Illuminations

The Rope Method: A Novel Method of Teaching Rotation of the Midgut

Embryological development, especially that of the gastrointestinal system, is one of the most challenging concepts covered during the first year of medical school. Many students have a hard time visualizing the complex steps of this process and, consequently, struggle to master this topic. By achieving an understanding of how the gastrointestinal system develops, students are more equipped to understand the inner workings of the viscera and their blood supply. To help students master this concept, I have developed an affordable, innovative three-dimensional method of teaching embryological midgut rotation using a nylon rope, yarn, colored tape, and a newspaper.

The primitive gut is divided into three regions: the foregut, the midgut, and the hindgut, nourished by the celiac, superior mesenteric, and inferior mesenteric arteries. During the fifth week of intrauterine life, the midgut forms a “loop.” The superior mesenteric artery divides this loop into two segments: the caudal prearterial segment and the cranial postarterial segment. During the sixth week of intrauterine life, the midgut loop grows rapidly and moves into the umbilical cord, an event called “physiological umbilical herniation.” Herniation occurs as the liver and kidneys become too large to occupy the abdominal cavity. During this movement, the loop of the midgut rotates 90° in a counterclockwise direction, with the prearterial segment moving to the right and the postarterial segment moving to the left. The prearterial segment grows rapidly over the next few weeks, and, by the 10th week of intrauterine life, the growth of the liver and kidneys has slowed and the anterior abdomen has grown in size. The combination of these events allows for the return of the intestines to the abdominal cavity. Upon return, the midgut rotates 180° in the counterclockwise direction, with the prearterial segment occupying the left side of the abdomen and the post-arterial segment occupying the right side of the abdomen (1).

Clearly, this is a complex series of events that is difficult to both visualize and represent on paper. Therefore, I developed a model to provide a physical demonstration of these events. After introducing the topic in class, I invited two students to assist me with my demonstration. A hole was made in the center of a page of newspaper, with the newspaper representing the anterior abdomen wall and the hole representing entry to the umbilical cord. Three strings were tied to the rope, representing the celiac, superior mesenteric, and inferior mesenteric arteries (Fig. 1). Red tape was wrapped around the portion representing the prearterial segment so it could be distinguished from the postarterial segment through the rotations. One student held the newspaper and the other stood behind the first student, holding the rope. I then demonstrated how the loop of the midgut formed and herniated out of the abdomen (Fig. 2). I also demonstrated the two rotations of the gut and the gut’s return to the abdomen following growth (Fig. 3).

Students find lectures more enjoyable when simple, interactive models are used to explain complex topics. This inexpensive, easy technique proved to be a useful supplement to the lecture. It is also something that they may build themselves as a guide while studying. The class responded positively to the three-dimensional demonstration of midgut rotation. Some claimed that this model helped them to remember the material and that it made the process easier to understand. They also requested that I use this technique more often during lectures. A similar technique was used in the past (2) as a way to make lecture more fun, interesting, and meaningful.

REFERENCES

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Fig. 1. Nylon rope shaded to show divisions of the gut: the foregut (FG), the midgut (MG), and the hindgut (HG). Yarn tied to nylon rope depicts the celiac (CA), superior mesenteric (SMA), and inferior mesenteric (IMA) arteries.
Fig. 2. Physiological umbilical herniation. The newspaper represents the abdominal wall, and the hole in the middle represents the entry to the umbilical cord (PU). Note that the loop is divided into two segments by the SMA: the prearterial segment (PAS) on the right and the postarterial segment (POAS) on the left.

Fig. 3. The gut after its return to the abdomen. Note the relationship of the SMA to the divisions of the gut following rotation. After an 180° rotation and return to the abdomen, the PAS is now on the left side of the SMA and the POAS is now on the right.