

Meckel Diverticulum

Congenital ileal outpouching • Ectopia • Complications

Dr Abu Suraih Sakhri

MBBS, MD (Pathology)

www.abusuraisakhri.com

Learning outcomes

- Trace the vitelline duct and explain persistence of a true ileal diverticulum.
- Identify characteristic location, wall structure and heterotopic epithelium.
- Connect ectopic gastric tissue to ulceration, bleeding and abdominal symptoms.
- Differentiate Meckel diverticulum from mimics and apply diagnostic reasoning.

Meckel diverticulum in one sentence

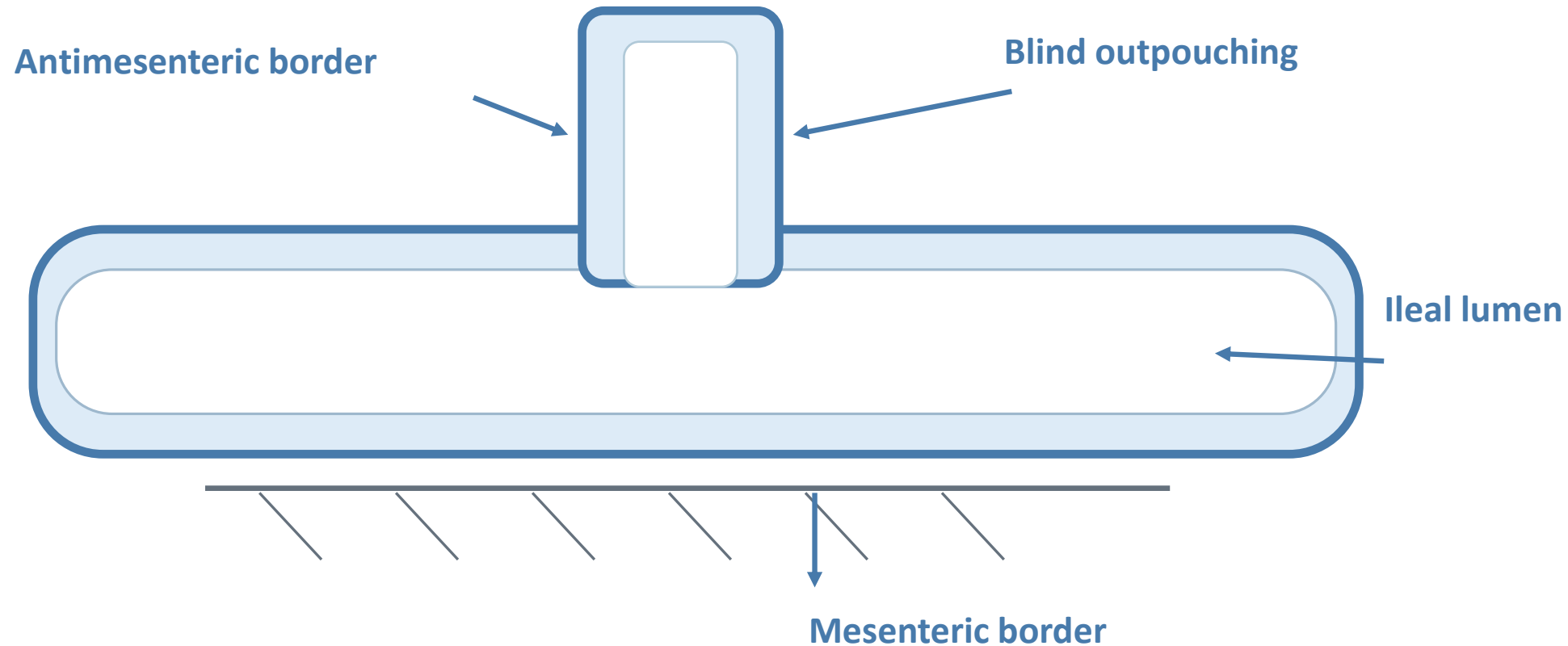
A congenital, true diverticulum of the ileum.

