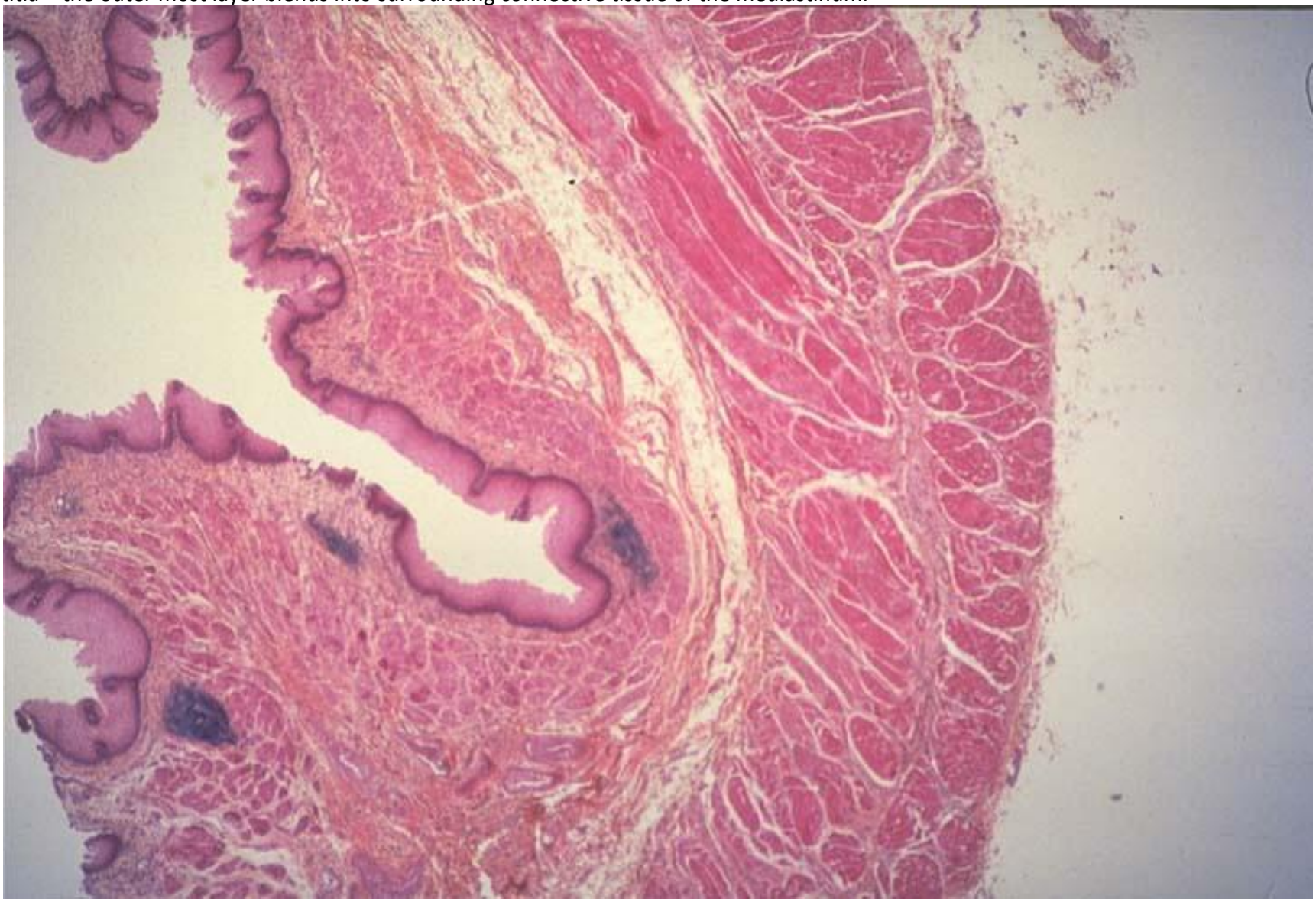
Lab 2
Esophagus & Stomach

Georgia Duker, PhD

K34 Esophagus - Upper

As with all the tubular portion of the GI tract, the esophagus is built of four layers:

1. mucosa = stratified squamous mucous type epithelium, lamina propria, and a smooth muscle muscularis mucosa (slightly darker red in staining,just below the lymphocyte nodules)
2. submucosa =loose connective tissue
3. muscularis externa = inner circular and outer longitudinal muscle; here in the upper third of the esophagus, both are made of skeletal muscle
4. adventitia = the outer most layer blends into surrounding connective tissue of the mediastinum.

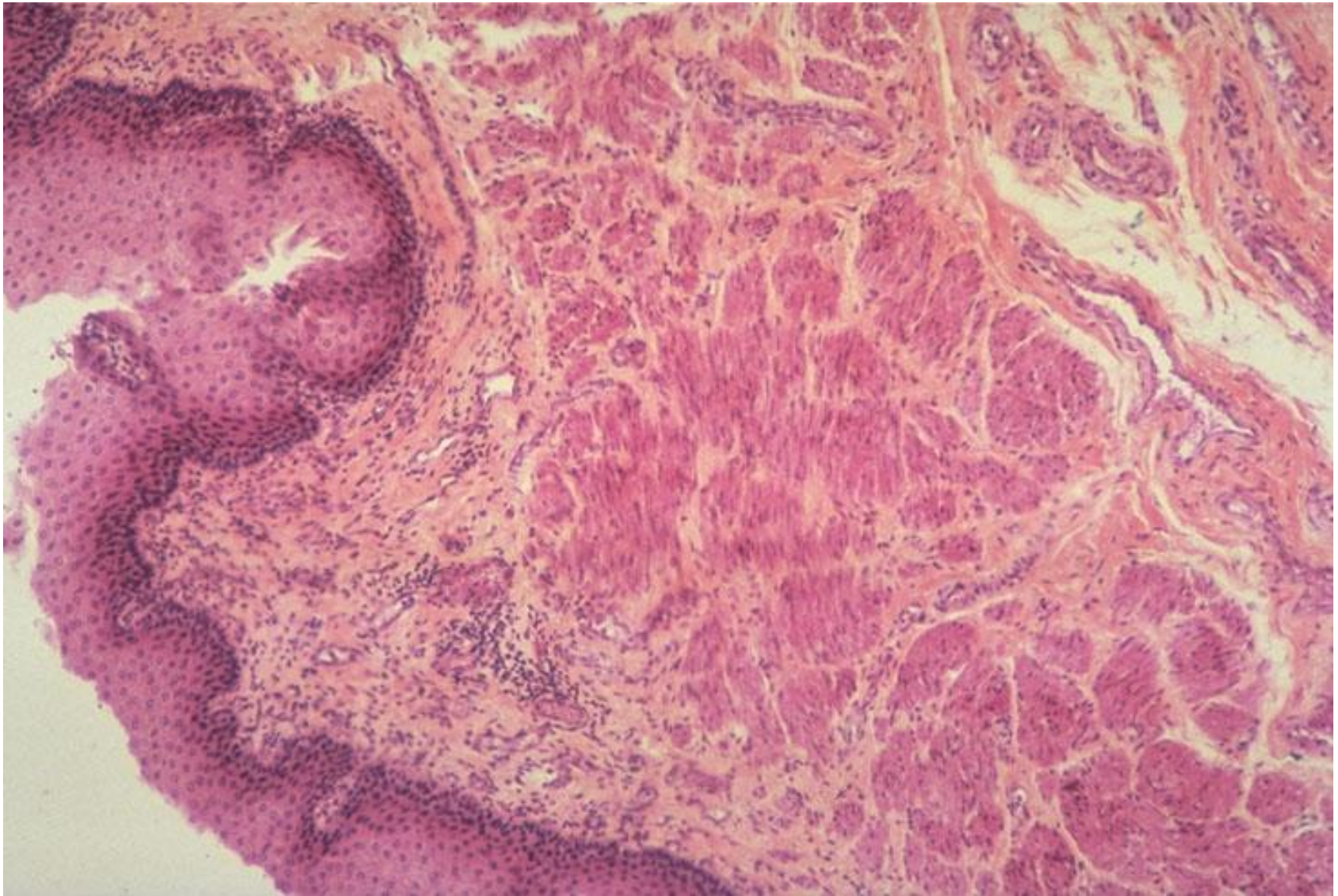


K35 Esophagus - Upper

Esophagus - Upper

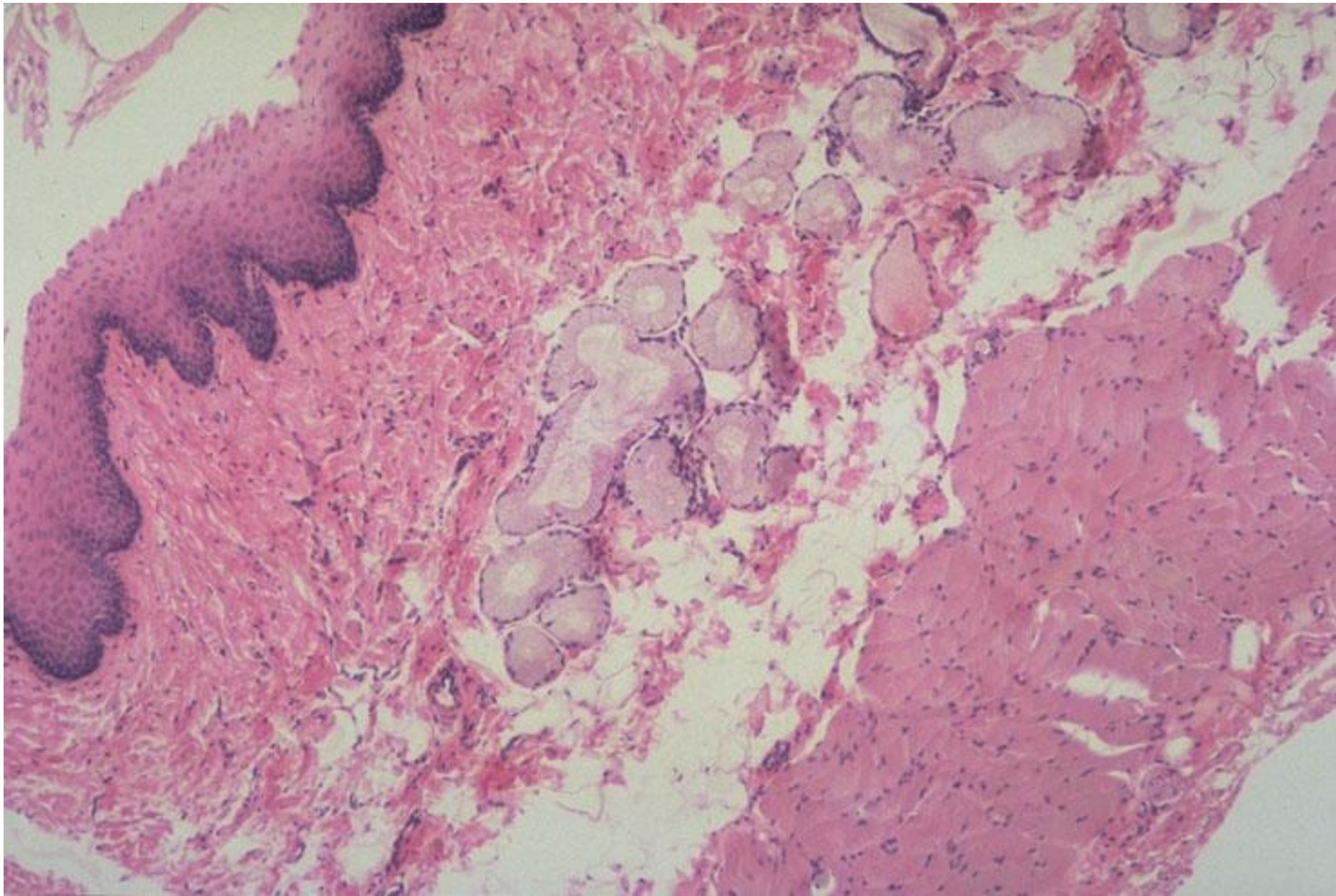
The mucosa itself is composed of three layers.

1. The epithelium is stratified squamous, mucous type, therefore nuclei persist out to the surface. Rete pegs interdigitate to attach the epithelium to the underlying lamina propria.
2. The lamina propria contains scattered lymphocytes, normal for the GI tract
3. The muscularis mucosa is smooth muscle, longitudinally oriented (therefore cut here in cross section).



K36 Esophagus - Upper

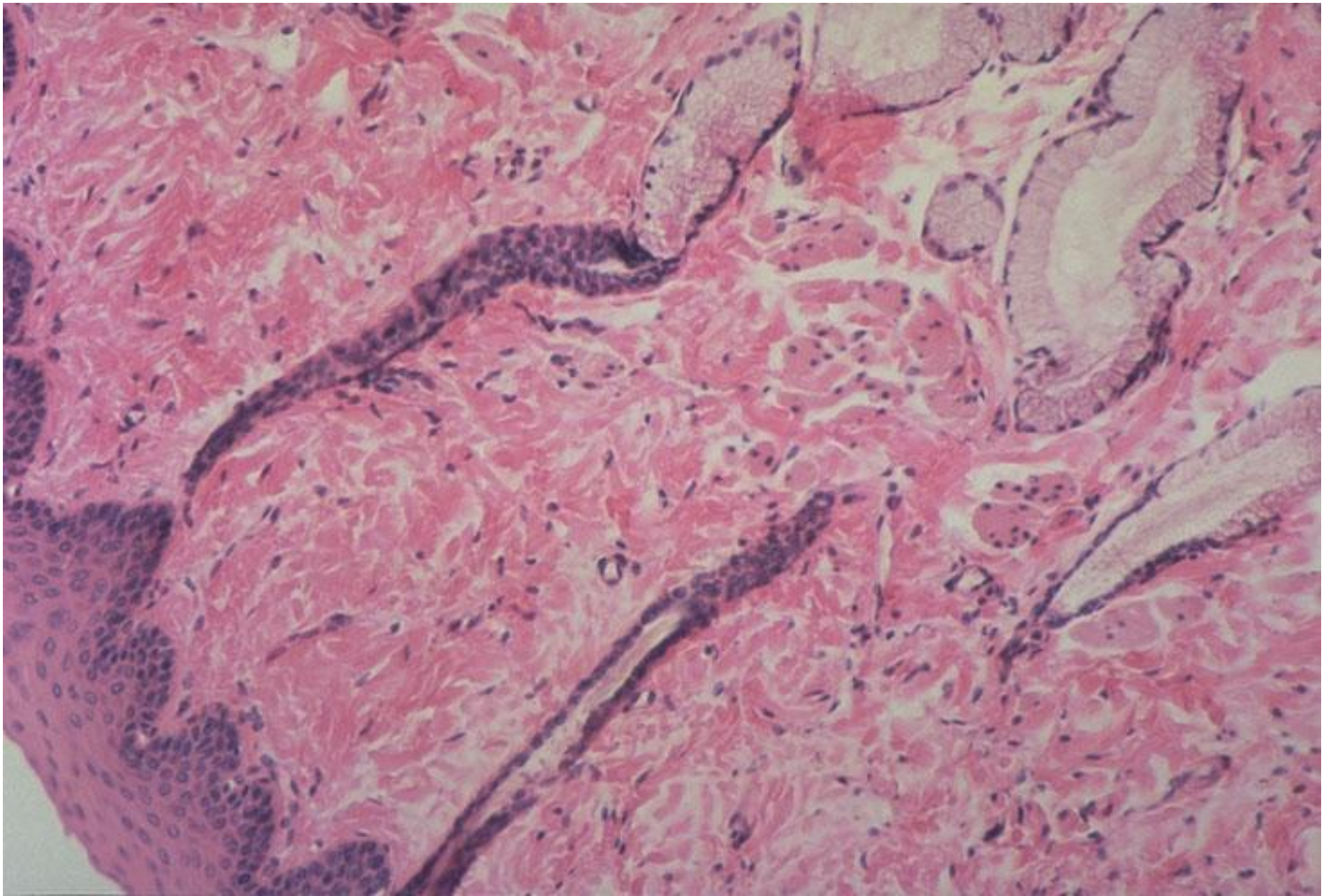
The esophageal submucosa is a wide layer of varying densities. Larger blood vessels and the submucosal or esophageal glands (mucous type) are prominent here. A scattered number of automonic fibers are present as the submucosal or Meisner's plexus (not seen on this slide). Skeletal muscle fibers are easily discerned in the muscularis externa.



K37 Esophagus - Upper

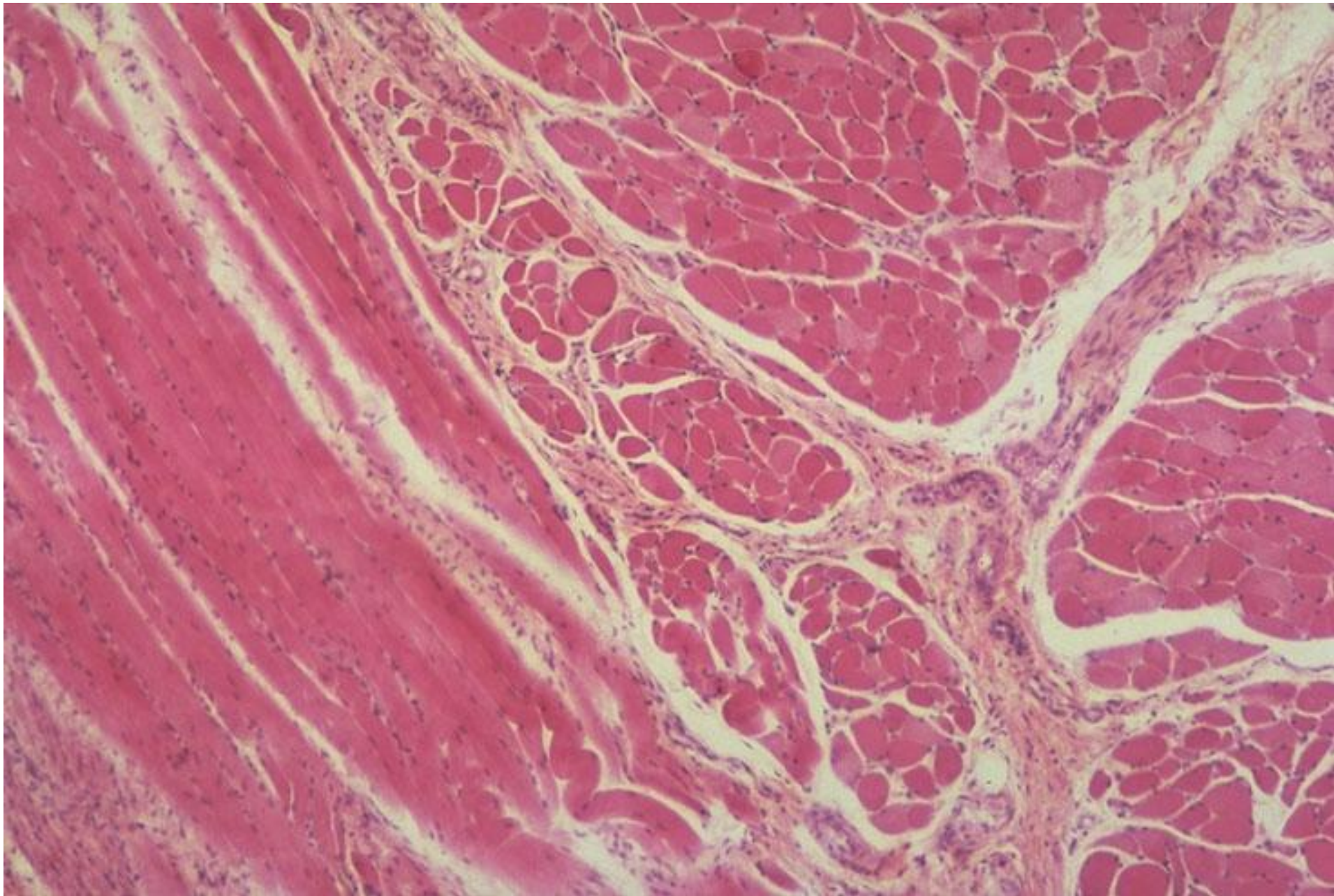
The ducts from the submucosal or esophageal glands course through the layers of the mucosa on their way to the esophageal lumen. These glands provide lubrication for swallowing.

Can you differentiate the fine smooth muscle bundles of the muscularis mucosa from the surrounding dense connective tissue?



