NAME UNAH. CHIKE

COURSE CODE ANA206

MAT/NO 17/MHS01/315

Dept ANATOMY

LVL 300(c.o)

Rotation of the midgut happens during the second month of intra-uterine life. This is the gastrointestinal tract, consisting of the foregut, the hindgut, and the midgut. The midgut is continuous with the vitelline duct or yolk stalk, which later becomes obliterated.

Here's the aorta, here are the three arteries that supply the GI tract: the celiac for the foregut, the inferior mesenteric for the hindgut, and the superior mesenteric for the midgut.

As the midgut develops it protrudes into the body stalk forming a loop, with the superior mesenteric artery forming the axis of the loop.

As it protrudes, the midgut loop makes a quarter turn counter-clockwise, so its distal part is to the left and its proximal part is to the right. The distal part of the loop develops a bulge that will become the cecum, and the proximal part of the loop becomes quite convoluted.

During the time these changes are happening, the body continues to grow, and the abdominal cavity becomes large enough to allow the midgut to return.

The proximal part of the loop returns first. It passes under the distal part, and over to the left, that’s towards us in this view. The distal part of the loop returns last. It passes in front of the proximal part, and ends up over to the right.

Let's look at the same sequence of events from in front and somewhat to the left, so that we can understand how these changes produce a rotation of the midgut.

Here's the midgut loop protruding towards us, and making its first quarter turn counter clockwise. A bulge appears for the cecum, and the proximal part of the loop becomes convoluted.

The abdomen becomes larger, and the proximal limb of the loop returns. It passes under the distal limb, in effect making another quarter turn counter clockwise. Then the distal limb returns, completing the third quarter turn. This proximal part of the midgut, the distal duodenum, ends up behind this distal part of the midgut, the proximal transverse colon.

Understanding those developmental changes helps us understand not only where the duodenum lies, but also why the colon is where it is.

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| The midgut extends from the **apex of the duodenal loop**, which is fixed to the large liver anlage via the bile duct, to the **last third of the transverse colon**.   Its parts are:   * Inferior part of the duodenum with the duodeno-jejunal bend * Jejunum * Ileum with the iliocaecal valve * Cecum with vermiform appendix * Ascending colon * Transverse colon (2/3)   The midgut is supplied with blood by the **superior mesenteric artery** and innervated by the **vagus nerve (CN X)**. Within the whole midgut and rectum unit there exists only one **dorsal mesenterium**, the ventral being readsorbed. Differentiation occurs in a cranio caudal sequence within a time window of roughly one week. |  | |  | | --- | |  | |

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| **Intestinal rotation** |  | |  |  |  | | --- | --- | --- | | |  | | --- | | **Animation** | | Intestinal rotation (7.2 MB) | | |

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| In stage 13, ca. 32 days, **IMG_25613**IMG_257 the midgut begins to extend into the umbilical coelom and forms the umbilical loop, whereby initially from the apex only a wide connection to the **umbilical vesicle** exists. In the further development this junction becomes constricted to become the omphalomesenteric duct. Mostly it is later obliterated, but can also partially remain as a [Meckel's diverticulum](patholdigest04.html" \l "meckel). In the beginning (stage 13, ca. 31 days, **IMG_25813**IMG_259) the umbilical loop is positioned sagittally. |  |  |

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| **Fig. 19 -**Intestinal rotation: stage 13, ca. 32 days |  | **Legend** |
| IMG_260   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | |  |  | | --- | --- | | **1** **2 3** | Stomach Mesenterium Parietal peritoneum | |  | |  |  | | --- | --- | | **4 5 6** | Intestinal loop  Omphalomesenteric duct Cecum | | | |  | **Fig. 19** The intestinal tube becomes enwrapped by the visceral peritoneum that connects it to the posterior body wall forming the dorsal mesenterium (red surface). In this stage the intestinal tube is almost straight and is connected to the umbilical vesicle by the omphalo- mesenteric duct. |
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| Only when the **umbilical loop** lengthens and grows into the **umbilical coelom** does it experience a **rotation of 90 degrees in a clockwise direction** as seen from the embryo. The cranial pedicle comes to lie to the right and the caudal to the left (stage 14, ca. 33 days, **IMG_26114**IMG_262). The umbilical loop now has a **horizontal position**. Through the cranio-caudal growth gradient, the cranial pedicle forms first through lengthening of several loops in the umbilical coelom. |  |  |