- It is a solitary blind sac that remains continuous with the bowel lumen.
- It develops from incomplete involution of the vitelline duct.

Definition: What makes a true diverticulum?

- Blind pouch communicates with the alimentary lumen.
- The outpouching contains the layers of the native intestinal wall.
- Wall-layer continuity distinguishes a true diverticulum from a pseudodiverticulum.

Ileal location: The antimesenteric border



Original anatomical schematic; Positioning and topology, not scale.

Bowel-wall continuity defines the lesion

Mucosa

Submucosa

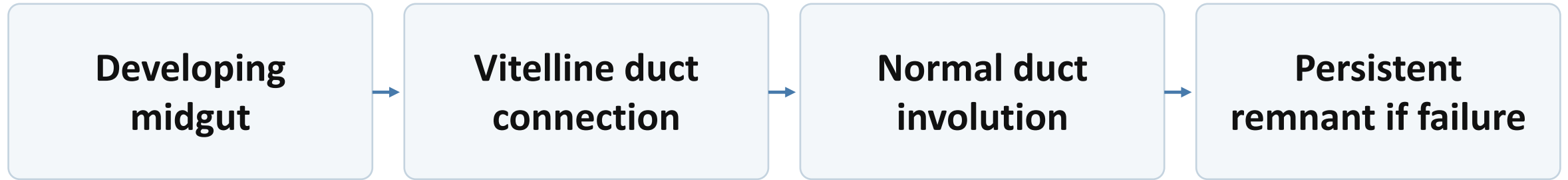
Muscularis propria

Serosal covering

All principal bowel-wall layers continue into the outpouching.

Three main wall layers: Mucosa, submucosa and muscular wall; Serosa lies externally.

Embryologic origin of Meckel diverticulum



The vitelline duct originally connects the developing intestinal lumen to the yolk sac.

Vitelline duct: The normal connection

Embryonic intestinal lumen ↔ yolk sac

- The vitelline duct is a developmental channel, not a postnatal intestinal structure.
- Normal disappearance prevents a persistent intestinal outpouching.

Failed involution creates a diverticulum



The resulting ileal lesion is a congenital remnant rather than an acquired pressure outpouching.

Why congenital classification matters

- The initiating defect occurs during development, even if discovered decades later.
- Clinical onset and embryologic origin are different concepts.
- An asymptomatic adult finding does not convert a congenital lesion into an acquired one.

Congenital abnormality versus tissue ectopia

Structural anomaly

Failed vitelline duct involution

Antimesenteric blind ileal sac

Native bowel layers present

Ectopic tissue

Normal tissue at an abnormal site

Gastric or pancreatic tissue possible

Acid secretion explains secondary injury

Parent context: Congenital gastrointestinal anomalies

- Timing and type of developmental insult shape the resulting abnormality.
- Some congenital anomalies alter patency; Meckel diverticulum alters local architecture.
- Meckel diverticulum may coexist with histologically ectopic tissue.

Population frequency

$\approx 2\%$

**Approximate prevalence in the
population**

- This is the conventional Robbins “rule of 2’s” estimate.
- Most affected individuals never develop clinical symptoms.

Typical position

≈60 cm

**Within two feet of the ileocecal
valve**

- The location is approximate, not an absolute diagnostic cutoff.
- It is a diverticulum of the ileum, not of the cecum or appendix.

Typical length

≈ 5 cm

Approximately two inches long

- This is a mnemonic average, not a required lesion size.
- The blind-ended tubular or saclike configuration is the more important architectural feature.

Sex distribution

2 : 1

Male : Female ratio

- An approximately twofold male predominance.
- Sex distribution is a population pattern, not a rule for individual diagnosis.

Age at symptomatic presentation

≤ 2 years

**Symptoms often emerge in
early childhood**

- Symptomatic cases as most often evident by age two.
- Presentation later in life remains possible.

Lifetime clinical expression

$\approx 4\%$

Ever become symptomatic

- Prevalence and symptomatic risk are not the same denominator.
- Approximately 96% do not develop symptoms under this textbook estimate.