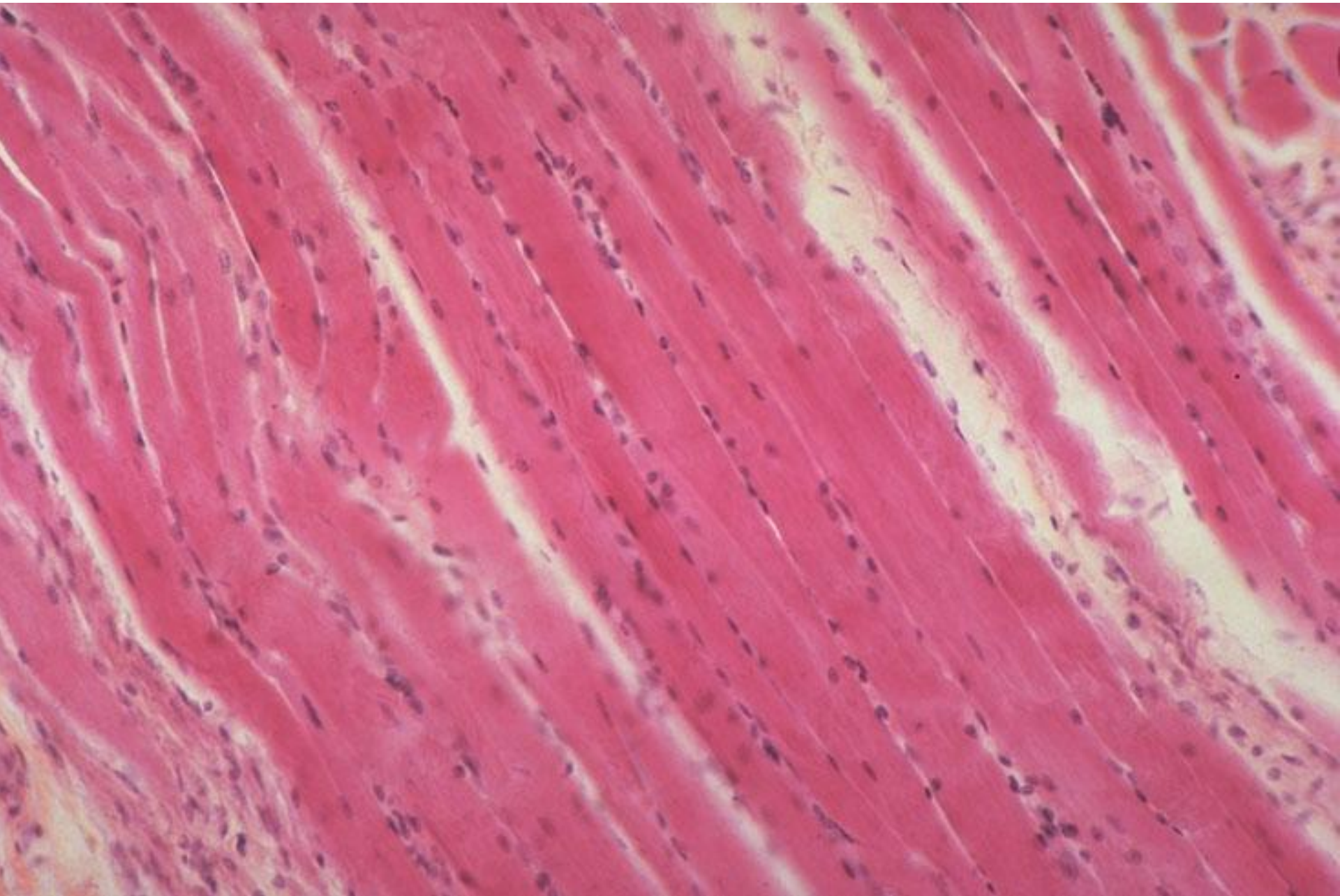
K38 Esophagus - Upper

Both layers of the muscularis externa are composed of skeletal muscle.



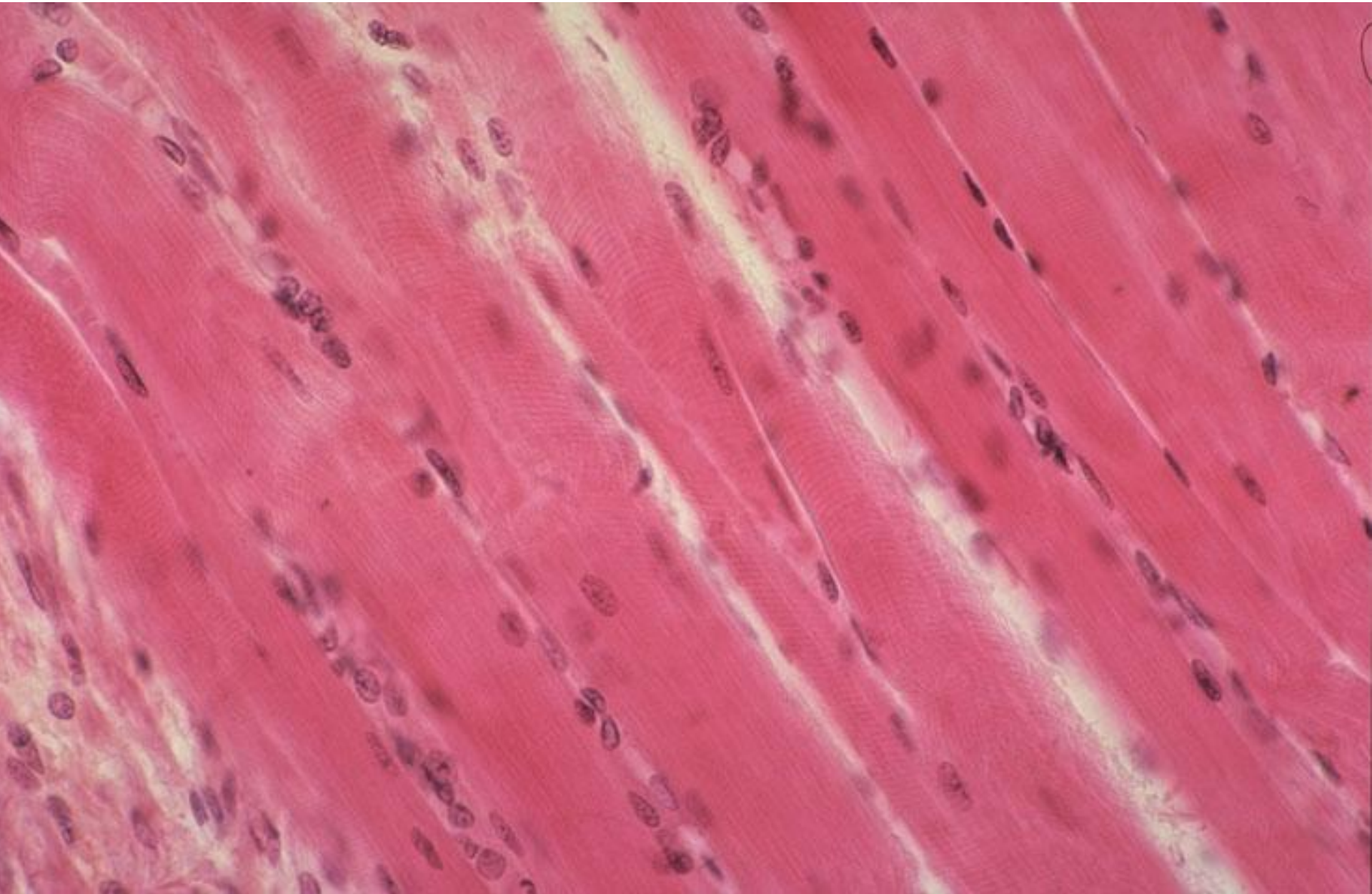
K39 Esophagus - Upper

Skeletal muscle of the muscularis externa



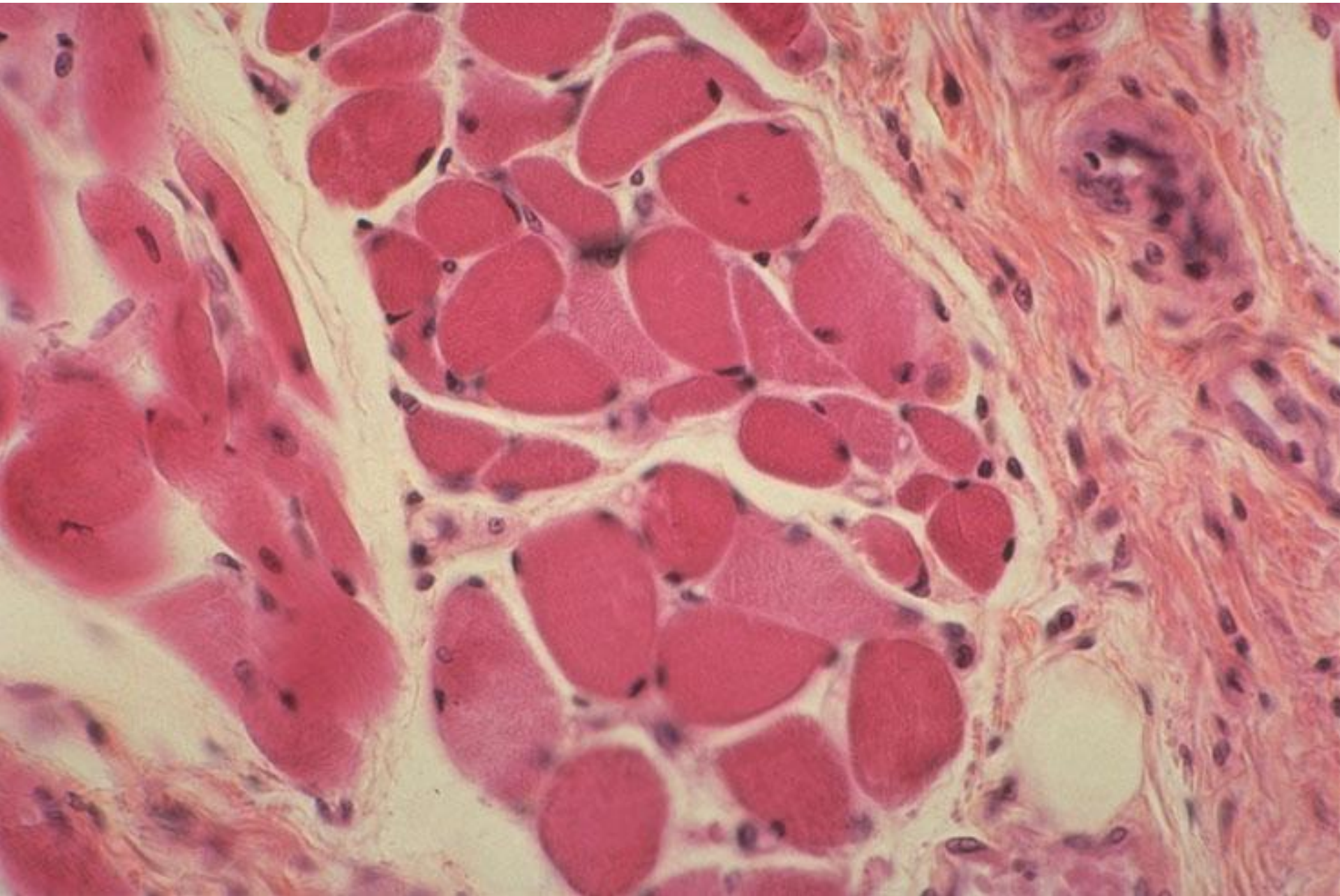
K40 Esophagus - Upper

Skeletal muscle of the muscularis externa, longitudinal section.



K41 Esophagus - Upper

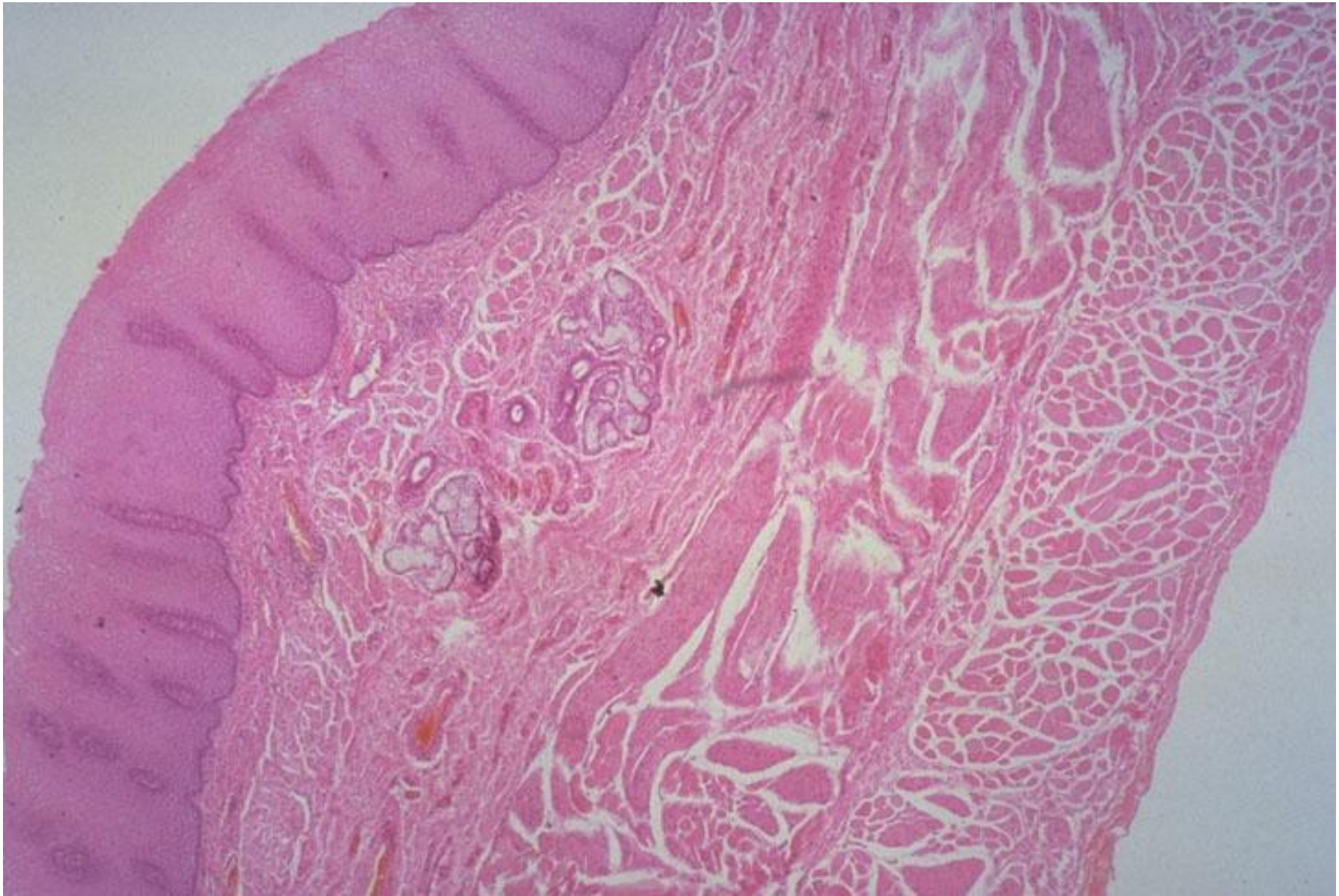
Skeletal muscle of the muscularis externa, cross section.



K42 Esophagus - Middle

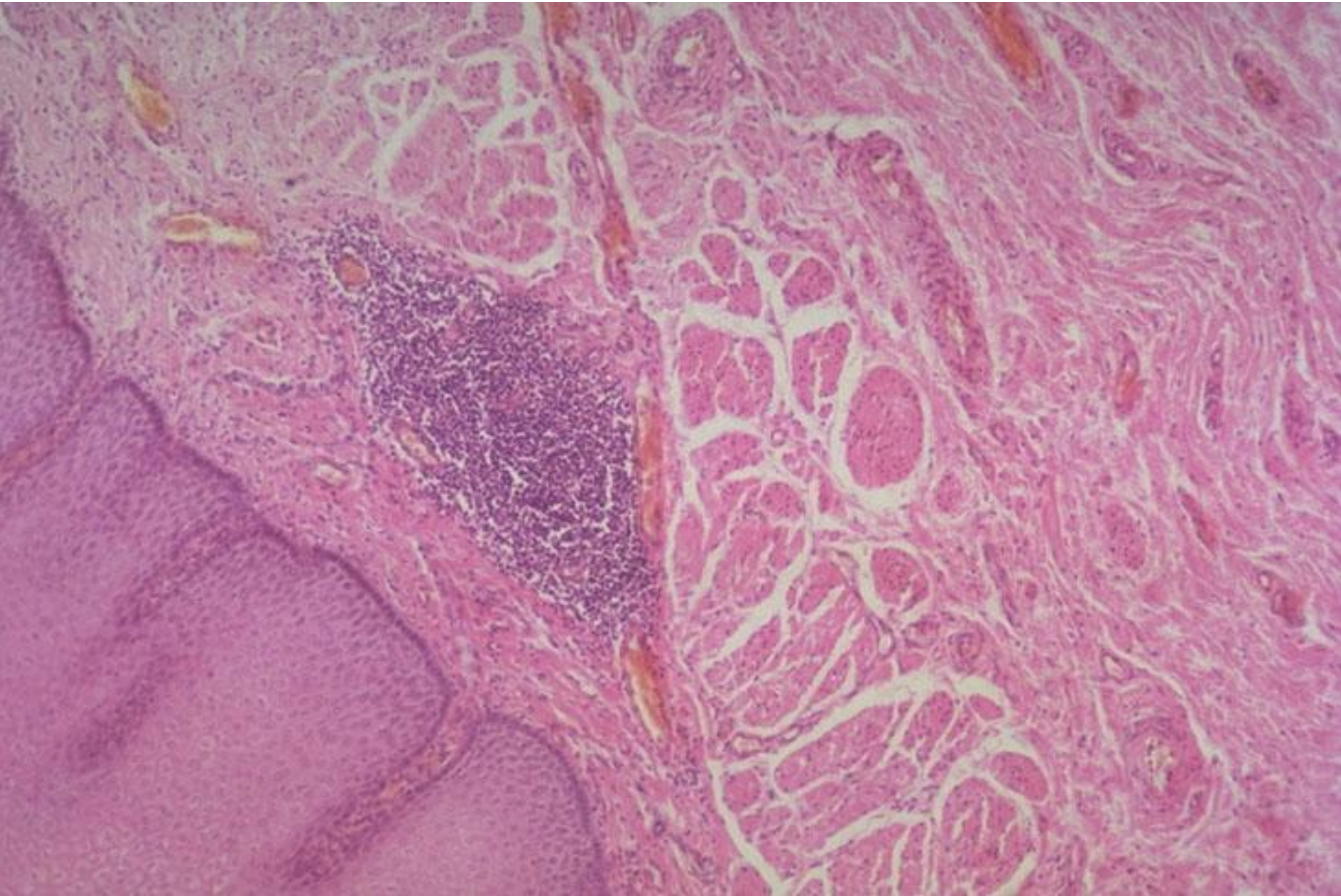
Distinguish the four major layers:

1. Mucosa = epithelium, stratified squamous, mucous type; lamina propria & muscularis mucosa.
2. Submucosa = note the esophageal submucosal glands.
3. Muscularis externa = inner circular & outer longitudinal
4. Adventitia



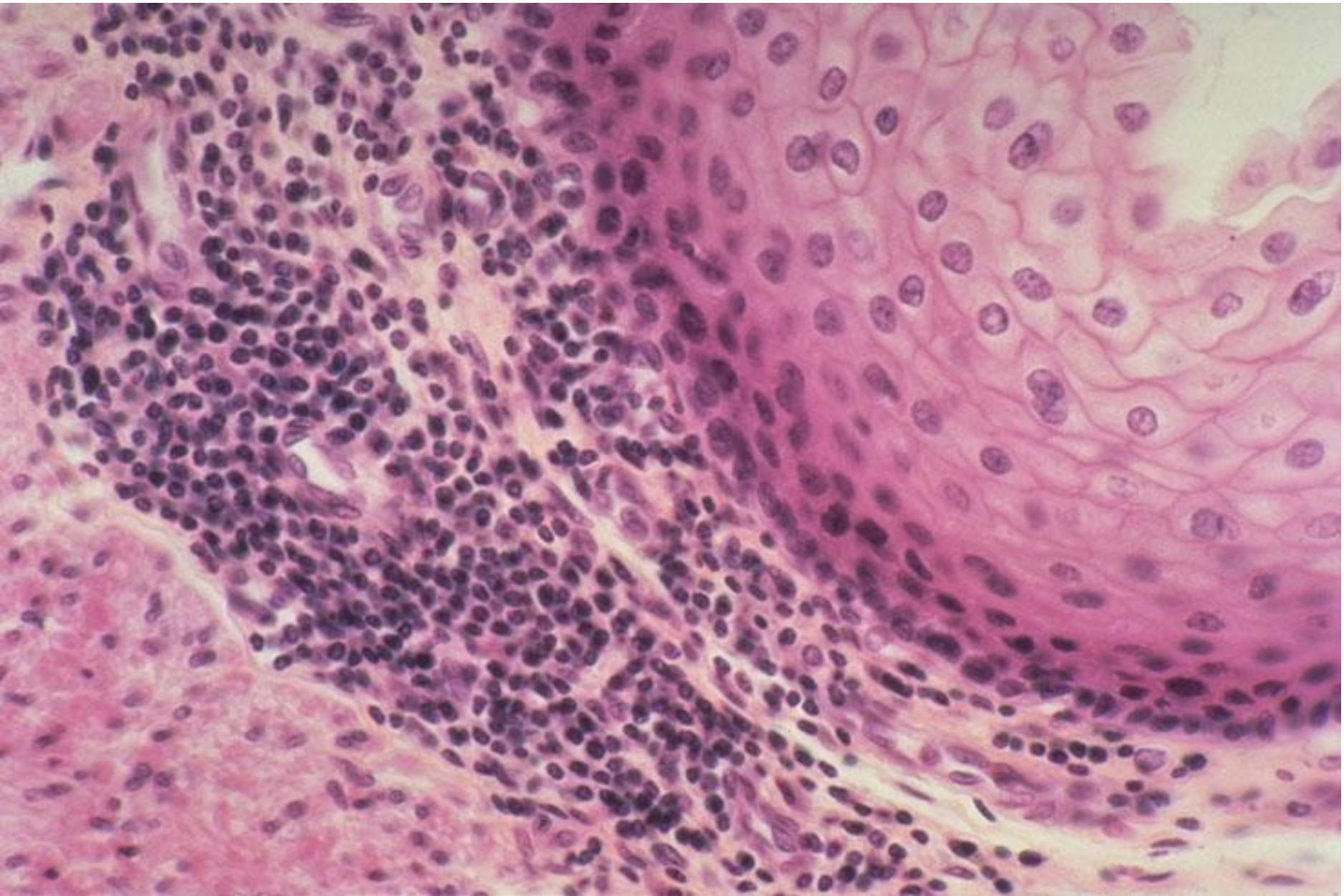
K43 Esophagus - Middle

The mucosa is composed of a stratified squamous epithelium, lamina propria with lymphocyte nodule, and the musclaris mucosa, smooth muscle oriented longitudinally, therefore cut in cross section here.



