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Microvascular Architecture in a Case of Gastric Antral Vascular Ectasia (Watermelon Stomach)

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To the Editor: The luminal treatment of mucosal ectasias by the endoscopists requires a three-dimensional anatomic mental image of the plausible vasculature pattern of the lesion and its context among normal vascular anatomy. As an extreme example, watermelon stomach (gastric antral vascular ectasia, GAVE) refers to the endoscopic finding of prominent linear erythema in the gastric antrum, associated with histological findings of mucosal vascular ectasia and microthrombi within mucosal capillaries (1,2). The entity can result in gastrointestinal hemorrhage and severe iron deficiency anemia.

A 74-year-old man had gastric bleeding and persistent anemia (3). Upon referral to our hospital, he endoscopically had linear antral erythema and, histologically showed microthrombi within antral mucosa. Both were characteristic of GAVE. He subsequently required antrectomy for gastric outlet obstruction secondary to a healed ulcer. We studied vascular casts prepared in the antrectomy specimen using methyl salicylate for clearing and tissue digestion. Additional details of the case and a control antrectomy specimen, the methods, and interpretations are available in the Supplementary Text and Figures.

Dissecting microscopy and scanning electron microscopy revealed an extensive network of tortuous and ectatic mucosal vessels in antral mucosa, most prominent on the ridges of rugae and near the mucosal surface (Figures 1 and 2). The majority of vessels contiguous with the ectatic network were of capillary size. The ectatic vessels often existed within an otherwise intact mucosal capillary bed. Ectatic vessels had occasional direct continuity with deeper arterioles and venules. The current three-dimensional studies illustrated and clarified the relation of the ectatic vessels to neighboring vessels of the mucosal capillary network and ruled out the existence of submucosal vascular anomalies. The pictorial anatomy presented here may help calibrate the conjectural three-dimensional mental images held by the operator as these and other forms of ectasias are treated endoscopically.

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SUPPLEMENTARY MATERIAL is linked to the online version of the paper at <http://www.nature.com/ajg>

Our studies supported previous conceptions of GAVE, by which ectasias emerge within a developmentally normal mucosal vasculature due to a mechanical cause. Presumably, hypercontractility creates or exaggerates not only the abnormally prominent antral folding (and perhaps induces mucosal prolapse) but also generates extraordinary intraluminal pressure within the innermost vessels, those near the mucosal surface and the apices of the folds. Analogous to the pattern of inflation of a long balloon, high intraluminal pressure would not initially produce prominent dilatation. Yet, once the limits of elastic distensibility were surpassed, focal weakening of the capillary structure would occur at the apical sites at which the pressure exceeded a threshold. Wall tension would increase geometrically (proportional to the fourth power of the increase in the luminal radius) with any increase in wall diameter, according to the law of LaPlace. This relationship initiates propagation of the dilatation for considerable distance along the vessel, as long as the wall tension exceeds the elastic threshold, but would not necessarily permit the ectasia to cross the vessel branch points at which distension (and therefore the propagation of the wall tension) may be structurally resisted. Vessel dilatations would not easily propagate beyond the apices of the mucosal fold, as a relatively higher tissue pressure at lower mucosal levels may counterbalance any increase in vascular intraluminal pressure produced by antral contractions. Such a schema would be consistent with the findings of the current study.

The bulk of the ectasias were superficial and readily accessed by luminal interventions. Some features of this examined case, however, may help explain treatment failure and bleeding complications of therapy, especially (1) the minority of vessels that had ectatic extension into some deep mucosal vessels and (2) the partial involvement of gastric rugal valleys and proximal duodenum in the extensive network of ectatic vessels. It seems readily apparent that this progressive ectatic process could continue post therapy among the remaining mucosal vessels, particularly if periodic episodes of high intraluminal pressure, perhaps attributable to hypercontractility, persist.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.

Watermelon stomach, gross and dissecting microscopic appearances after vascular casting.

(a) Opened specimen. Duodenal margin and pyloric channel are on the upper left, and the proximal margin is on the right. The antral rugal folds have linear bands of “erythema” due to filling by red vascular casts in continuity with the arteries along the lesser and greater curvatures of the stomach. The veins were injected to yield blue casts. (b) Similar, close-up of antrum. (c) Sections of the antrum. Distinct vessels reach to the upper surfaces of the rugal ridges. A vascular blush affecting the ridges mirrors the antral bands seen in the unsectioned specimen. Rugal valleys are largely spared. (d) After tissue clearing, deeper aspects of the mucosal vascular pattern become visible. Here, the arterial injection, which was the first injection, resulted in red casting material within the venous side. (e) Similar, close-up of antral section. (f) After tissue digestion with KOH, only the casts remained. These are the antral mucosal casts corresponding to the ridges shown in panels d and e. Such casts were osmium-coated and viewed by scanning electron microscopy (SEM).

Figure 2.

Antrum of watermelon stomach, scanning electron microscopy (SEM) appearances. **(a)** A rugal fold has severely tortuous dilatations across the surface and often affects even deeper areas of the mucosal capillary network as seen in the upper half of the image. Submucosal vessels and some broken pieces of mucosal casts are seen in the lower half. **(b)** Same view, close-up. **(c)** Submucosal vessels contiguous with ectatic mucosal capillaries can be identified. **(d)** Ectatic mucosal capillaries often coexist with a delicate capillary network. **(e)** Same view, close-up. The cast of the large vessel appears torn at the site of a space-filling defect. This finding was extensive only within the specimen of watermelon stomach and was interpreted as a possible filling defect owing to thrombus. **(f)** A typical view “upward” (toward the lumen) through the base of the mucosa, with the superficial tortuosities partially obscured by the lower delicate capillary network.