The “rule of 2’s”: Utility and limits

What it helps recall

Approximate frequency and anatomy

Typical sex ratio and presentation age

A useful memory aid at the bedside

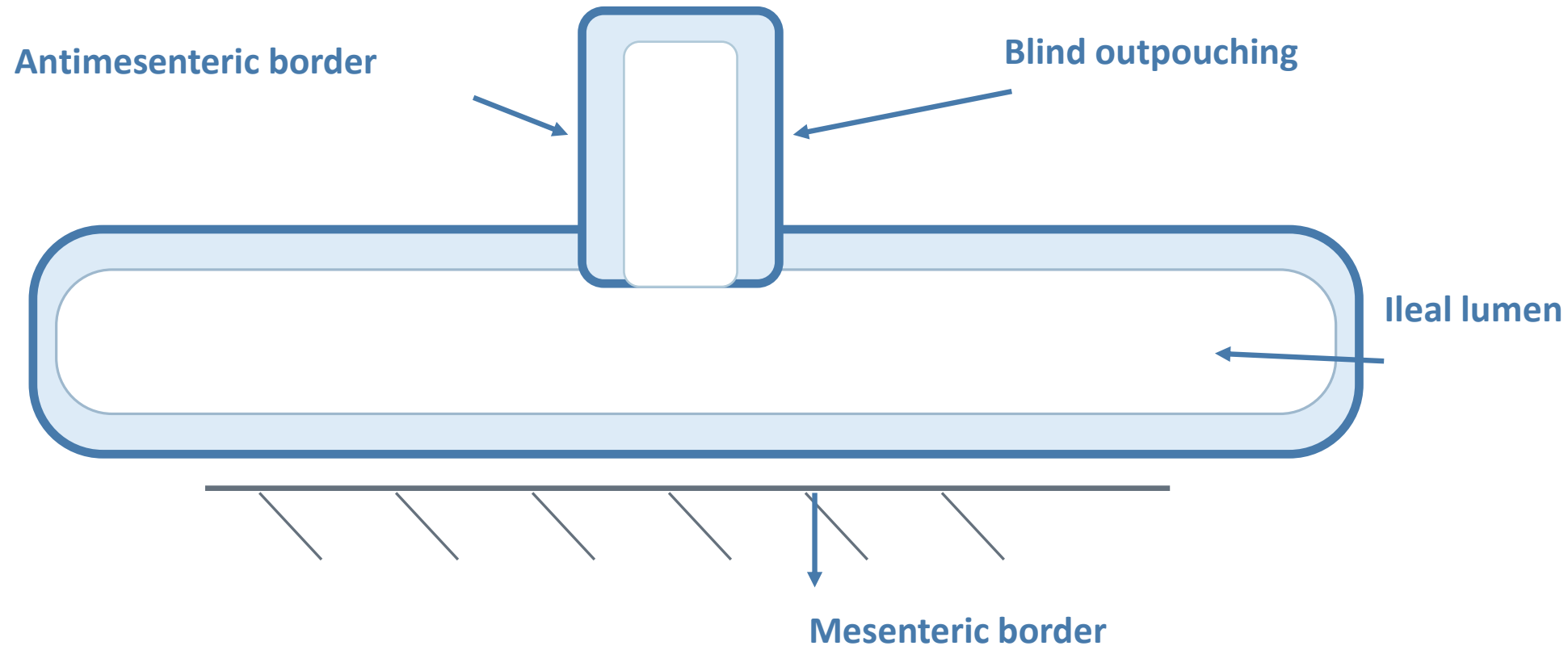
What it cannot establish

An individual diagnostic probability

A strict distance or length requirement

Exclusion of atypical or adult cases

Gross morphology: Solitary blind sac



Original anatomical schematic; Positioning and topology, not scale.

What “blind-ending” means

- The diverticulum has a single opening into the adjacent ileal lumen.
- Its distal end terminates rather than continuing as a second intestinal passage.
- This anatomy allows luminal contents to enter a dead-end pouch.