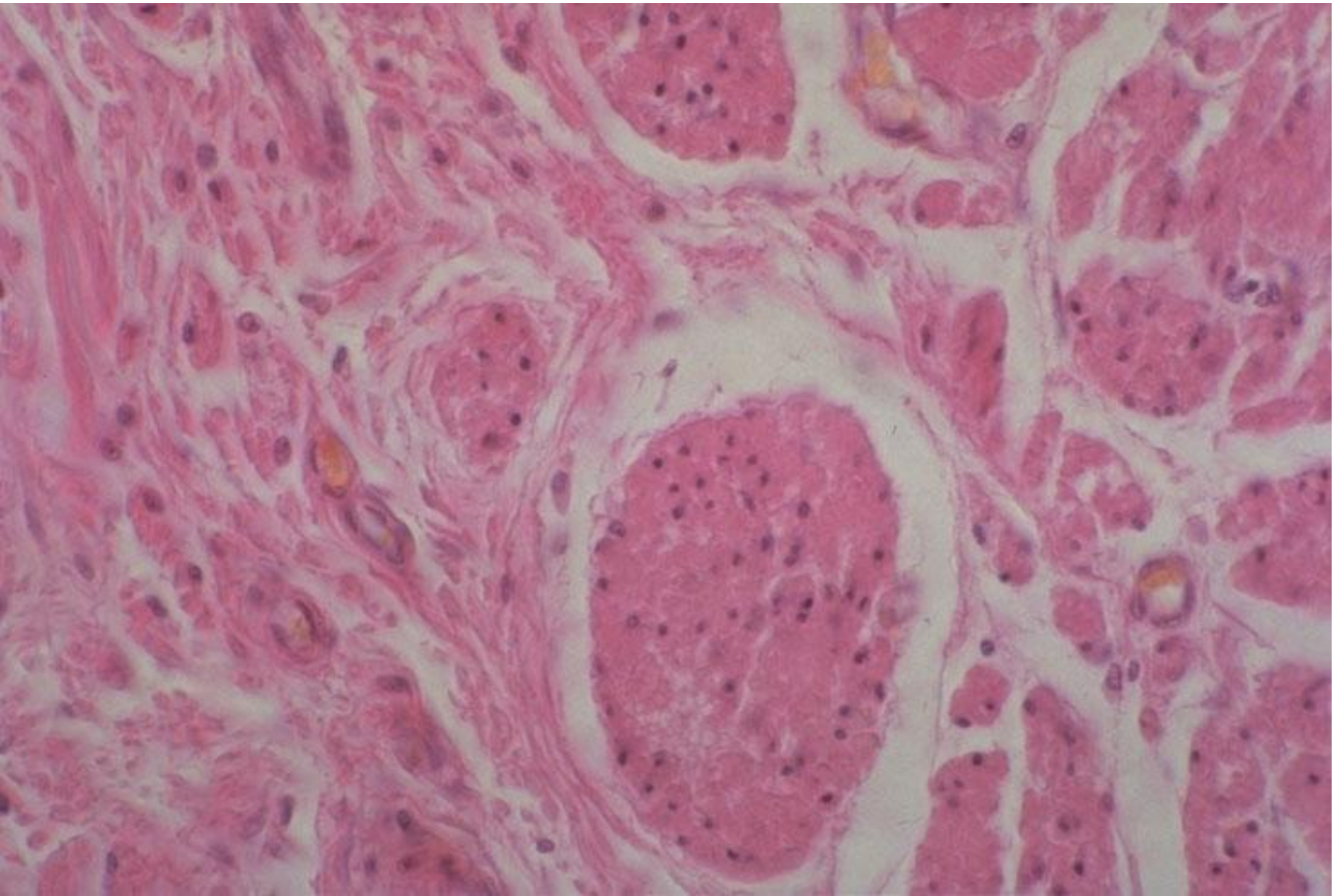
K44 Esophagus - Middle

Nuclei are clearly visible to the surface of the stratified squamous epithelium.
The lamina propria contains lymphocytes expressing the integrin "addressin", $\alpha 4\beta 7$, that recognize a homing ligand on the mucosal endothelial cells, MadCAM-1. (see the Mucosal Immunology Lecture)



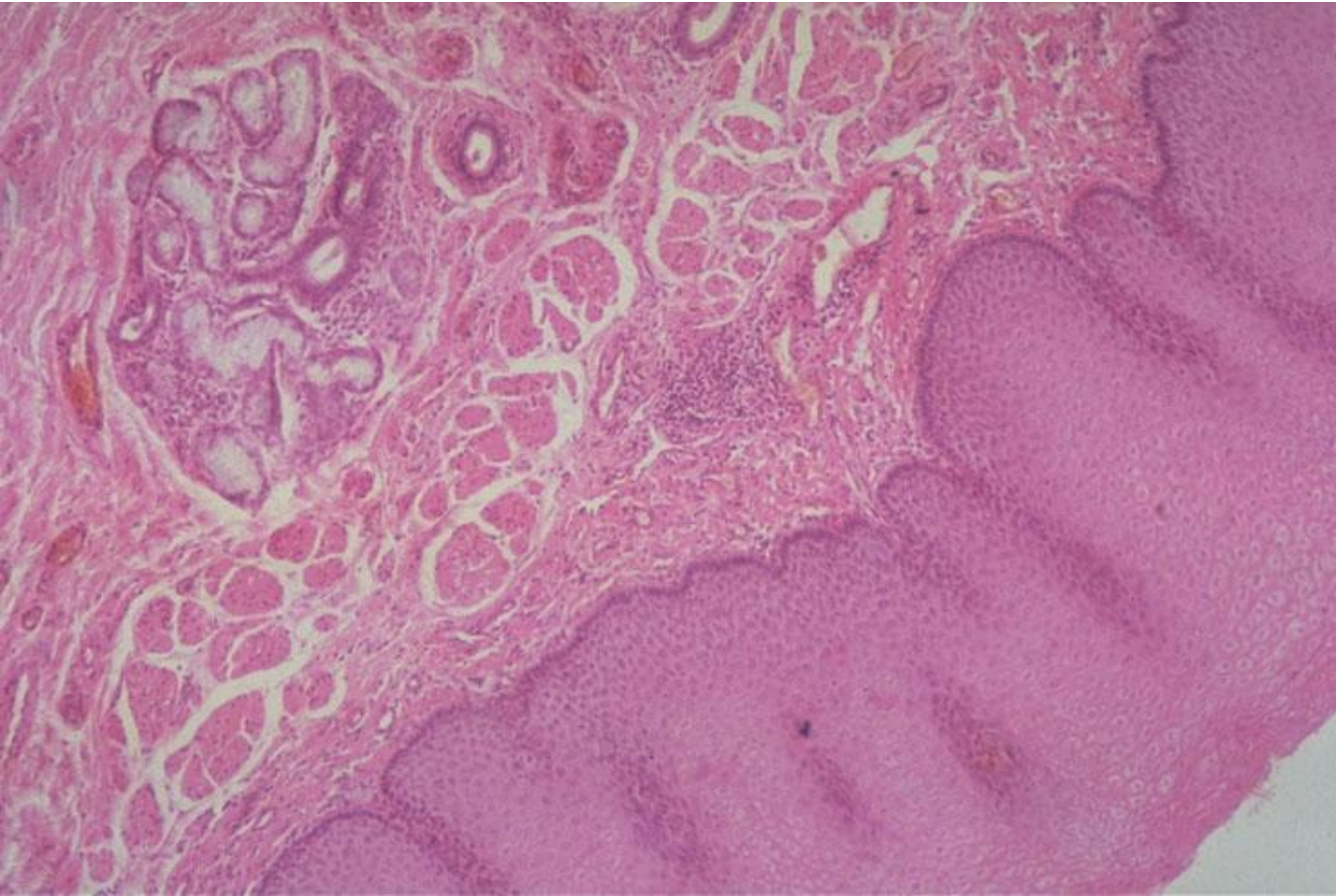
K45 Esophagus - Middle

Small bundles of smooth muscle of the muscularis mucosa can be distinguished from the surrounding connective tissue. Remember that since smooth muscle cells are not individually innervated, they communicate via gap junctions. Thus the clusters of smooth muscle cells.



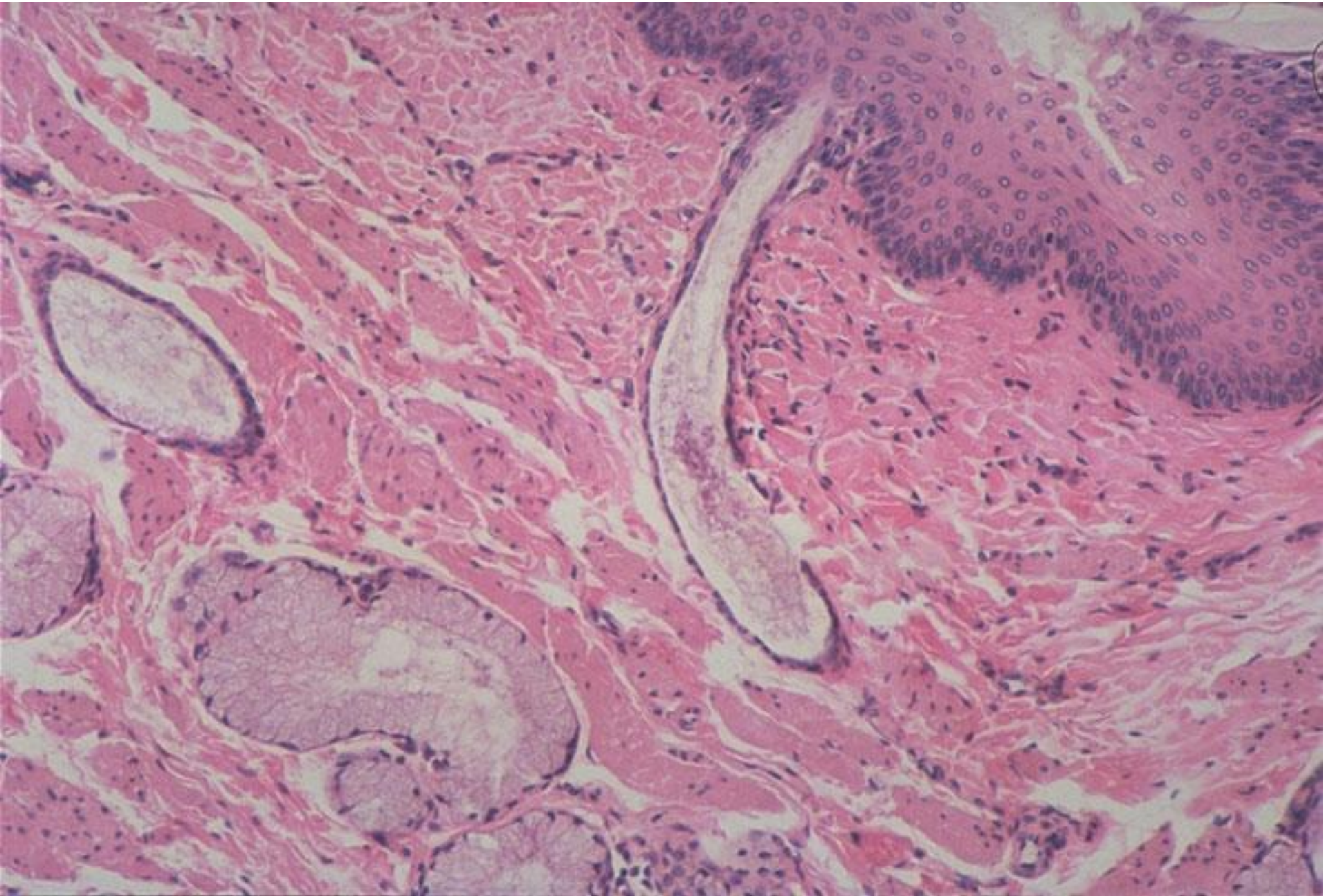
K46 Esophagus - Middle

Deep to the three strata of the mucosa, esophageal glands are found in the submucosa.



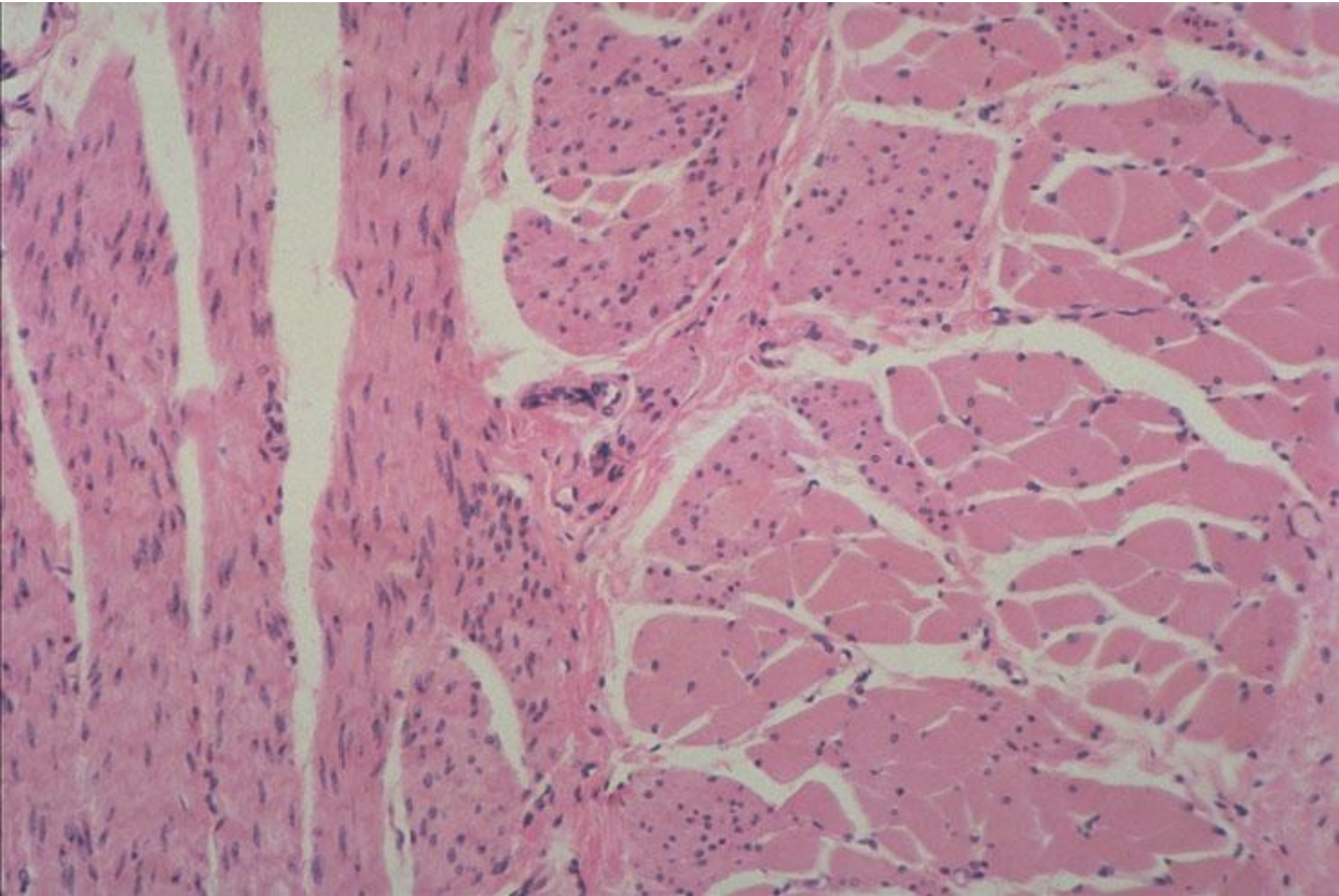
K47 Esophagus - Middle

Ducts from the submucosal esophageal glands penetrate the strata of the mucosa to access the esophageal lumen.