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| **Fig. 20 -**Intestinal rotation: stage 14, ca. 33 days |  | **Legend** |
| IMG_263   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | |  |  | | --- | --- | | **1** **2 3** | Stomach Mesenterium Parietal peritoneum | |  | |  |  | | --- | --- | | **4 6** | Intestinal loop Cecum | | | |  | **Fig. 20** The navel opening is schematically indicated by the blue ring. The developing intestines invade the abdominal space, gliding into it. |
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| The developing umbilical loop extends further into the umbilical coelom because there is no more room for it within the embryo's abdominal cavity. It is the time of the strongest flexion of the embryo. Very soon a thickening in the region of the caudal pedicle of the intestinal tube is also to be seen: the **cecum**. Visually, it becomes an important fixed point for purposes of orientation. |  |  |

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| **Fig. 21 -**Intestinal rotation: stage 16, ca. 39 days |  | **Legend** |
| IMG_264   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | |  |  | | --- | --- | | **1** **2 3** | Stomach Mesenterium Parietal peritoneum | |  | |  |  | | --- | --- | | **4 6** | Intestinal loop Cecum | | | |  | **Fig. 21** The entire intestinal loop has relocated in the umbilical coelom due to the limited space conditions in the abdominal cavity. The intestinal loop now has a horizontal orientation and the lengthening tube has formed several loops in the cranial pedicle. The caudal part is still straight. |
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| As development proceeds the intestinal loop turns further around its **own axis**. In stage 18 (ca. 44 days, **IMG_26518**IMG_266) the extension of the intestinal loop into the umbilical coelom has reached its maximum. This **physiologic navel hernia**remains in existence up to the 9th week of pregnancy. ([Omphalocele / umbilical hernia](patholdigest04.html" \l "omphalozele)) |  |  |

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| **Fig. 22 -**Intestinal rotation: stage 18, ca. 44 days |  | **Legend** |
| IMG_267   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | |  |  | | --- | --- | | **1** **2 3** | Stomach Mesenterium Parietal peritoneum | |  | |  |  | | --- | --- | | **4 6** | Intestinal loop Cecum | | | |  | **Fig. 22** The largest part of the intestinal loop lies in the umbilical coelom and several loops have formed through the lengthening in the cranial, small intestine region. |
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| At first, the **loops of the small intestine** return into the abdominal cavity and come to lie in the left half surrounded by the **horizontal** and **descending part of the colon** that never left the abdominal cavity. The rotation now amounts to more than **180 degrees** and the colon is also shifted more and more into the abdominal space. The repositioning of the physiologic umbilical hernia is facilitated by the righting of the embryo's body. |  |  |

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| **Fig. 23 -**Intestinal rotation: stage 20, ca. 49 days |  | **Legend** |
| IMG_268   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | |  |  | | --- | --- | | **1** **2 3** | Stomach Mesenterium Parietal peritoneum | |  | |  |  | | --- | --- | | **4 6** | Intestinal loop Cecum | | | |  | **Fig. 23** With the return of the intestines into the abdominal cavity the small intestine is moved to the left side and the cecum and the ascending part of the large intestine to the right. Initially the cecum may possibly be found in the upper right quadrant (elevated cecum). |
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| Thus, after the reintegration of the intestinal loops into the abdominal cavity from the physiologic umbilical hernia, the derivatives of the originally caudal pedicle occupies the **upper** and **ventral part of the abdominal cavity**. At the end of the embryonic period this part migrates downwards into the **iliac fossa**, whereby an additional rotation occurs. The whole rotation of the intestines thus amounts to approximately **270 degrees**. As a consequence, the **mesenterium** also turns with it and in its insertion it crosses over the **inferior part of the duodenum**. ([Malrotation and congenital high cecum](patholdigest04.html" \l "malrotation)) |  |  |

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| **Fig. 24 -**Intestinal rotation: stage 23, ca. 56 days |  | **Legend** |
| IMG_269   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | |  |  | | --- | --- | | **1** **2 3** | Stomach Mesenterium Parietal peritoneum | |  | |  |  | | --- | --- | | **4 6** | Intestinal loop Cecum | | | |  | **Fig. 24** As a rule the cecum grows caudally and comes to lie in the right iliac fossa. Through rotation of the whole small intestine of more than 270 degrees the mesenterium also rotates thereby and moves off from the posterior wall over the inferior part of the duodenum to the small intestine.   |  |  | | --- | --- | | |  | | --- | | Overview of the illustrations | | |
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