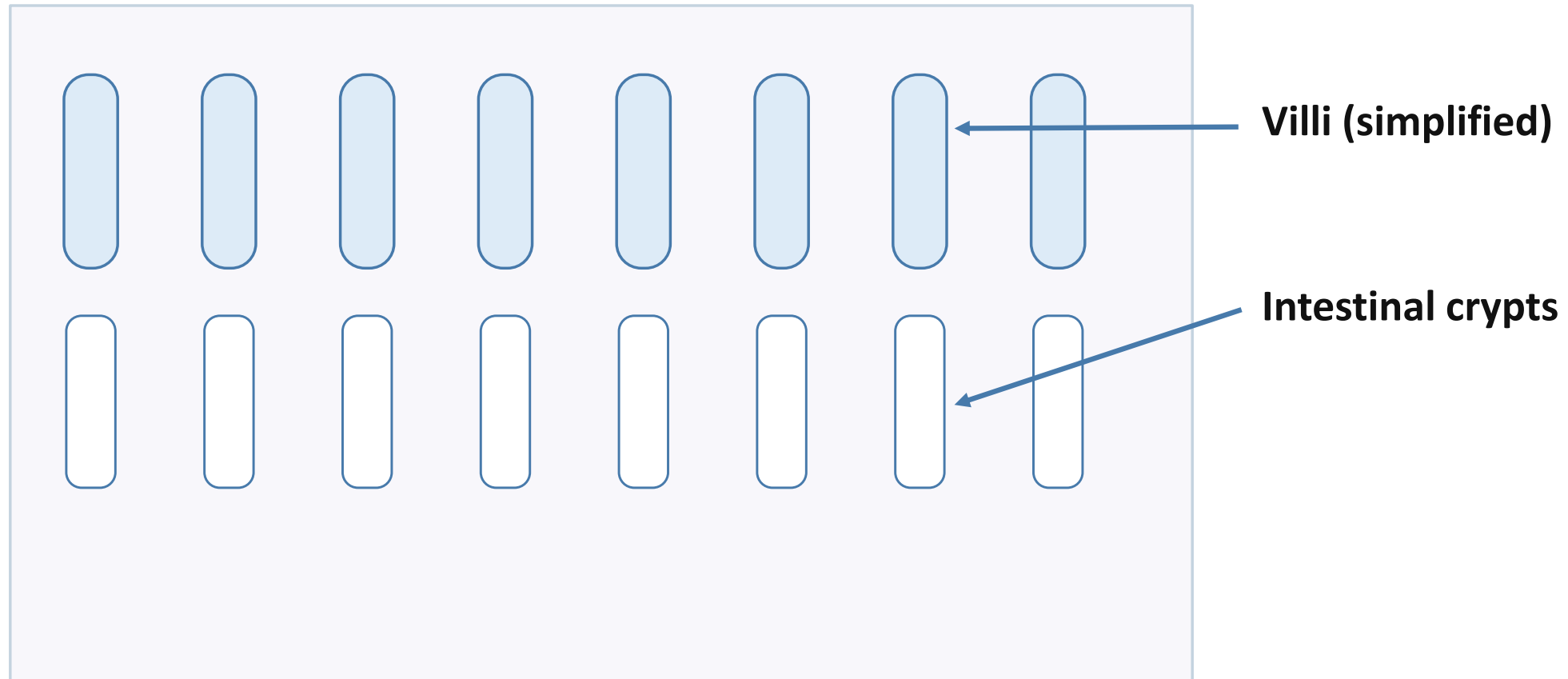
Why the antimesenteric side is diagnostic

- The lesion arises from the side opposite the mesenteric attachment.
- Orientation can aid interpretation of an ileal resection specimen.
- A mesenteric-side cyst or duplication is a different anatomic configuration.

Normal ileal mucosa may line the pouch

- The mucosal epithelium can resemble adjacent small intestine.
- Small intestinal differentiation is compatible with a true Meckel diverticulum.
- Abnormal location and wall anatomy remain critical even without ectopia.