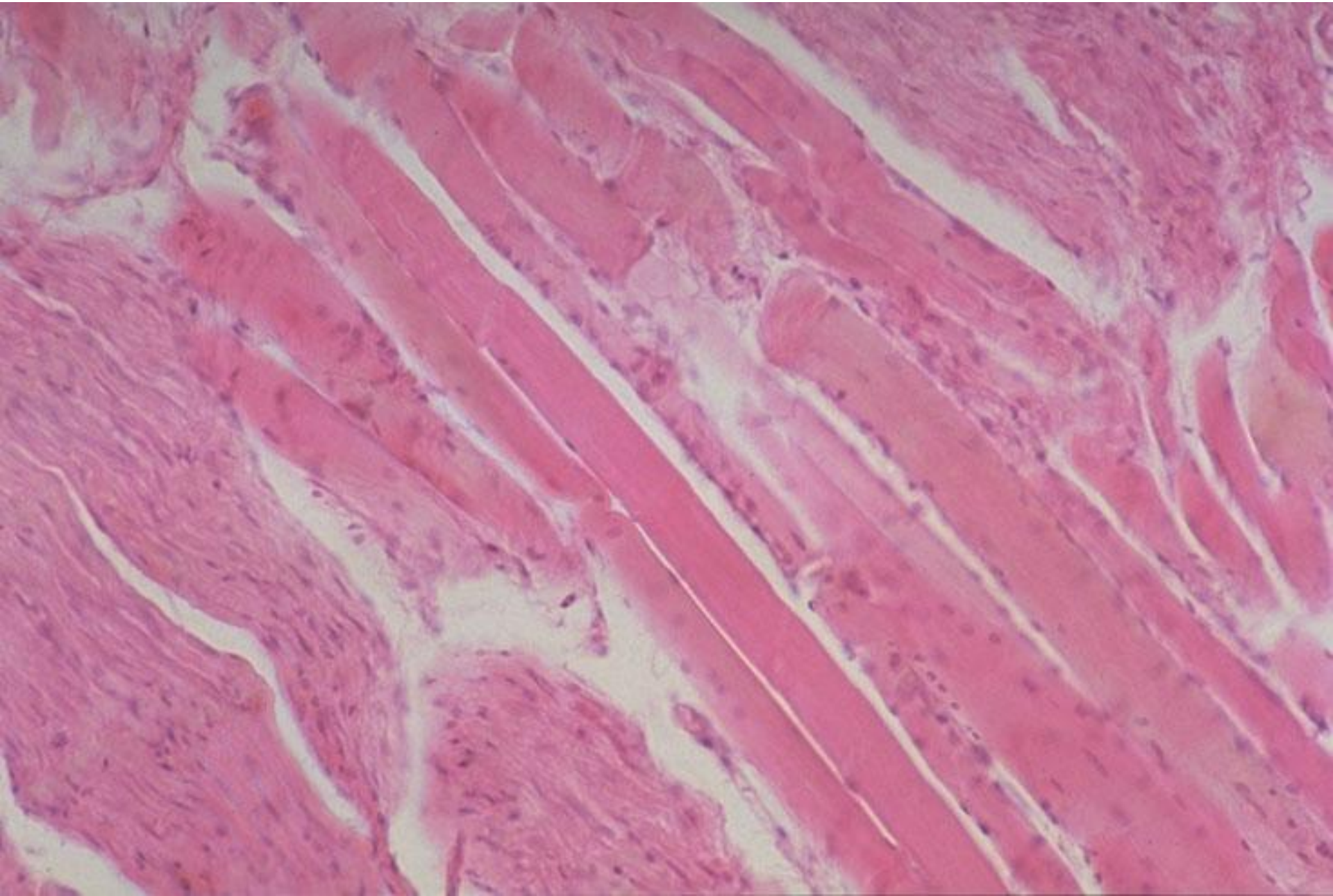
K48 Esophagus - Middle

The muscularis externa is a blend of both skeletal and smooth muscle. This is the only unique feature that distinguishes the middle third from the upper and lower esophagus.



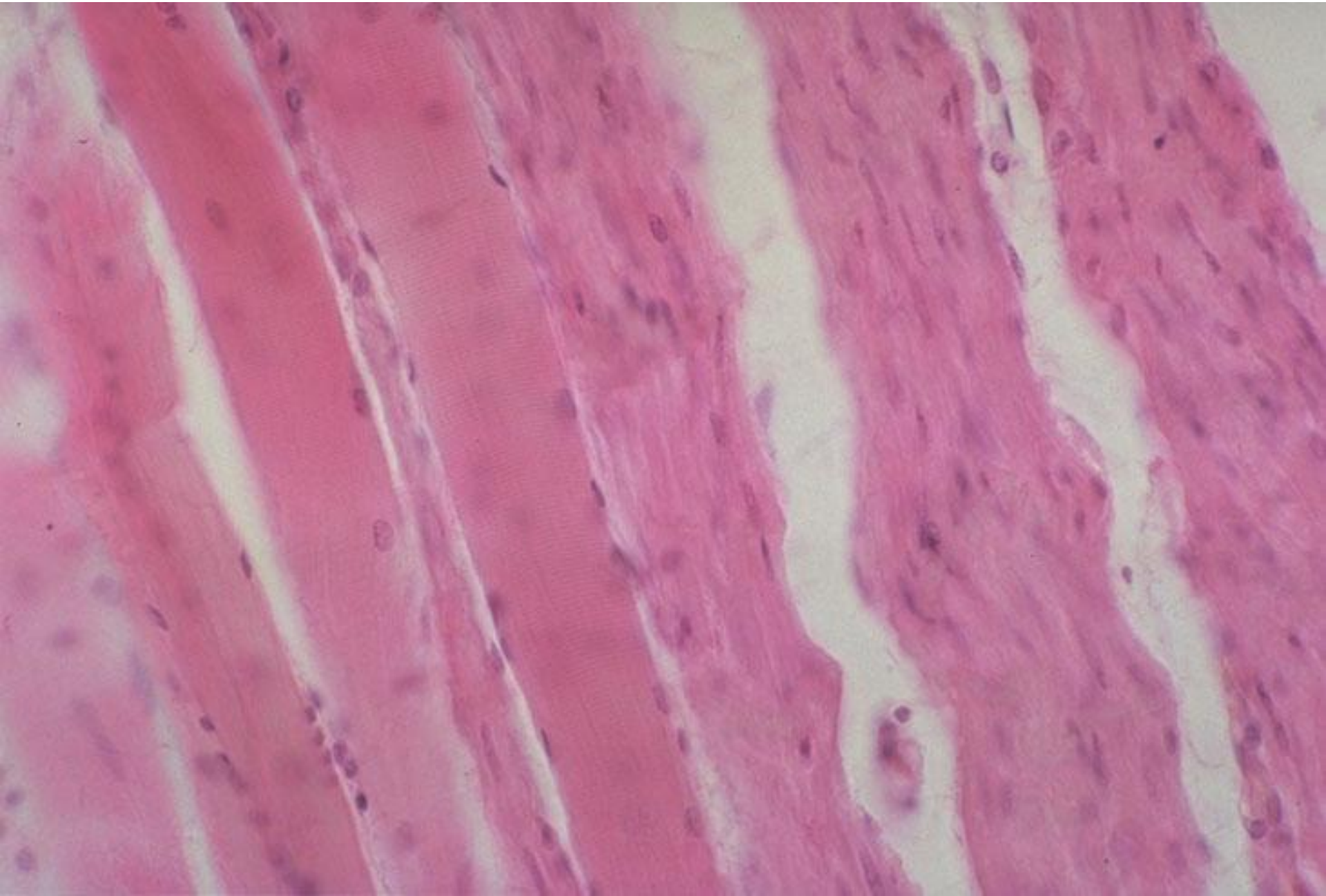
K49 Esophagus - Middle

Muscle fibers of the inner circular layer are cut in longitudinal orientation. Both smooth and skeletal muscle are present.



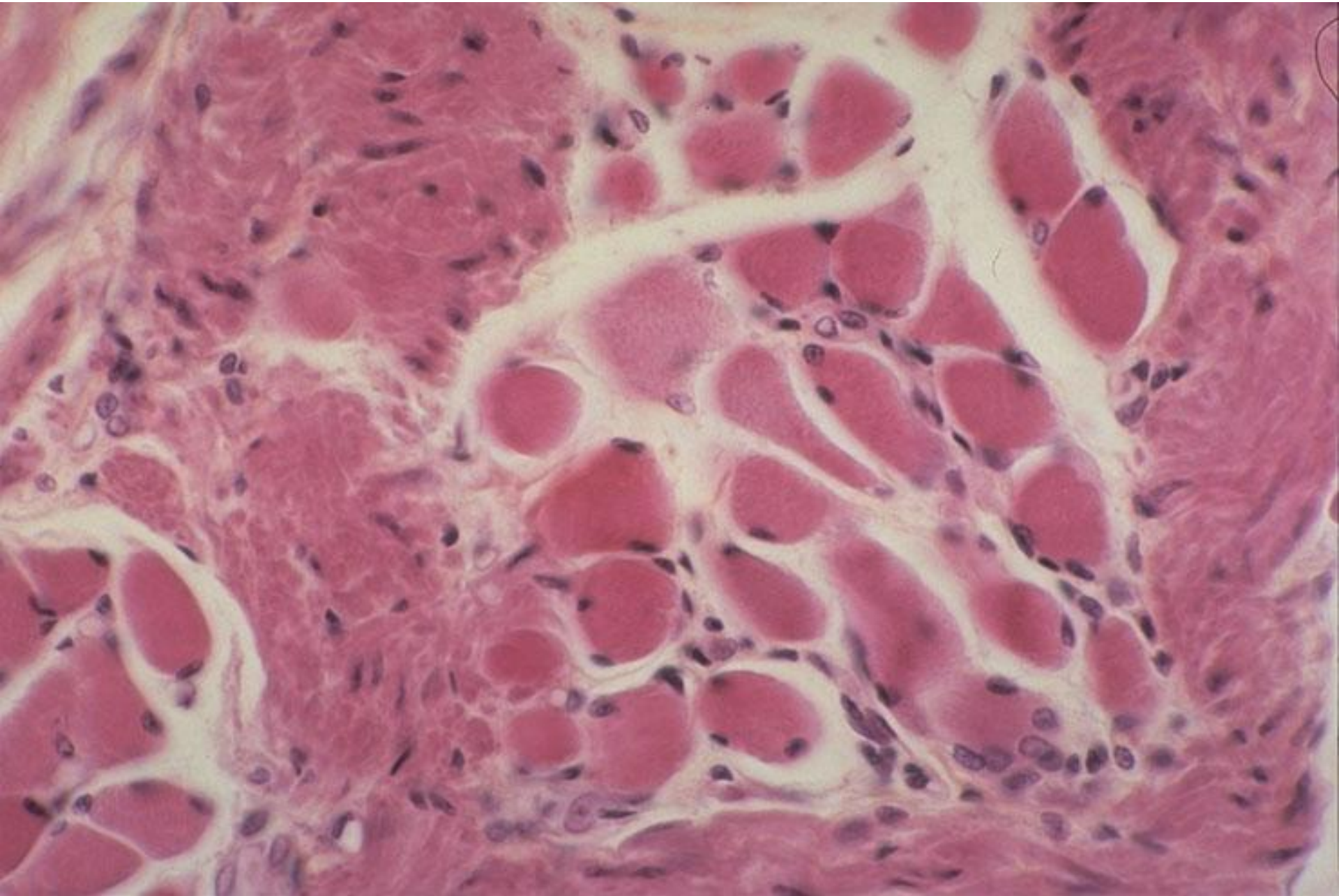
K50 Esophagus - Middle

Muscularis externa - longitudinal section through both smooth and skeletal muscle.



K51 Esophagus - Middle

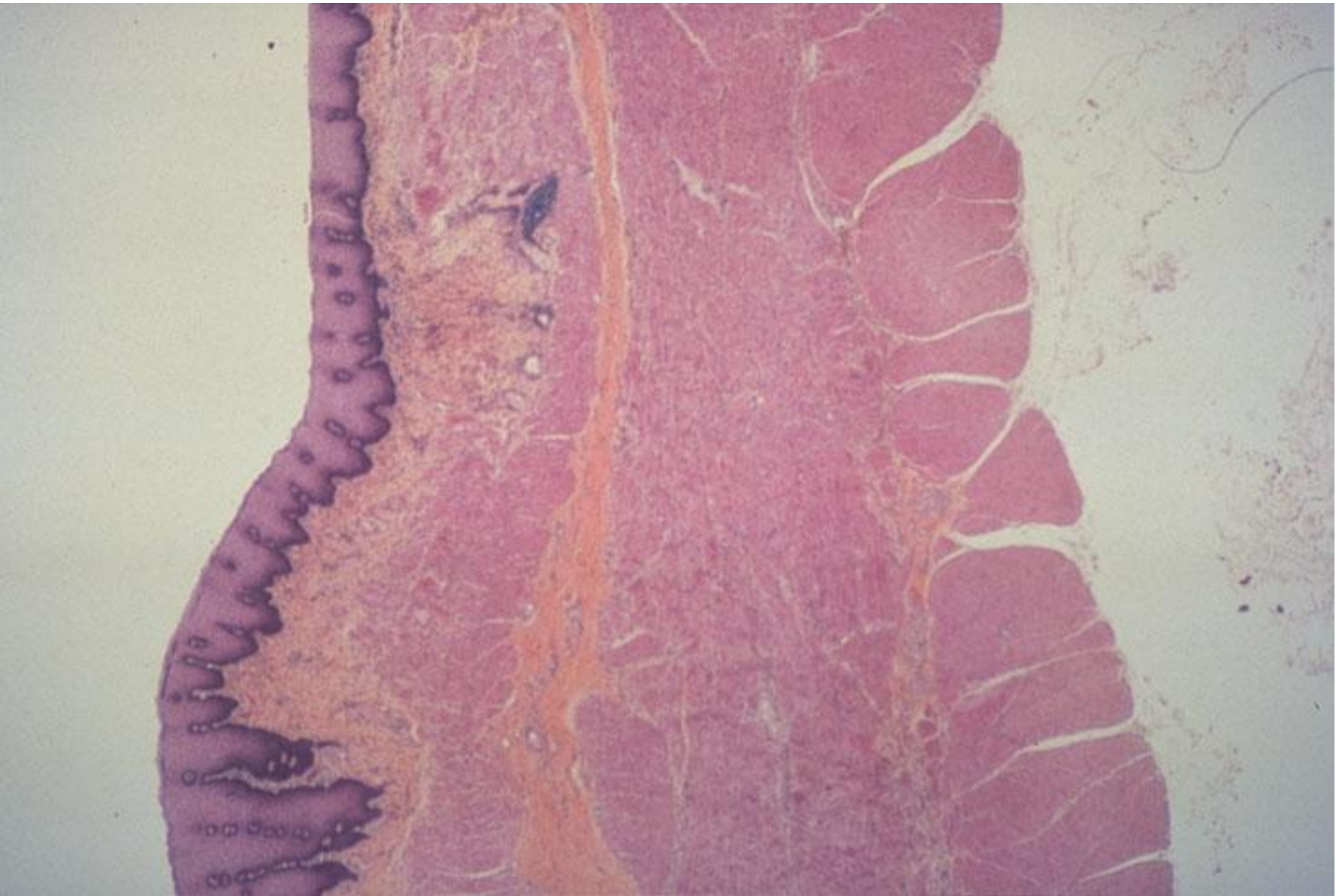
Muscularis externa - cross section through both smooth and skeletal muscle.



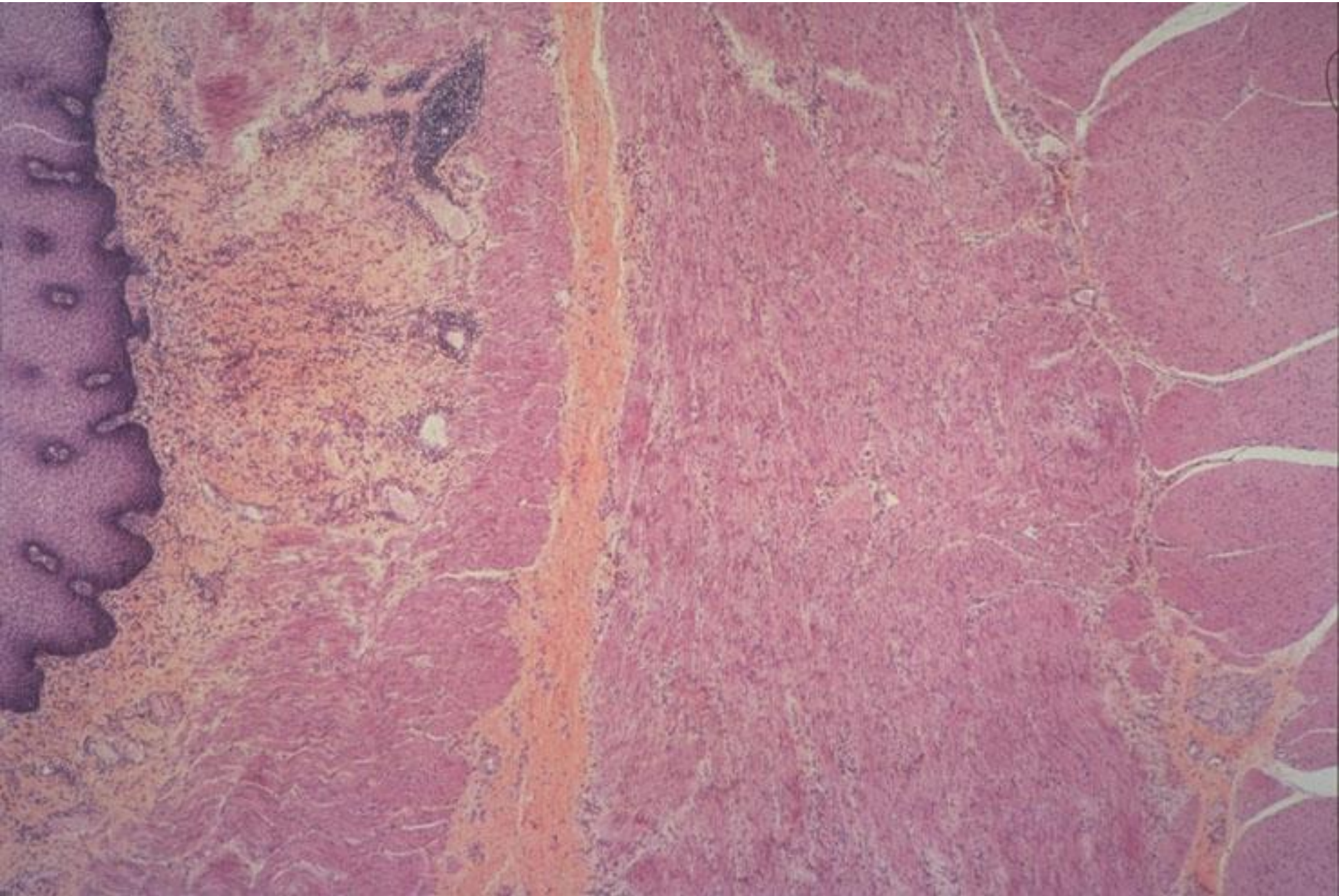
K52 Esophagus - Lower

Distinguish the four major layers:

1. Mucosa = epithelium, lamina propria, muscularis mucosa
2. Submucosa = here, rather a dense, slightly orange tissue layer
3. Muscularis externa = all smooth muscle; note the thickened circular layer that forms the lower esophageal sphincter
4. Adventitia or serosa = as the esophagus penetrates below the diaphragm, it is covered by a serosa

