Chapter 23
DEVELOPMENT OF THE DIGESTIVE SYSTEM

The adult digestive system is the direct descendant of the primitive yolk sac; its germ layer source, therefore, is embryonic endoderm. Towards the end of the third week of human development, head and tailfolds undercut the yolk sac, so that three distinct parts of the digestive system can be recognized; they are (1) foregut, (2) midgut, and (3) hindgut (Fig. 23.1). At first a straight midline tube between future mouth and anus, the embryonic digestive system is suspended from the dorsal body wall by the dorsal mesentery. This double-layered membrane transmits the dorsal aorta and its three unpaired, abdominal branches: celiac, superior and inferior mesenteric arteries—supplying, respectively, foregut, midgut, and hindgut. A ventral mesentery connects ventral body wall and foregut. Its lower, free, sickle-shaped border, the falciform ligament, transmits the umbilical vein, passing from the placenta through the umbilical ring towards the sinus venosus. To get there, the umbilical vein must navigate the septum transversum.

The Convoluted Stage

In embryos of six weeks, some growth of the digestive tract has taken place. The tube is now longer than the dorsal mesentery and that part of the body wall along which it runs. It turns, twists, and soon deviates from the midline in several places, forming in the process the prominent duodenal and midgut loops. Figure 23.1 illustrates the basic plan and outcome of its parts: the foregut in the headfold gives rise to the pharynx, esophagus, stomach, and the proximal one-half of duodenum, as well as to both respiratory and hepatic diverticula. The midgut develops into small intestine, starting with the distal one-half of duodenum, and large intestine up to, and including, the proximal two-thirds of transverse colon. The hindgut in the tailfold turns into the rest of the large bowel.

The apex of the duodenal loop points to the right and is held in place by the falciform ligament (Fig. 23.2). The attachment of the ligament to the gut wall marks the transition between foregut and midgut regions. The proximal limb of the duodenal loop, therefore, is foregut territory; the distal limb, midgut.
The midgut loop lies in the median plane and, for the time being, curves forward (Fig. 23.1). Its apex is continuous distally through the umbilical ring with the vitello-intestinal duct and degenerating yolk sac. The roots of the loop are firmly secured to the dorsal body wall by condensations in the dorsal mesentery—the so-called retention bands. The proximal limb of the midgut loop develops into the jejunum and all but the last few coils of ileum; the distal limb forms the rest of the ileum, cecum, appendix, ascending colon, and transverse colon, except for its terminal one-third.

Focus on the Foregut

By the end of the fourth week of human development the oropharyngeal membrane has disintegrated, continuity between oral cavity and primitive pharynx has been achieved, and amniotic fluid swallowed by the embryo passes into the foregut. I traced the early development of the primitive pharynx in chapter 12, but must return to it now, for much important detail was left unsaid at that time. The embryonic pharynx is the direct source of the parenchyma of several major organs—i.e., of cell populations carrying out organ-specific functions. The lungs and thyroid gland both begin as outgrowths from the floor of the primitive pharynx—the former as the pulmonary diverticulum, the latter as the thyroglossal duct. The alveolar epithelial cells of the lung and the secretory cells of the thyroid gland, therefore, are endodermal in origin. (N.B., the non-specific components, e.g., connective tissue, form the stroma of organs.)

The pulmonary outgrowth begins as the laryngotracheal groove, a keyhole shaped opening in the floor of the pharynx (Fig. 23.3). While retaining its connection to pharynx, the diverticulum elongates and descends in front of the pharynx for a short distance, then divides to form right and left lung buds. The initial segment of the pulmonary outgrowth persists as the mucosal epithelium of larynx and trachea. Repeated branching of the lung buds creates air-conducting passages of ever diminishing size leading to thin-walled air sacs (alveoli) where physiologic exchange takes place.

The thyroid gland develops as a median endodermal thickening in the floor of the primitive pharynx over the second pharyngeal arch. The thickening develops into a hollow passage, the thyroglossal duct, which grows tailwards ventral to the budding respiratory system (Fig. 23.3). The duct bifurcates near the commencement of the trachea to form the isthmus and lobes of the thyroid gland, then usually disappears without a trace. The foramen cecum (Fig. 23.4), located at the apex of the sulcus terminalis dividing body and root of the tongue, marks the site of the original thyroglossal outgrowth.

And, speaking of the tongue, the mucosal epithelium of its root (posterior one-third) is believed to come from the copula—the upper part of the