Conceptual ileal mucosa: Villi and crypts



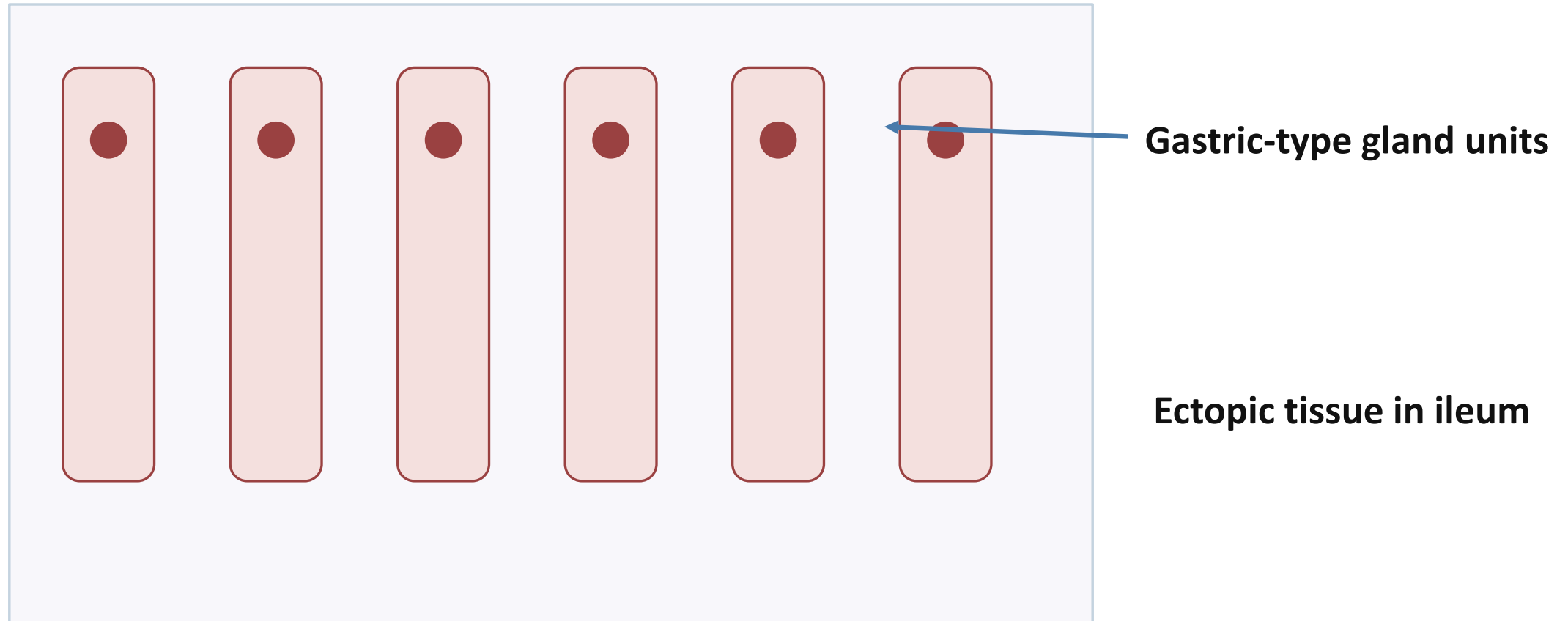
Original conceptual tissue schematic — not histology or a measured specimen.

Heterotopia within Meckel diverticulum

Ectopic gastric or pancreatic tissue may be present.

- An ectopic tissue component is not required to define the diverticulum.
- Functional activity of ectopic tissue can determine the complication pattern.