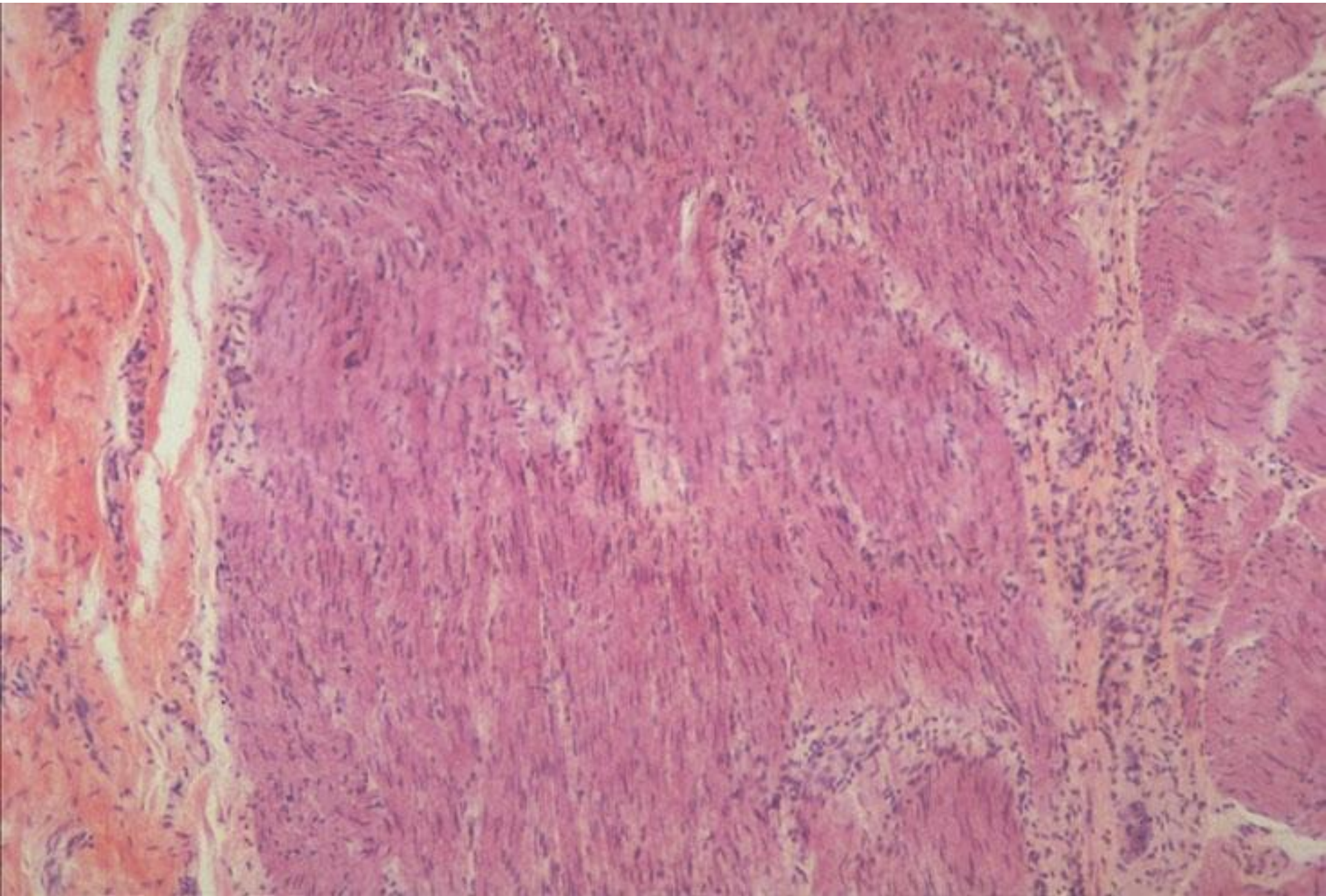


K53 Esophagus Lower



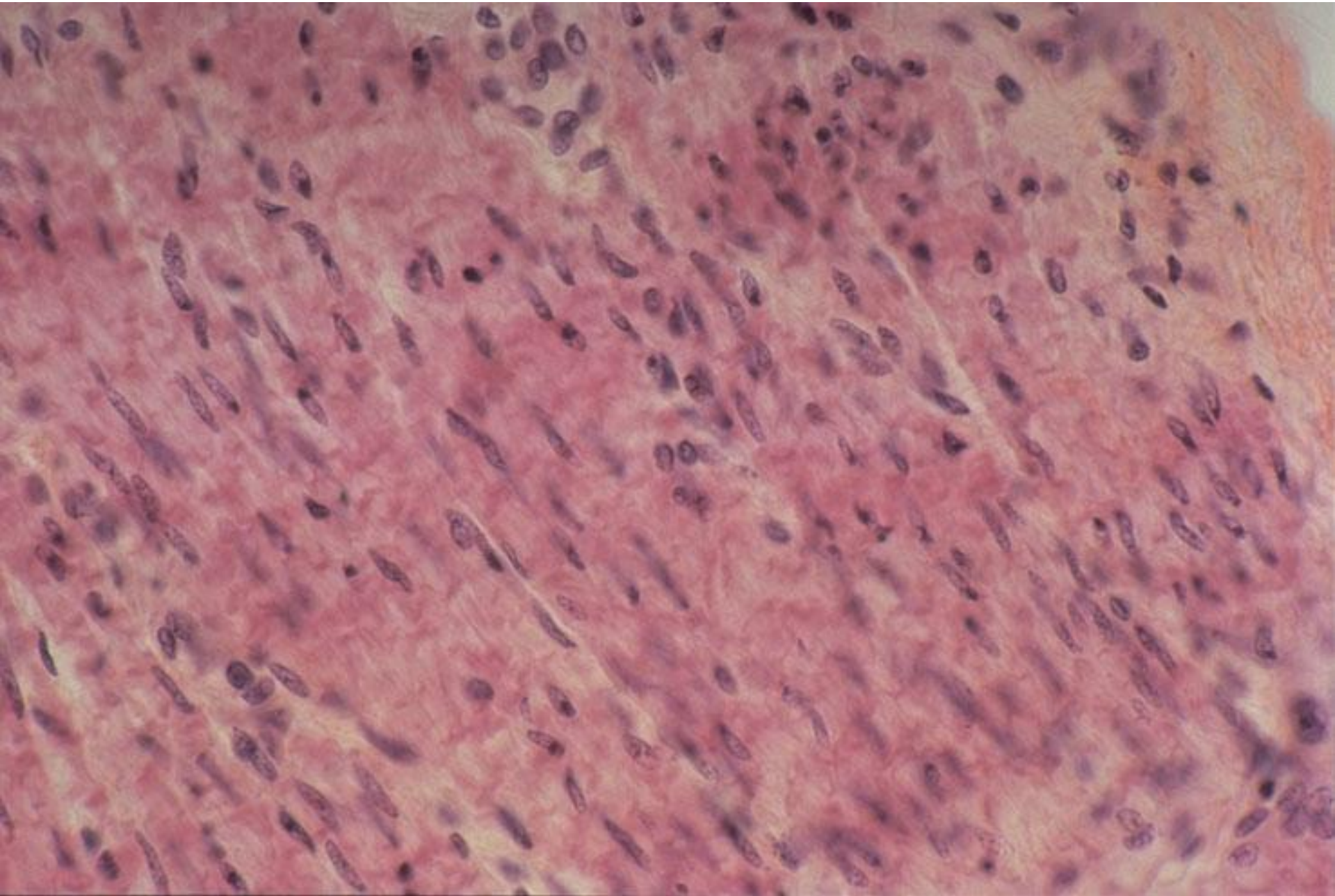
K54 Esophagus Lower

The lower esophagus is unique for the muscularis externa built of only smoth muscle.



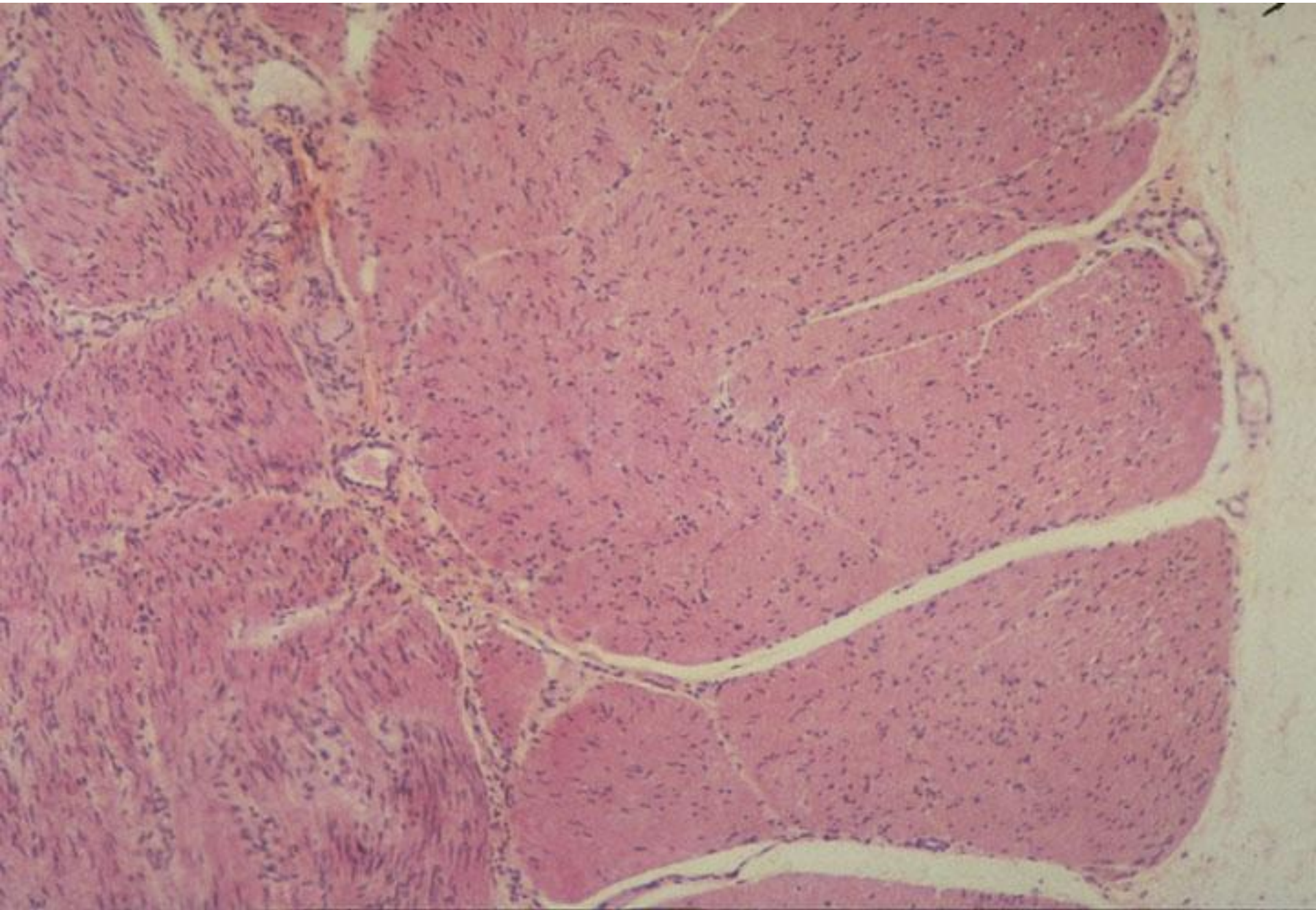
[K55 Esophagus Lower]

Higher power view of smooth muscle cut in longitudinal section.

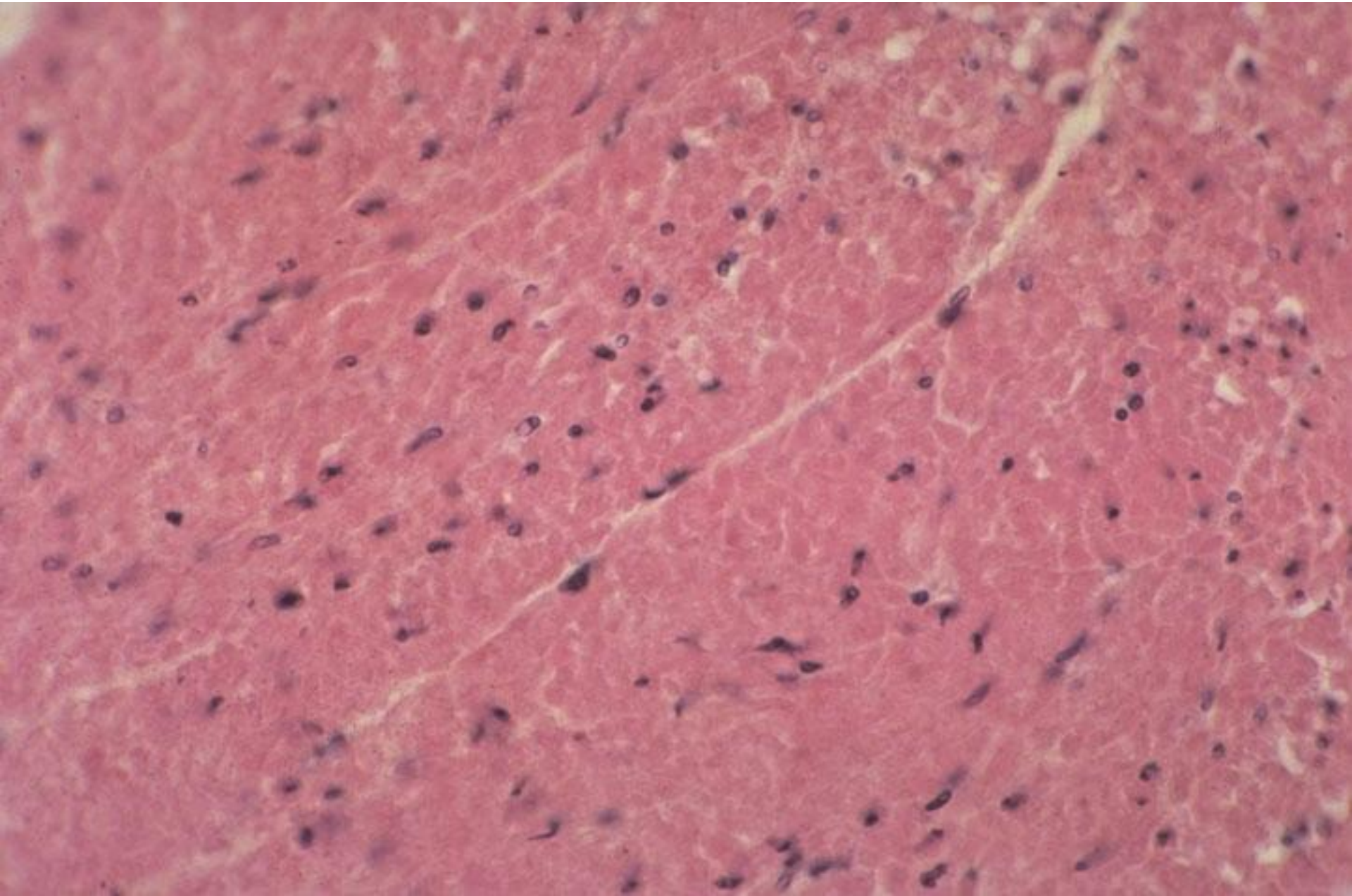


K56 Esophagus Lower

Both the circular and longitudinal layers of the muscularis externa are smooth muscle in the lower third of the esophagus.

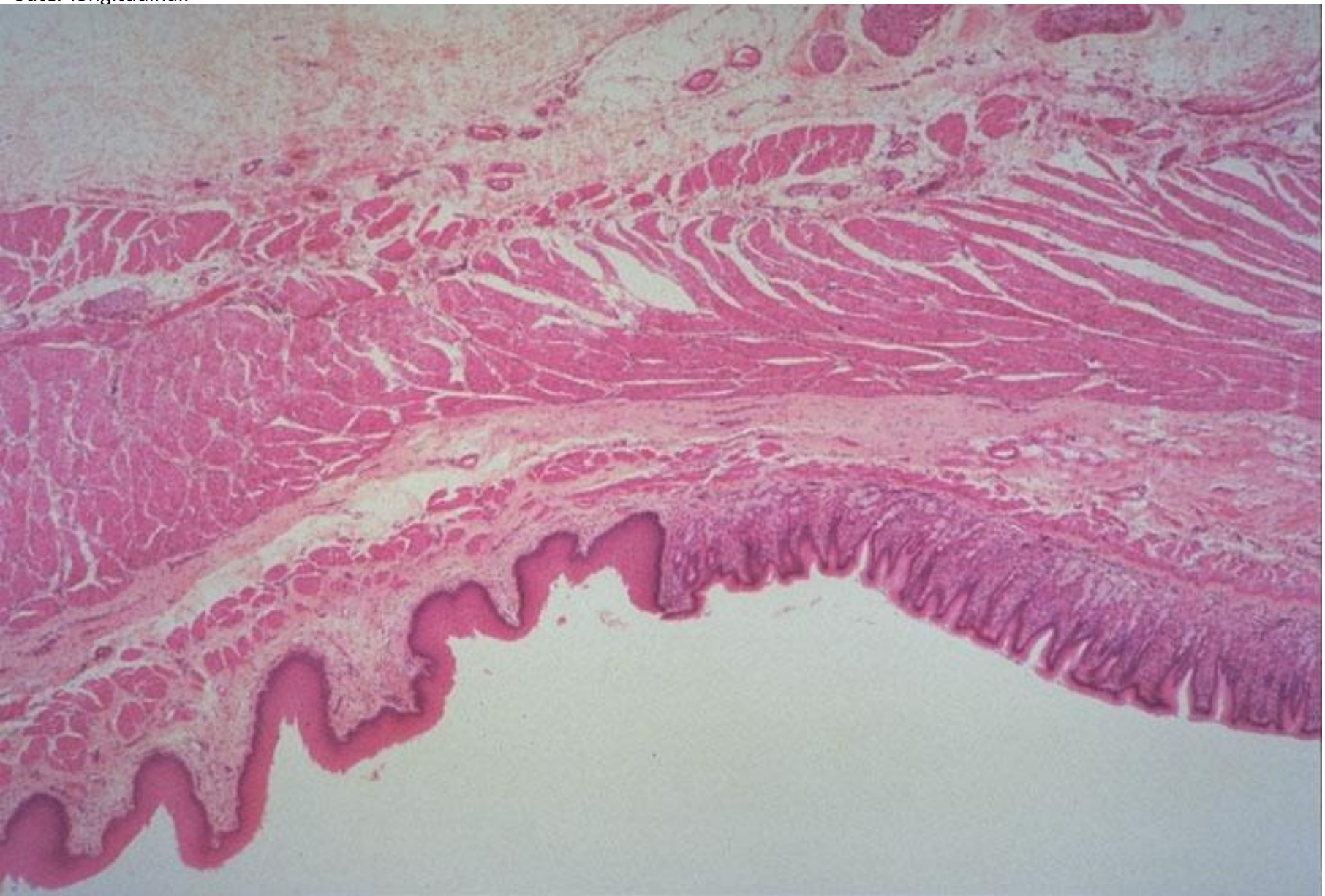


[K57 Esophagus Lower]
Smooth muscle cut in cross section.



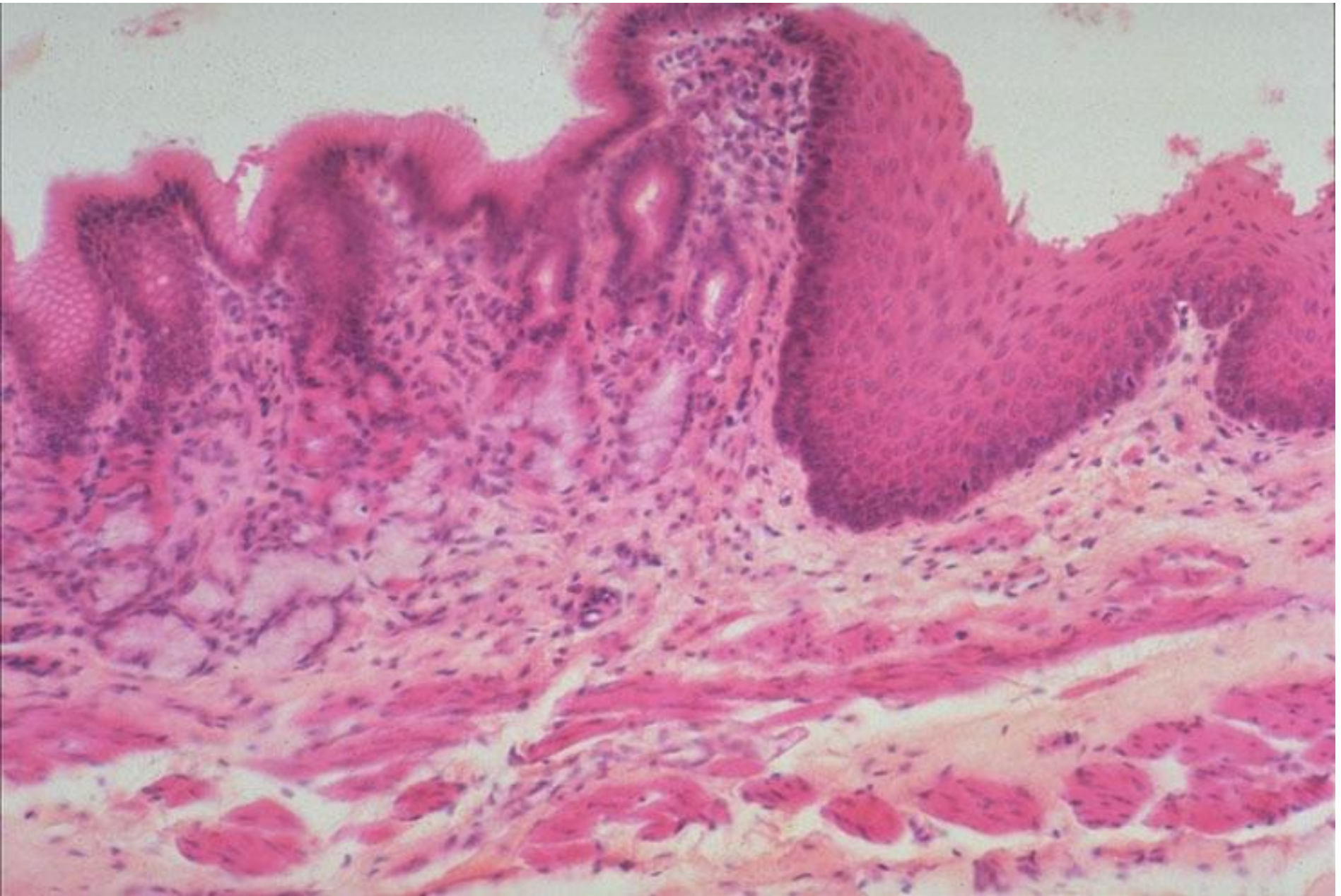
K58 Espohageal-Stomach Junction

There is an abrupt transition from the histology of the esophagus to the cardiac stomach. The stomach epithelium is characterized by pits and glands that project into the lamina propria. The muscularis mucosa becomes circularly oriented and lies immediately at the base of the gastric glands. Due to the unusual shape of the stomach, the muscularis externa becomes distorted into three layers: inner oblique, middle circular and outer longitudinal.



