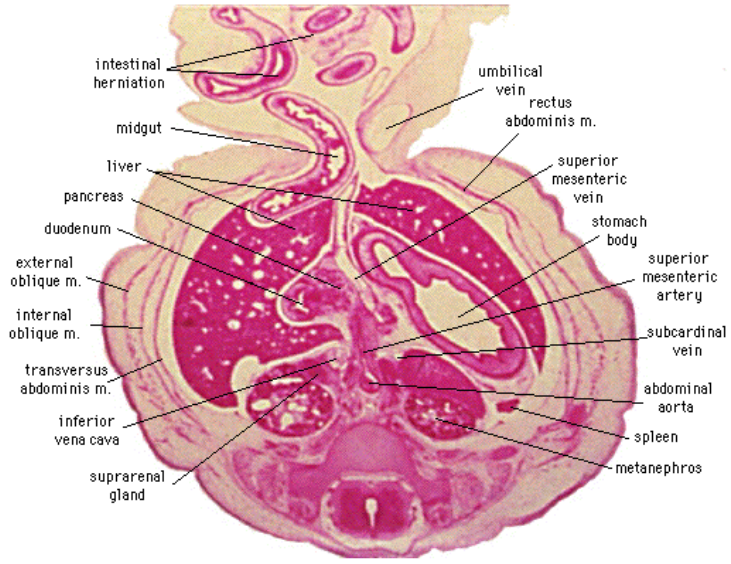
Principal Teacher: Dr Mark Hill

Specific Objectives:

1. Understand the different contributions of the trilaminar embryo to the gastrointestinal tract (GIT) system.
2. Brief understanding of yolk sac, endoderm development and folding.
3. Identify the adult structures developed from the fore-, mid- and hind-gut.
4. Understand the elongation, herniation and rotation of the mid-gut and appreciate the consequences of malrotation.
5. Brief understanding of the development of the liver, pancreas and spleen and identify the functions of these organs in the fetus.
6. Summarise the formation of the adult mesenteries of the gut.

Introduction

Gastrulation, "to form a gut" is the generation of the trilaminar embryo (ectoderm, mesoderm, endoderm), and is really just the earliest and first stage in GIT development, which is not completed until postnatal function has been established. In this class we will look at some key aspects of embryonic GIT development.



Human embryo (Carnegie stage 22, week 8) showing features of late embryonic GIT development.

Resources:

UNSW Embryology (http://php.med.unsw.edu.au/embryology)
This online class will work through a series of pages (see link below) with links to: electron micrographs, histological images, animations, glossary and additional resources. Serial images from selected developmental stages, early embryonic (stage 13), late embryonic (stage 22) and fetal (10 week) will also be used to show key features. Some congenital GIT abnormalities will also be discussed. There is an online Quiz to test your knowledge after completing the practical.

Practical Class Link:
http://php.med.unsw.edu.au/embryology/index.php?title=BGDB_Practical_-_Gastrointestinal_System_Development
Lecture Link:
http://php.med.unsw.edu.au/embryology/index.php?title=BGD_Lecture_-_Gastrointestinal_System_Development

Textbooks:

There are many good embryology textbooks available, select the one that best suits your studying style. The first two listed below are also available online through the UNSW library and are also linked from your online classes.
(More textbooks http://php.med.unsw.edu.au/embryology/index.php?title=Embryology_Textbooks)

1. **The Developing Human : Clinically Oriented Embryology** (8th ed.) Moore, Keith L; Persaud, T V N; Torchia, Mark G Philadelphia, PA : Saunders/Elsevier, (2008). Chapter 11
2. **Larsen's Human Embryology** (4th ed.) Schoenwolf, Gary C; Larsen, William J, (William James). Philadelphia, PA : Elsevier/Churchill Livingstone (2009). Chapter 14
3. **UNSW Embryology** (11th ed.) Hill, Mark (2011)
http://php.med.unsw.edu.au/embryology/index.php?title=Gastrointestinal_Tract_Development

Background:

If this is your first contact with embryology, I suggest that you take the time to examine general embryo development during the first 4 weeks prior to the class.

During the 4th week the 3 distinct portions (**fore-, mid-** and **hind-gut**) extend the length of the embryo and will contribute different components of the GIT. The large mid-gut is generated by lateral embryonic folding which "pinches off" a pocket of the **endoderm** of yolk sac, the 2 compartments continue to communicate through the villitine duct.

The oral cavity (**mouth**) is formed following breakdown of the **buccopharyngeal membrane** (=oropharyngeal) and contributed to mainly by the pharynx lying within the pharyngeal arches. The opening of the GIT means that it contains amniotic fluid, which is also swallowed later in development. At the other end of the GIT another membrane (**cloacal membrane)** also ruptures exposing a common **urogenital sinus**, which differentiates and separates to form distinct functional components. (**Urogenital sinus** development will be covered in Sexual Differentiation Practical)

The **hepatic diverticulum** (**liver** bud) lies under the **septum transversum** and is the earliest associated GIT organ that has differentiated, and will occupy a substantial region of the abdomen during development.

Much of the **midgut is herniated** at the umbilicus external to the abdomen through development. A key step in development is the rotation of this midgut that must occur to place the GIT in the correct abdominal position with its associated **mesentery**. The GIT itself differentiates to form significantly different structures along its length: oesophagus, stomach, duodenum, jejunum, ilium (small intestine), colon (large intestine).

The **mesentries** of the GIT are generated from the common dorsal mesentry, with the ventral mesentry contributing to the **lesser omentum** and **falciform ligament**.

The **pancreas** arises from 2 sources: the hepatic diverticulum (ventral) and the duodenum (dorsal). The pancreas also differentiates to establish specific cells for endocrine and exocrine function.

The **spleen** arises in week 5 within the **dorsal mesogastrium** as proliferating mesenchyme. Cells required for its hemopoietic function arise from the yolk sac wall. The spleen generates both red and white cells in the 2nd trimester. Note that embryonic RBCs remain nucleated.

Questions:

1. What parts of the GIT are derived from the different trilaminar embryo layers: endoderm, mesoderm, and ectoderm?
2. What associated organs differentiate in the dorsal and ventral mesogastriums?
3. What are the major nerve and blood supplies of the GIT?
4. Describe how both the stomach and midgut undergo rotation during development.
5. What newborn disease results from a lack of neural crest cell migration into the GIT?