Conceptual gastric ectopia: Gland architecture

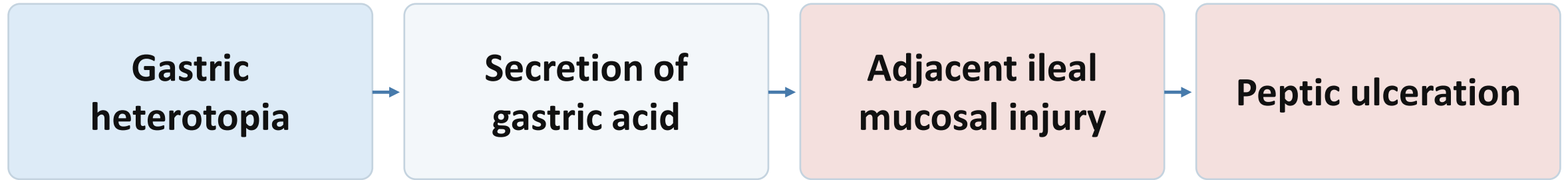


Original conceptual tissue schematic — not histology or a measured specimen.

Pancreatic ectopia: A structural finding

- Ectopic pancreatic tissue as a possible lining component.
- Its presence demonstrates tissue heterotopia within a congenital lesion.
- Do not infer acid-mediated ulceration from pancreatic tissue alone.

Pathogenesis of peptic mucosal injury



The injury is caused by acid acting on vulnerable neighboring small-intestinal epithelium.

Where ulceration develops

Meckel pouch contains gastric epithelium



Gastric tissue produces acid



Acid contacts adjacent small-bowel mucosa



Peptic ulcer forms in neighboring ileum

Peptic ulceration: A regional mismatch

- Gastric-type tissue is physiologically able to secrete acid.
- The surrounding ileal surface lacks the specialized gastric mucosal setting.
- Functional heterotopia can injure tissue even though the diverticulum itself is congenital.

Bleeding follows ulcerative injury



Blood loss is a consequence of peptic injury, rather than a defining property of every Meckel diverticulum.

Bleeding: What Robbins explicitly supports

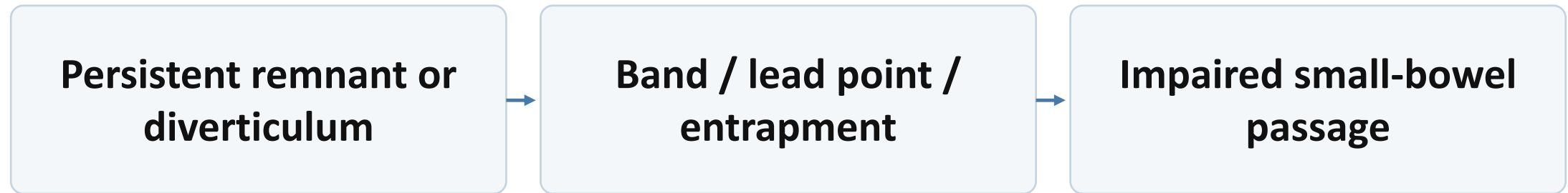
- Occult gastrointestinal bleeding is a recognized presentation.
- Bleeding is causally linked to ectopic gastric tissue and nearby ulceration.
- The clinical presentation may be intermittent, so absence of current bleeding does not exclude prior events.

Abdominal pain is not mechanism-specific

Pain may mimic appendicitis or obstruction.

- Pain alone does not identify peptic injury, inflammation or mechanical blockage.
- The regional anatomy explains why a right lower quadrant presentation can be misleading.

Mechanical obstruction: Additional mechanism



Obstruction mechanisms are supplementary clinical context, not detailed in the Robbins Meckel subsection.

Fibrous attachment and bowel trapping

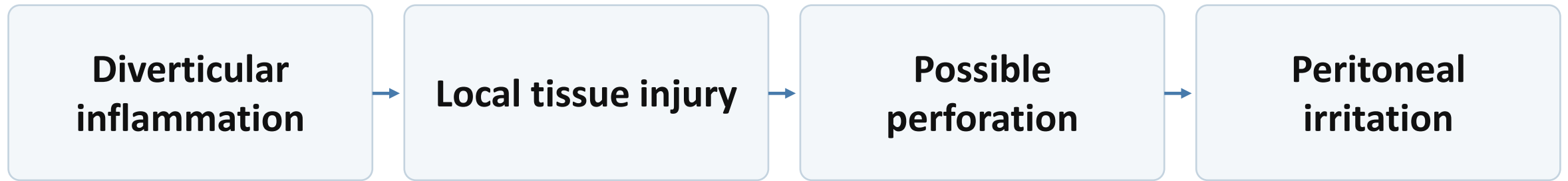
- Remnants of vitelline structures may leave fibrous attachments.
- A band can create a point around which bowel twists or becomes trapped.
- This provides an anatomic route from embryologic persistence to obstruction.