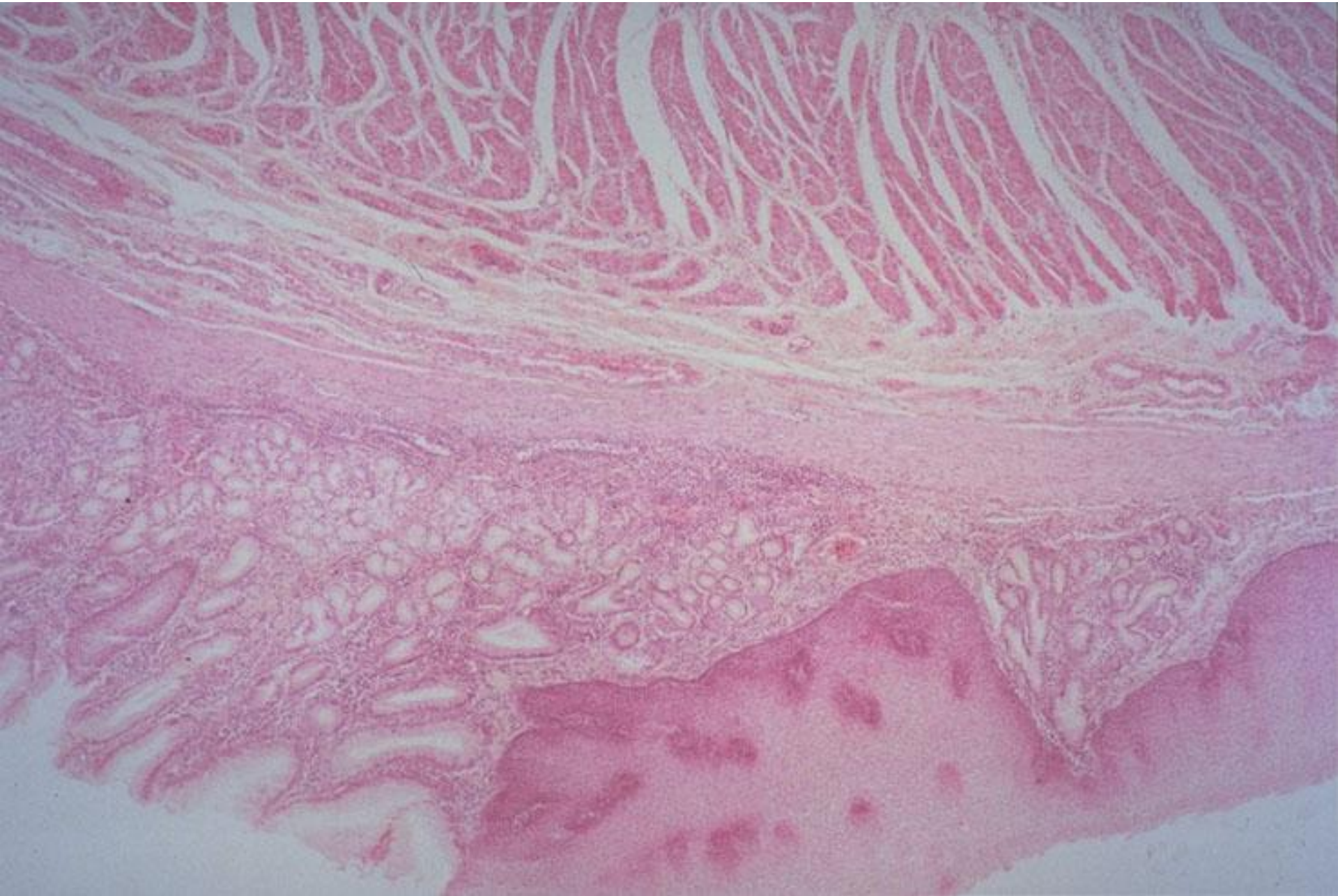
K59 Esophagus-Stomach Junction

The transition between esophagus and stomach is abrupt and reflects the different functions of the two organs from conduit to digestion and storage.



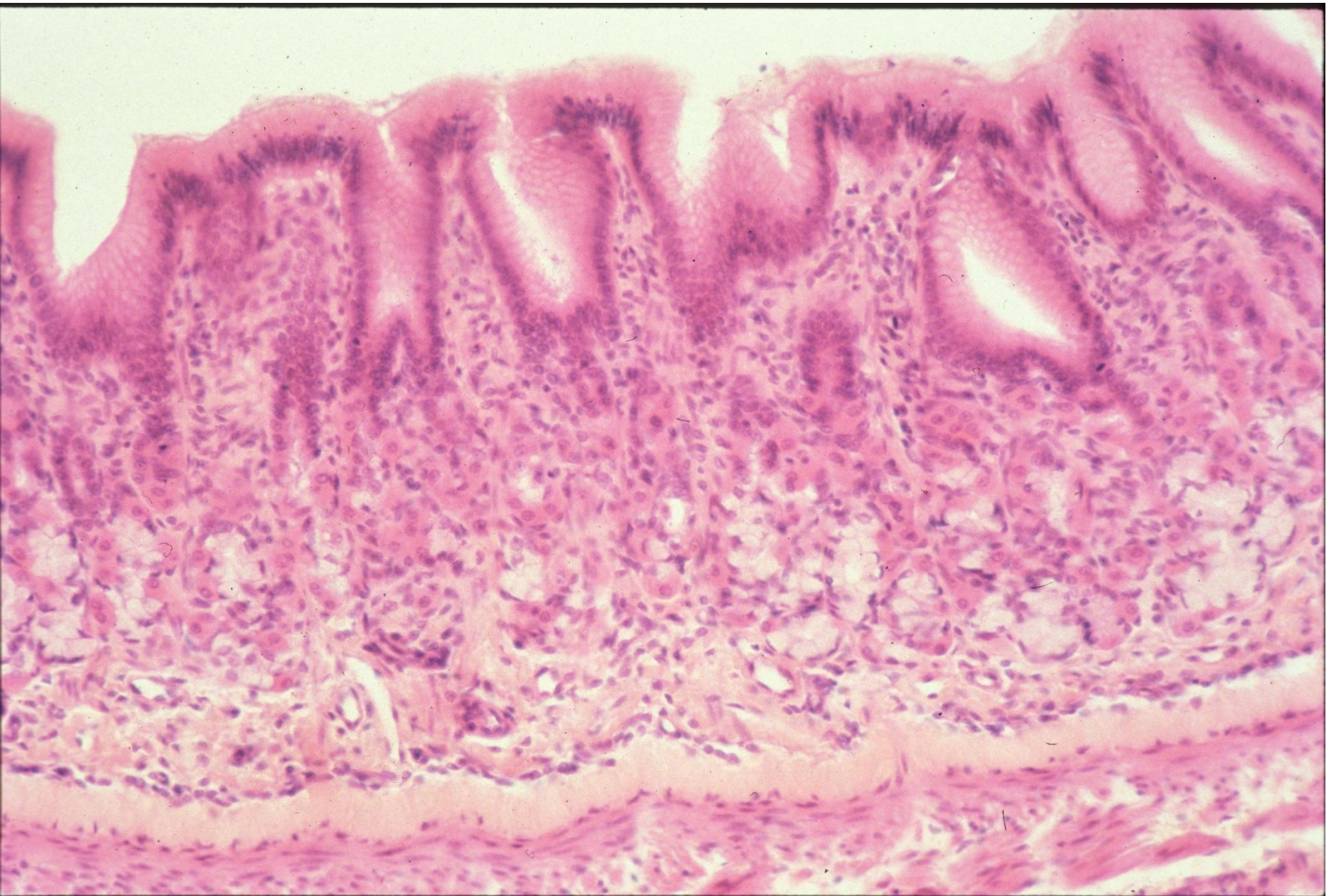
K60 Esophagus-Stomach Junction

Occasionally, at the junction of the cardiac stomach and the esophagus there is a back growth of the cardiac glands of the stomach into the lamina propria of the esophagus. These are still called cardiac glands and help to protect the esophagus from acid reflux.



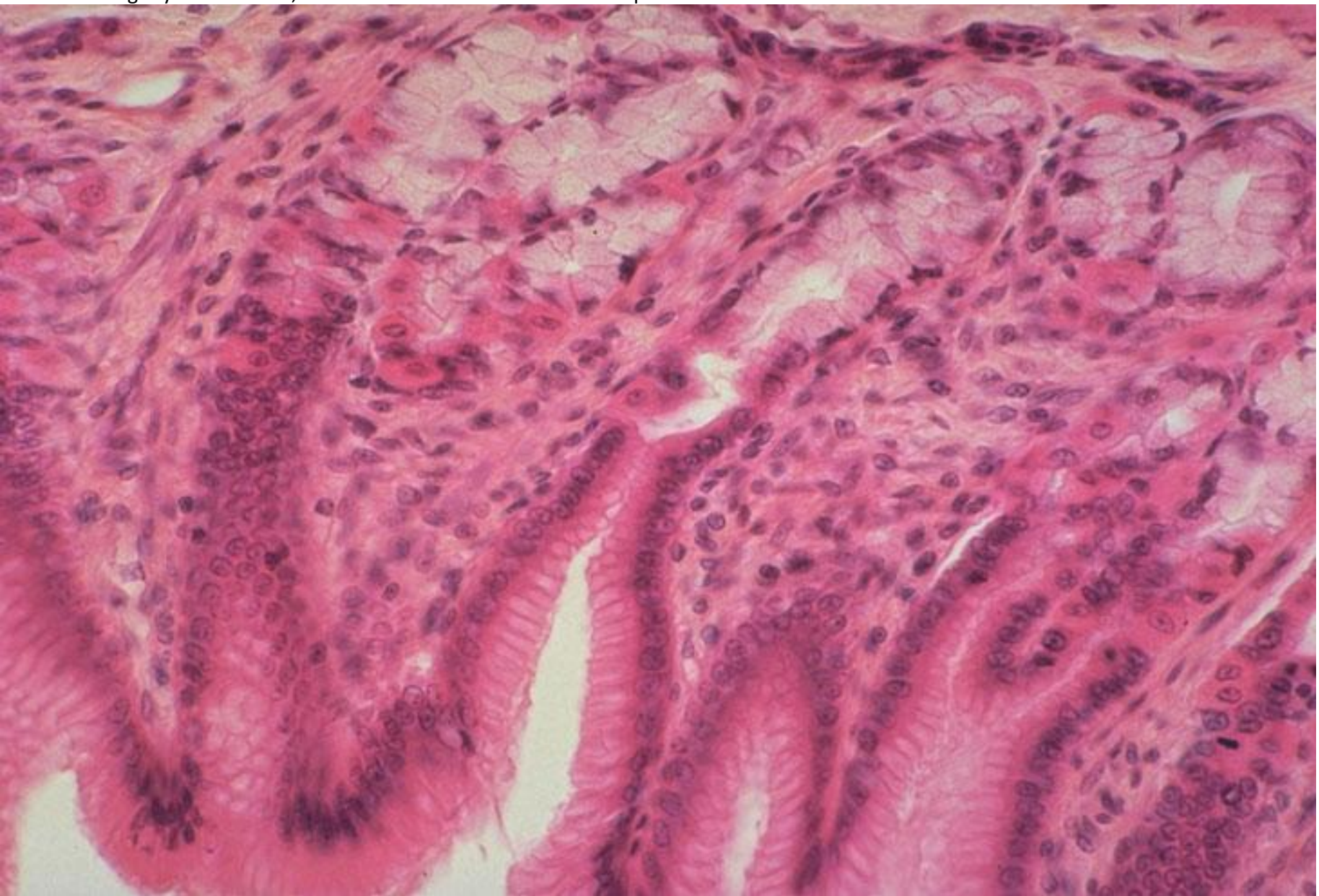
K61 Stomach - Cardiac

The cardiac stomach displays pits and glands with a 1:1 ratio in depth. While all gastric pits are all lined by surface mucous cells, the glands of the cardiac region contain predominantly mucous cells with scattered parietal cells. The large, round bright pink cells of the glands are the acid secreting parietal cells. The bottom of the glands rest on the muscularis mucosa.



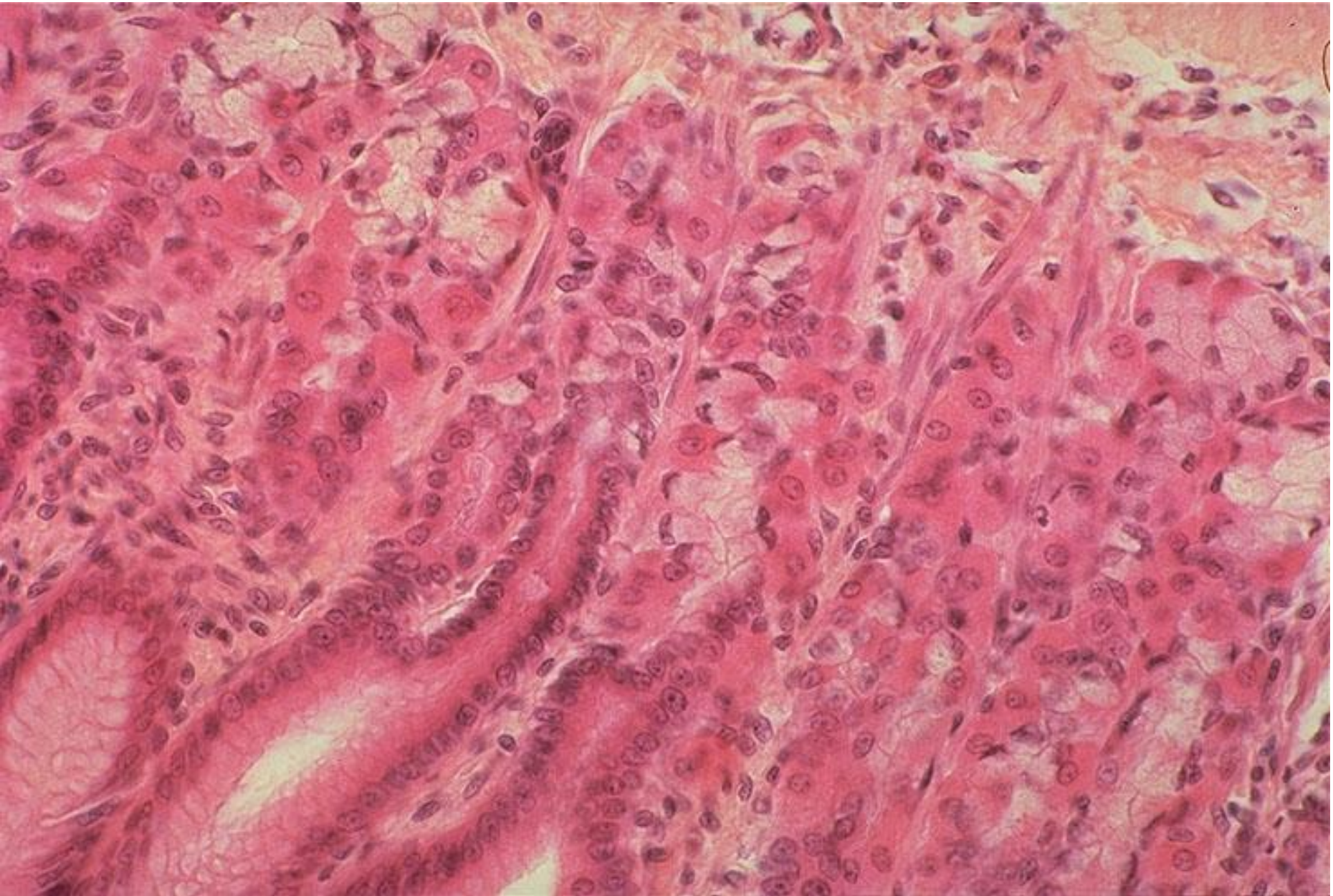
K62 Stomach - Cardiac

The cardiac stomach is characterized by surface pits into which drain 2-4 cardiac glands. The ratio of the lengths of pits:glands is 1:1 in the cardiac stomach. The pits are lined by surface mucous cells. These secrete an alkaline, bicarbonate rich mucous to coat and protect the stomach surface. Within the glands are the round, bright pink parietal cells that secrete HCl and Vit B12 intrinsic factor. Mucous cells within the glands release a neutral or slightly acid mucous, so as to not dilute the acid from the parietal cells.



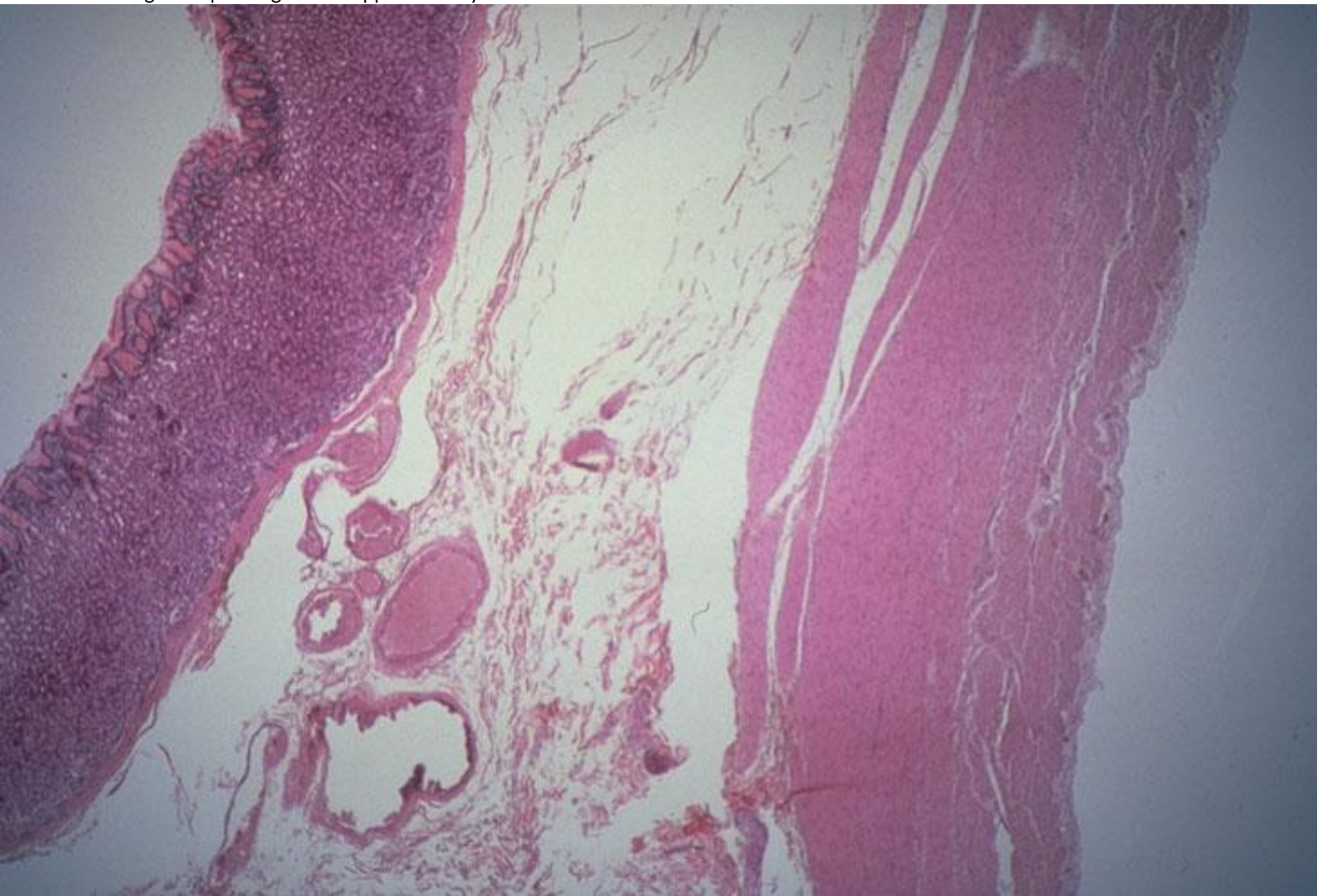
K63 Stomach - Cardiac

The round morphology of the parietal cells is due to the massive intracellular cannaliculus (requires EM to visualize). The extra surface area is needed to insert the transporters for H+K+ATPase and Cl-. The nuclei are therefore pushed up to the center of these plump cells. Large numbers of mitochondria (for ion pumping) renders the cytoplasm eosinophilic with H&E staining.