Intussusception as an obstructive pathway



A lead-point complication is possible even without gastric mucosal ectopia.

Inflammation and perforation



An inflamed or perforated Meckel diverticulum may resemble acute appendicitis.

Complication mechanisms are distinct

Peptic / hemorrhagic

Ectopic gastric acid secretion

Adjacent ulceration

Intestinal bleeding

Mechanical / inflammatory

Fibrous band or intussusception

Obstruction with abdominal symptoms

Diverticulitis or perforation

True versus pseudo-diverticulum

Meckel diverticulum

Congenital vitelline remnant

All main wall layers represented

Usually distal ileum; Solitary

Acquired colonic diverticulum

Typically acquired

Muscularis propria absent or thinned

Usually sigmoid colon; Often multiple

Why sigmoid diverticula are not the same entity

- Sigmoid diverticula commonly represent mucosal/submucosal outpouching.
- They generally lack the complete muscular wall of a true diverticulum.
- Anatomy and developmental mechanism differ despite shared terminology.

Gastric heterotopia: Two clinical settings

Meckel diverticulum

Ileal location within true pouch

Acid may ulcerate adjacent ileum

May present with GI bleeding

Esophageal inlet patch

Upper-third esophageal mucosal rest

Acid may produce esophagitis

Different clinical and anatomic context

Gross specimen orientation: A practical sequence

- Identify ileal segment and its mesenteric attachment.
- Locate any blind pouch on the antimesenteric wall.
- Trace the communication with ileal lumen.
- Examine adjacent mucosa for peptic ulceration.

Microscopic assessment: A practical sequence

- Confirm continuity of mucosa, submucosa and muscle into the sac.
- Describe whether mucosa is ileal-type or shows gastric/pancreatic ectopia.
- Look for ulceration and secondary inflammatory damage.
- Correlate the lesion with the specimen's anatomical orientation.