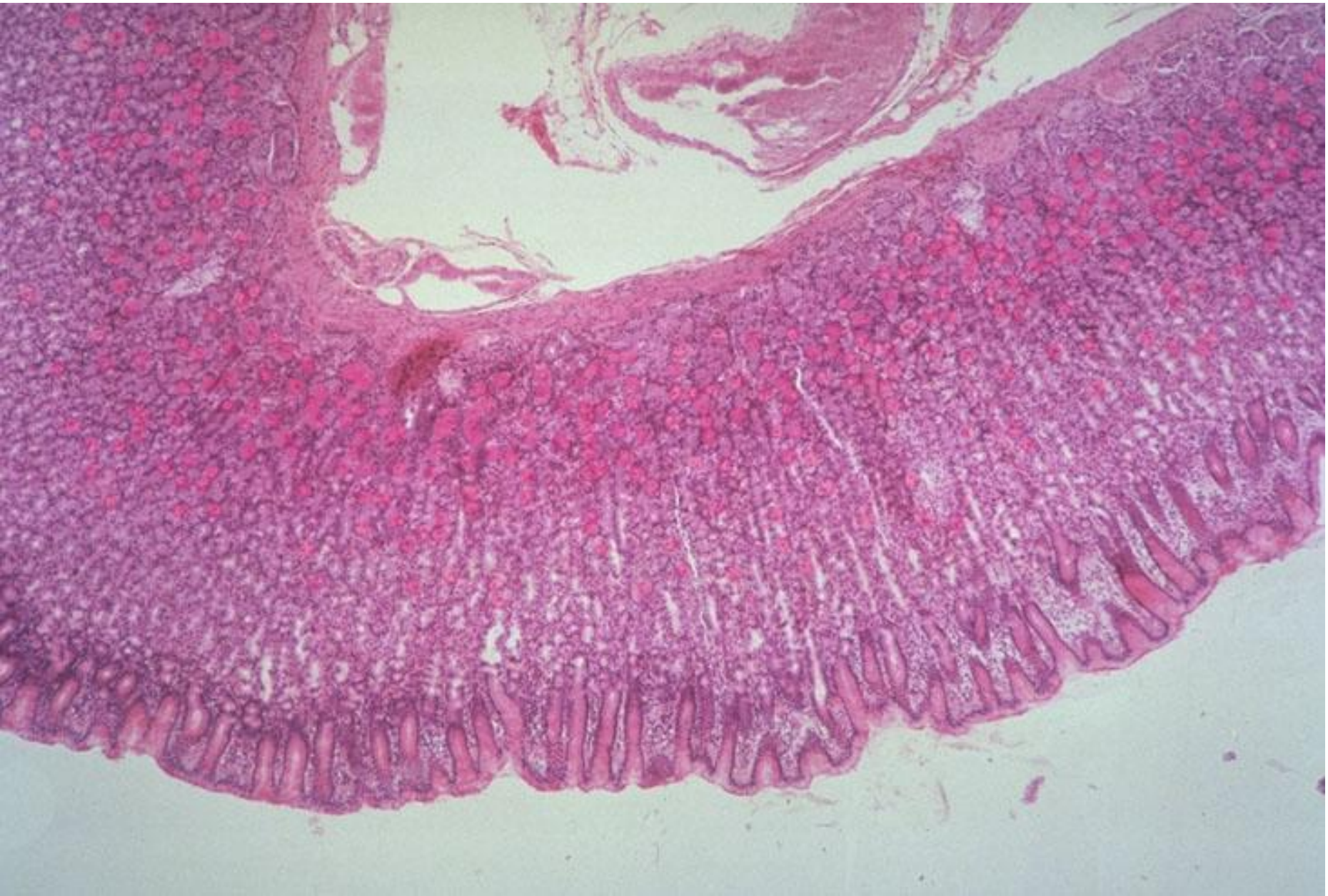
K64 Stomach - Body

This is the histological appearance of the stomach in the fundus, body and antrum. Note the broad, loose submucosa with large blood vessels to assimilate absorbed water. The thick muscularis externa churns and mixes the stomach contents. The mucosa is expand by very deep glands. The ratio of the lengths of pits to glands is approximately 1:4.



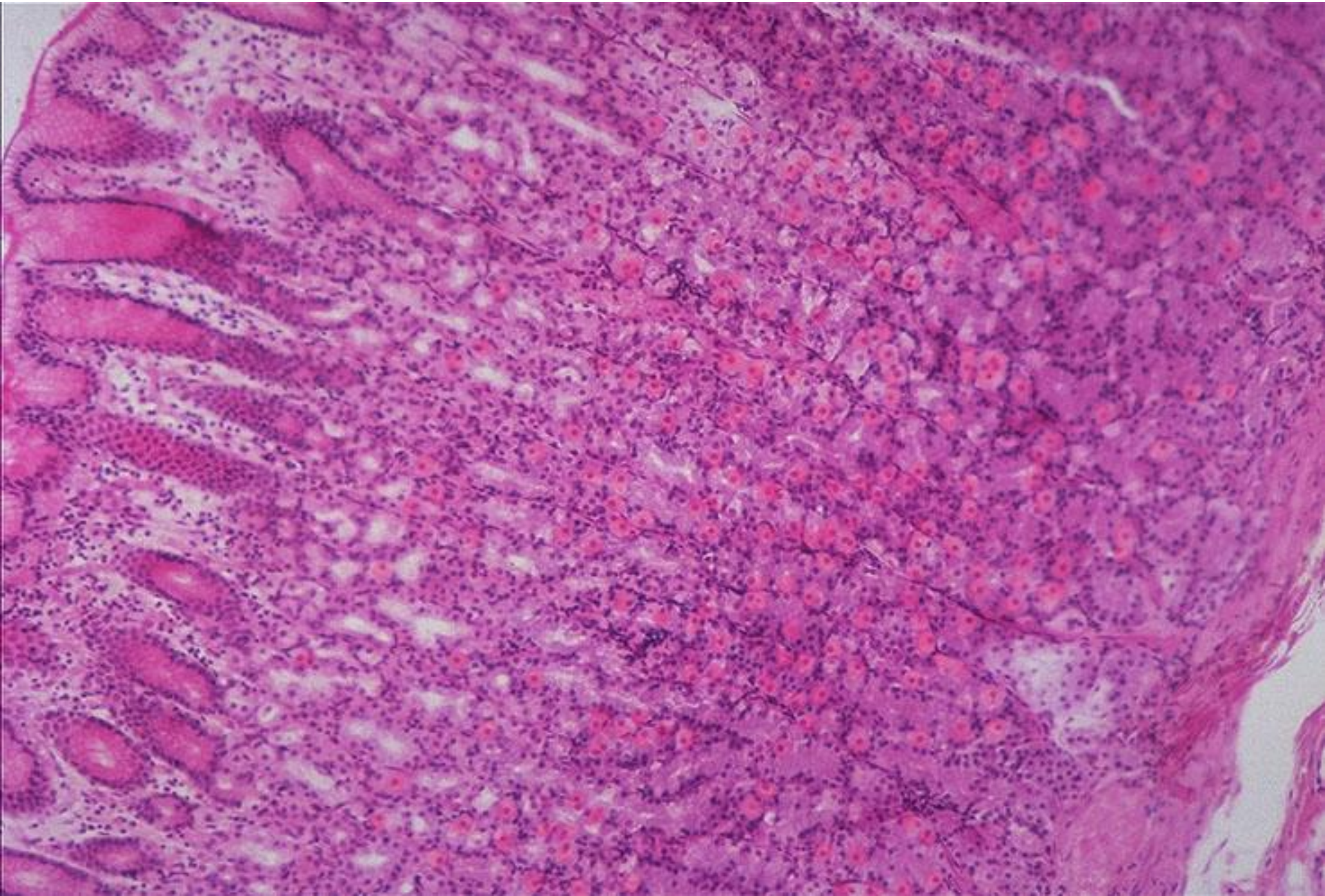
K65 Stomach - Body

The pits are lined by surface mucous cells (note pale pink cytoplasm). The long glands begin with the isthmus (source of stem cells for both the pits and glands); the neck (mucous neck cells and parietal cells); and the base (parietal cells and chief cells - pink and blue respectively). The muscularis mucosa is the pale pink band at the bottom of the glands (top of the slide), bordering the watery submucosa.



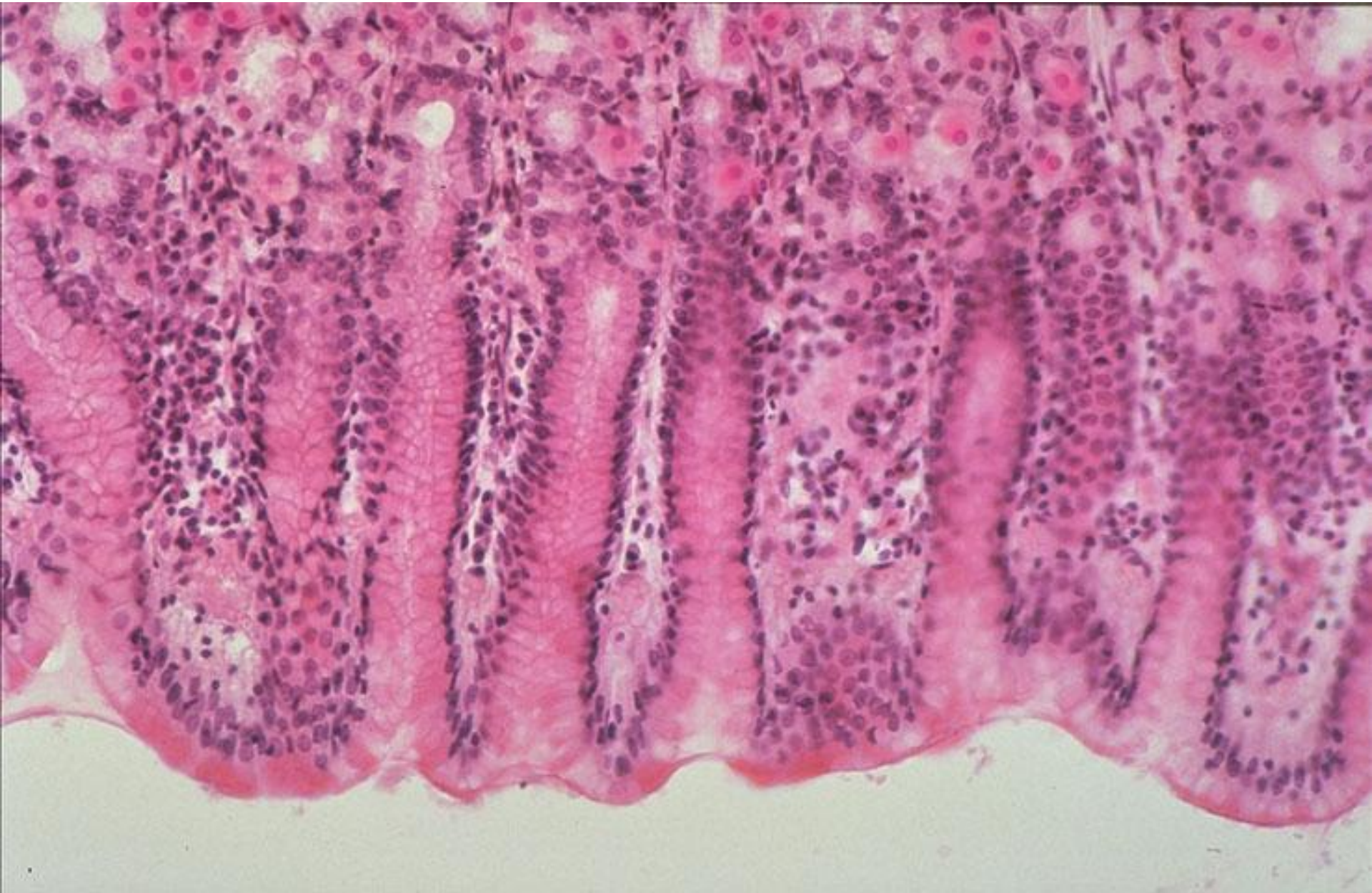
K66 Stomach - Body

The base of the glands are slightly basophilic due to the stored granules of enzymes in the chief cells. Chief cells secrete pepsinogen, rennin and lipase.



K67 Stomach - Body

Surface mucous cells of the gastric glands. These secrete mucous in response to the friction of food in the lumen, or chemical stimuli such as ethanol. The HCO_3^- concentration in the mucous is increased by Ca^{2+}, prostaglandins E & F, cholinergic agents and dibutyryl cGMP. Drugs that decrease the HCO_3^- include aspirin and NSAIDs.

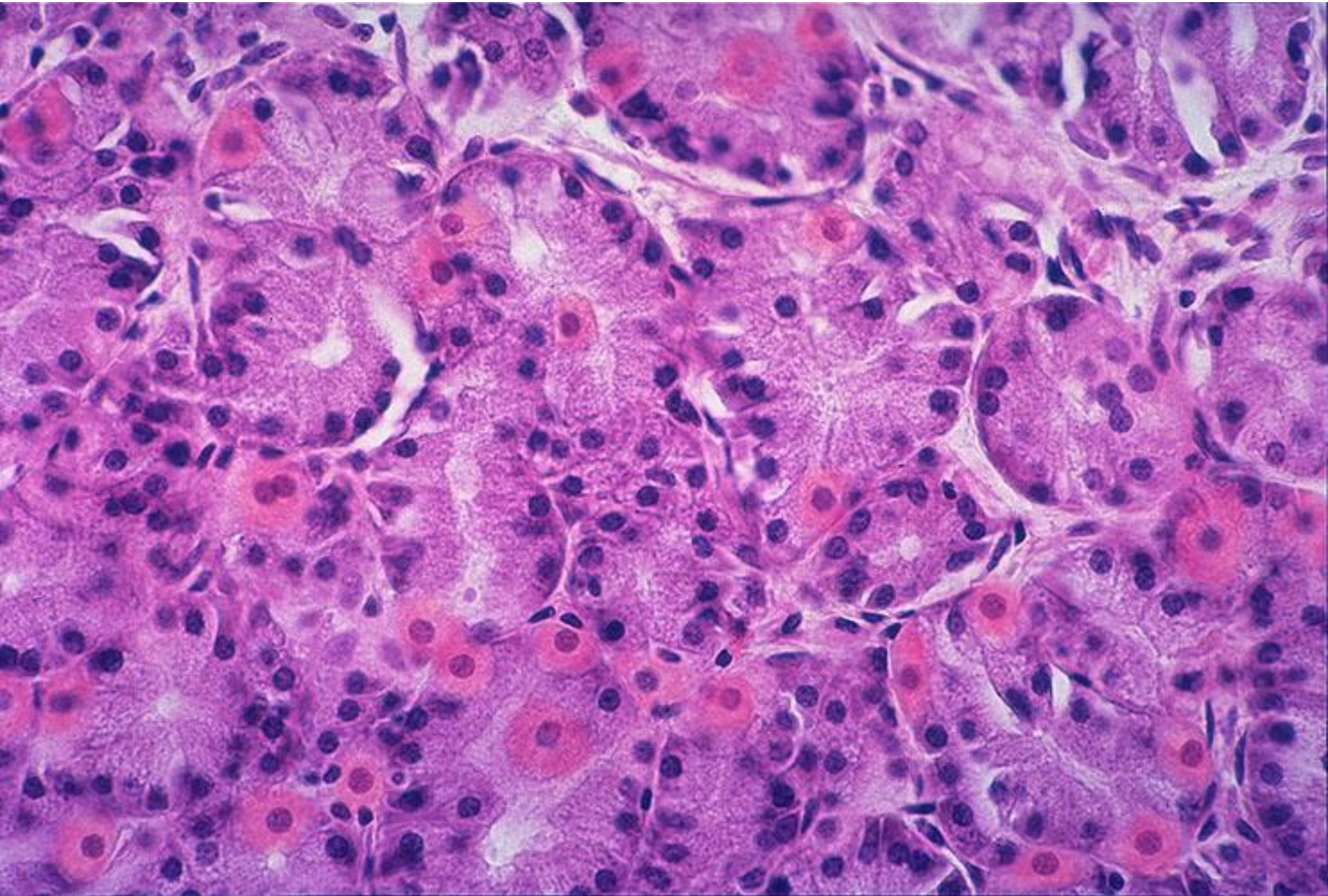


K68 Stomach - Body

The surface pits penetrate the lamina propria. Lymphocytes can be seen throughout the lamina of most sections of the GI tract.

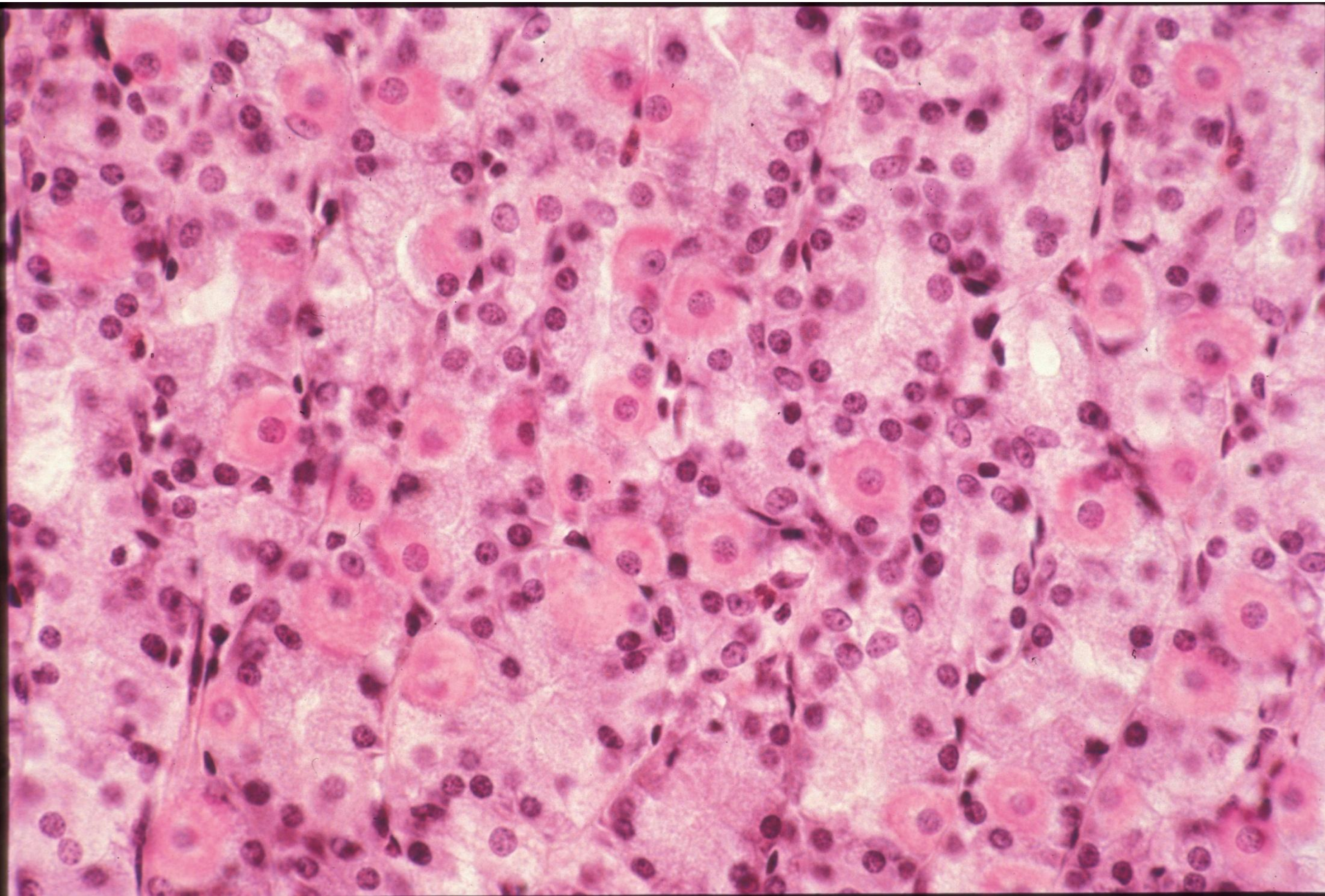
K69 Stomach - Body

Cross section from the base of the gastric glands displaying chief cells. The round nuclei are pushed to the base of the cells, while the gritty, basophilic apical end is fill with stored granules of secretions. The few parietal cells display eosinophilic cytoplasm and a central nucleus



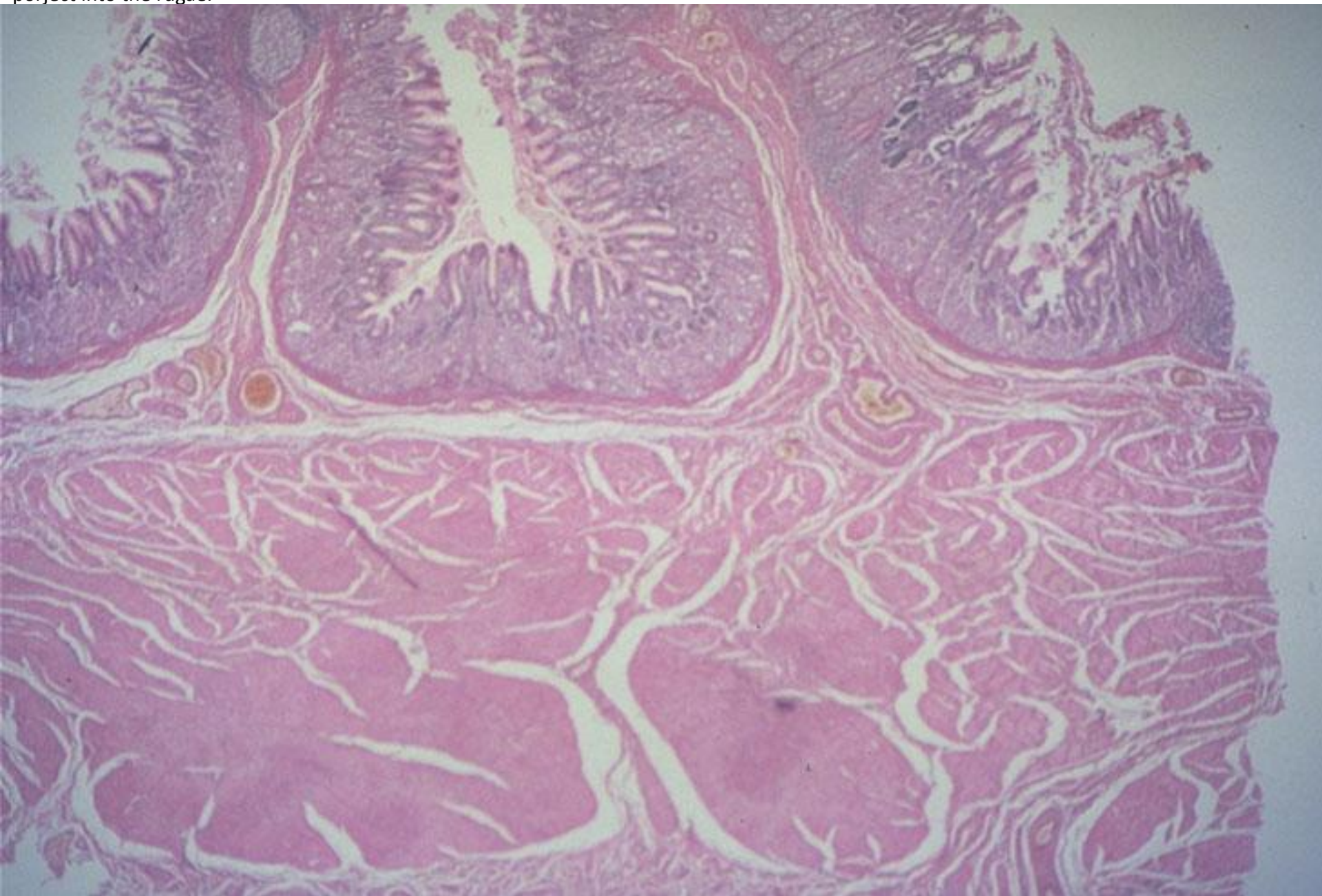
K70 Stomach - body

The slide shows the mid-region or body of the gastric glands. The large, pyramidal, eosinophilic cells with a central nucleus are the parietal cells. The slightly darker, gritty staining cells are mucous neck cells that produce an acidic mucous to flush out the gland lumen.



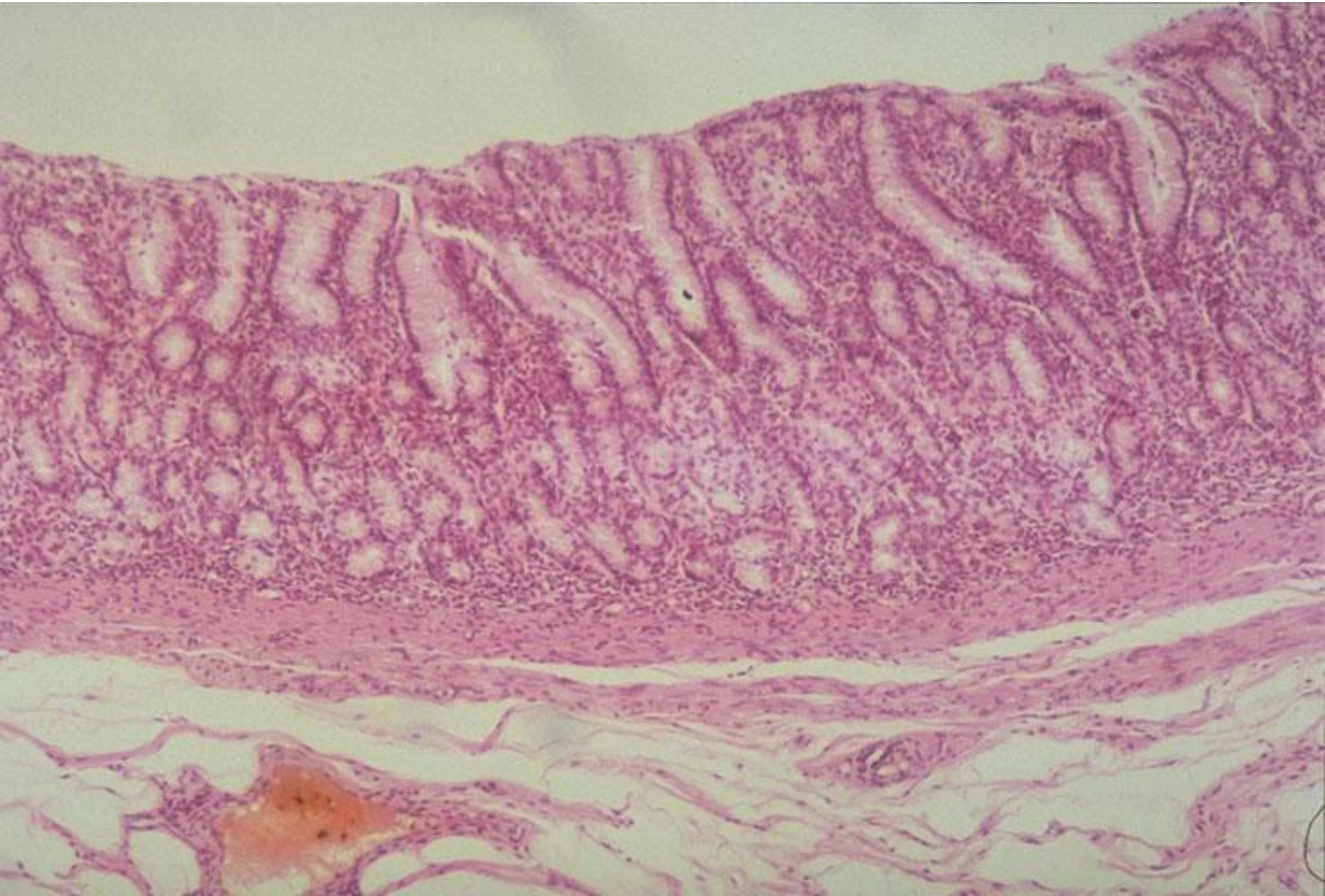
K71 Stomach - Body

The rugae of the stomach are large folds that contain a core of the submucosal layer. The entire mucosa, limited by the muscularis mucosa porject into the rugae.



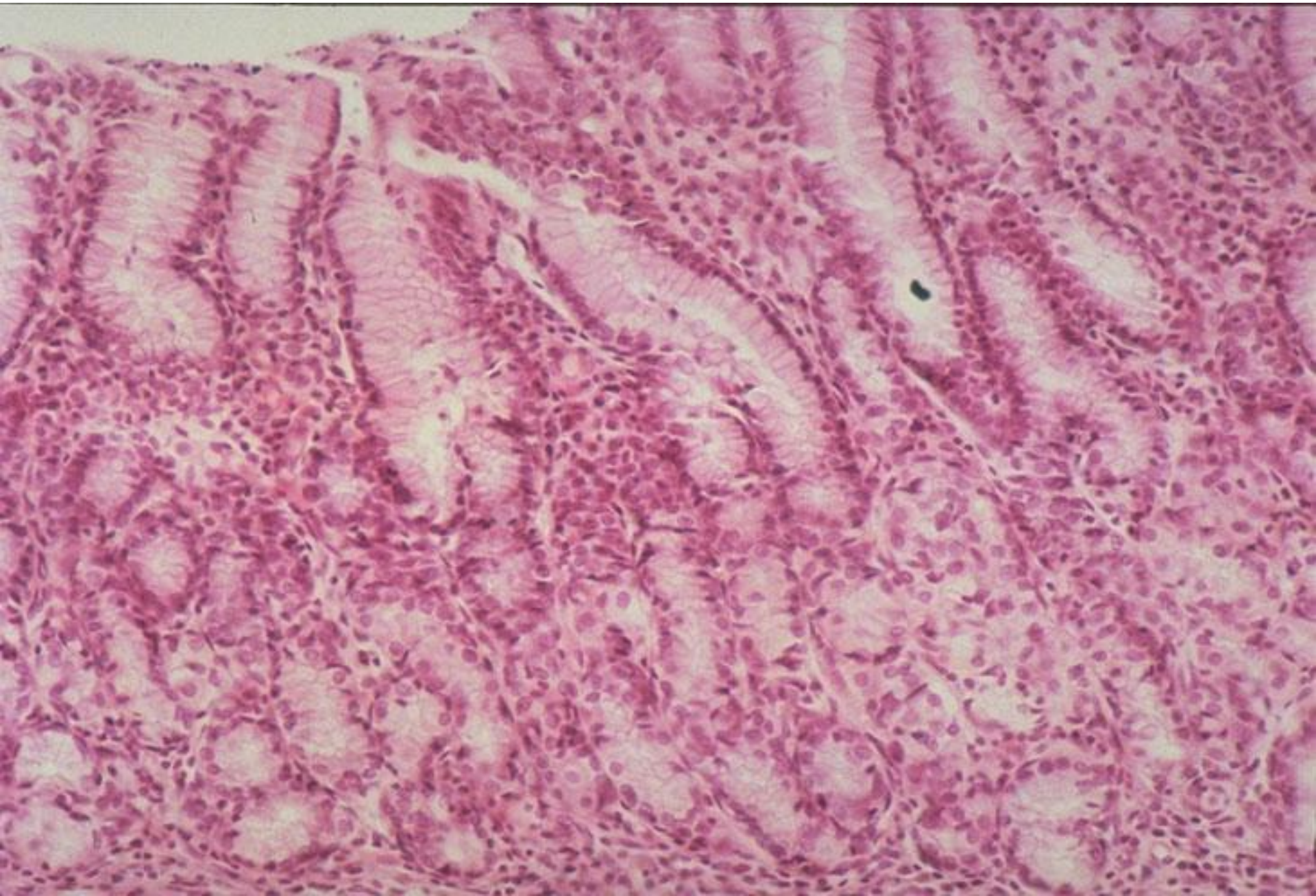
K72 Stomach - Pylorus

In the pyloric stomach the ratio of the lengths of pits to glands is again 1:1. The pits are deeper and more regular than in the cardiac stomach. The pyloric glands contain mucous cells only; parietal cells are notably absent.



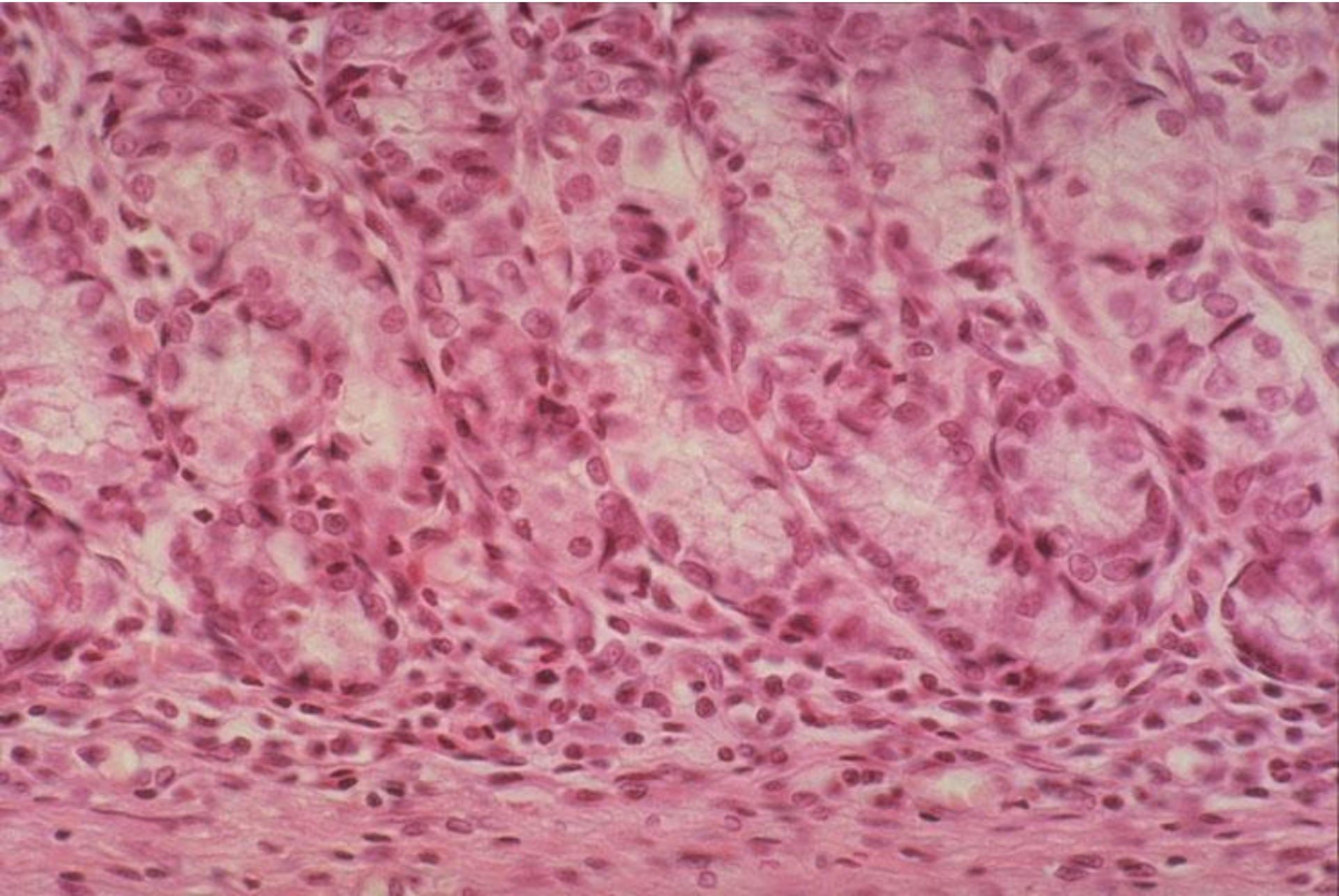
K73 Stomach - Plyorus

Pits with surface mucous cells and glands with neutral mucous cells form the pylorus.



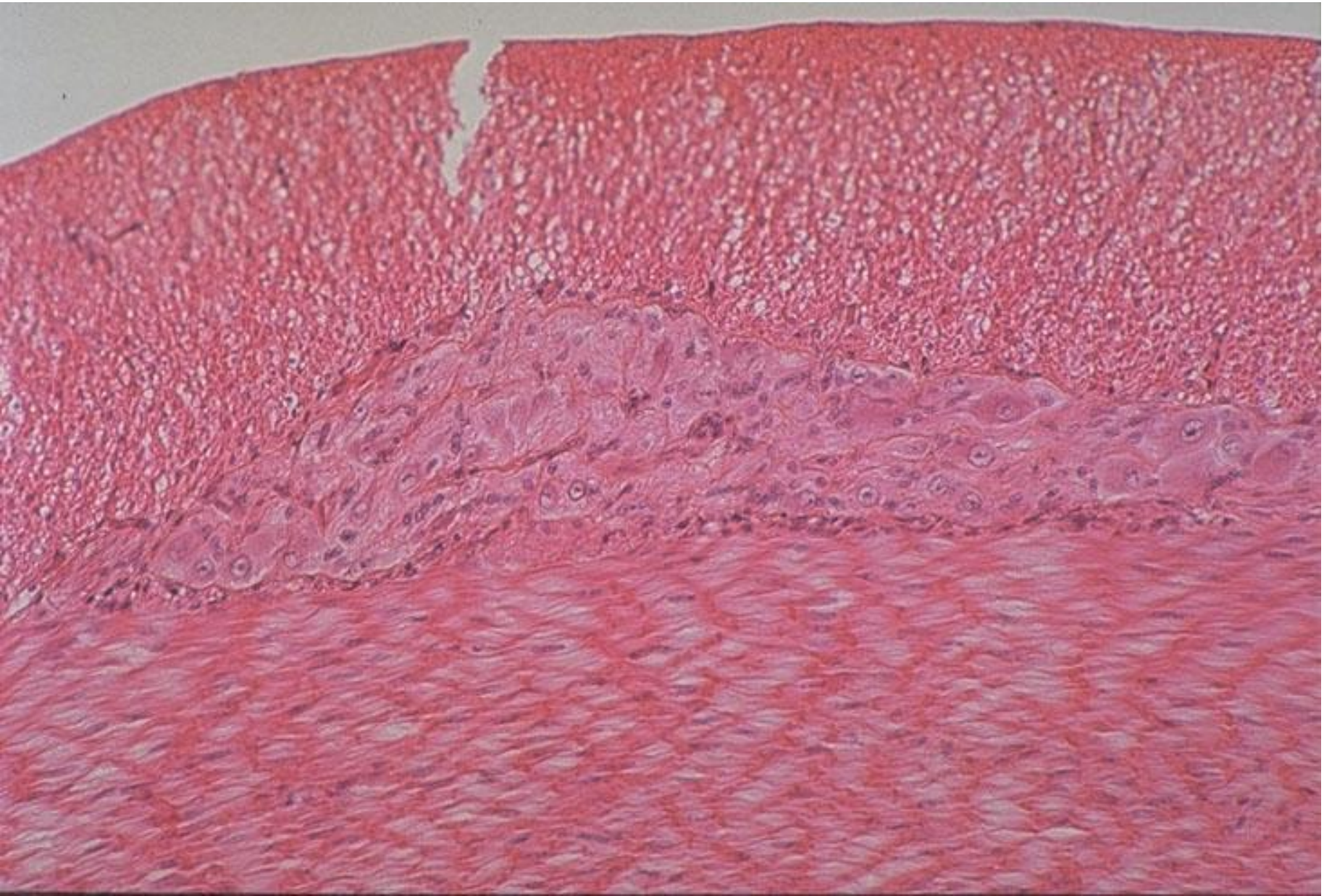
K74 Stoamch - Pylorus

The glands of the pylorus contain mainly neutral mucous secreting cells. The pale staining “fried egg” looking cells are G cells that secrete gastrin.



K75 Stomach - Muscularis Externa

The smooth muscle of the muscularis externa is innervated by the autonomic nervous system. Sandwiched between the circular & longitudinal layers is an Auerbach's (Myenteric) plexus. The large cell are the postganglionic parasympathetic neurons. Axonal fibers that pass through the plexus are postganglionic sympathetic and both the pre- and postganglionic parasympathetic.



K76 Stomach, Pylorus - Duodenum Junction

The lumen of the pylorus is in the upper left; the lumen of the duodenum is in the lower right. The thick expanse of the circular layer of the muscularis externa (center)is the pyloric sphincter. Shifting around the right side of the slide, one transitions from the stomach into the duodenum. It is difficult to see the transition of the mucosa, but a distinct difference in the submucosa is apparent. The most notable feature of the duodenum are the extensive glands that pack the submucosa. These Brunner's glands secrete HCO_3^- enriched mucus to neutralize the acidic chyme being delivered from the stomach.