Ileal versus gastric lining: How to describe it

Native ileal-type mucosa

Small-bowel absorptive mucosal pattern

Villus–crypt organization

Compatible with uncomplicated lining

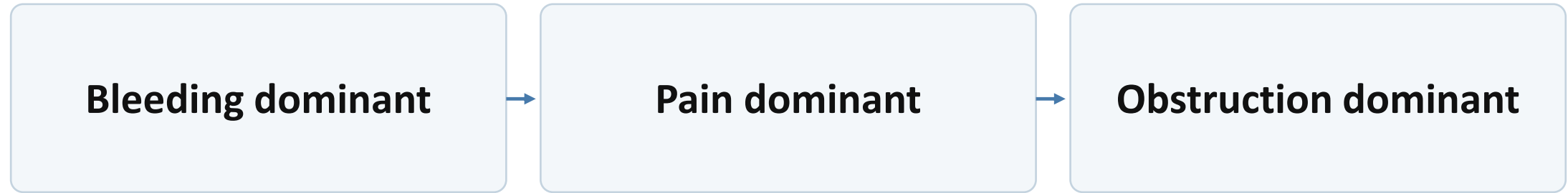
Gastric-type ectopic mucosa

Gastric gland differentiation

Epithelial type inappropriate for ileum

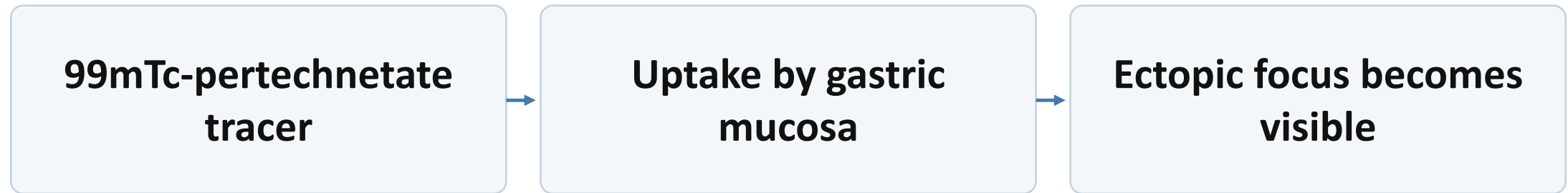
Functional acid secretion may matter

Clinical reasoning begins with phenotype



The clinical pattern directs evaluation; No single symptom uniquely identifies Meckel diverticulum.

Why technetium-99m can detect Meckel ectopia



A Meckel scan identifies functioning gastric mucosa, not the bowel-wall diverticulum directly.

Meckel scintigraphy: Interpretation principle

- Activity associated with ectopic gastric mucosa is sought outside the stomach.
- Tracer uptake depends on functional gastric mucosal cells.
- The test is most relevant when bleeding suggests gastric heterotopia.

Pediatric bleeding Meckel scan

80%

Pooled sensitivity; Meta-analysis (2023)

- Pooled specificity was 95% across 16 studies involving 1,115 children.
- Sensitivity is imperfect; Interpretation requires the appropriate clinical context.

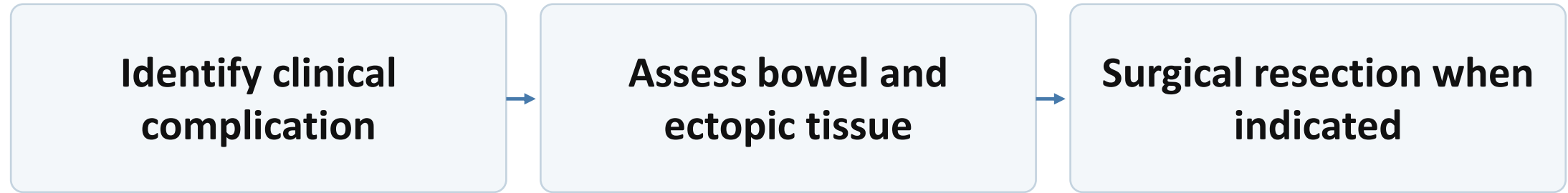
Negative scintigraphy is not definitive

- A study that visualizes gastric mucosa cannot directly prove that no diverticulum exists.
- False negatives may arise if detectable functioning ectopic gastric mucosa is absent or limited.
- The scan's performance applies to its studied pediatric bleeding population.

When imaging must address obstruction

- Symptoms of mechanical obstruction call for evaluation of bowel patency.
- A radiotracer test for ectopic gastric mucosa answers a different diagnostic question.
- Cross-sectional imaging and surgery are context-dependent clinical tools.

Symptomatic Meckel diverticulum: Treatment logic



Management must also address adjacent ulcerated ileum or compromised bowel when present.

Incidentally detected Meckel diverticulum

- The majority of lesions are asymptomatic throughout life.
- Removal of an incidentally found diverticulum is not an automatic conclusion.
- Operative risks, patient characteristics and lesion features must be weighed individually.

Evidence uncertainty: Incidental resection

- A 2024 systematic review included 42 eligible studies of incidental diverticula.
- Authors reported heterogeneity in patient selection and complication reporting.
- The review favored individualized decisions rather than a universal directive.

Case A — early childhood bleeding

A 20-month-old child has intermittent intestinal bleeding without a clear anorectal source. No prior bowel surgery.

What congenital lesion and mechanism should be considered?

Focus on the link between ectopic tissue and nearby mucosal injury.

Case A — reasoning

Meckel diverticulum with ectopic gastric mucosa.

- Persistent vitelline duct produces a true ileal pouch.
- Ectopic gastric acid can cause ulceration in adjacent ileal mucosa.
- The resulting injury offers a mechanism for bleeding.

Case B — acute right iliac fossa pain

A young patient presents with sudden right lower quadrant pain. The clinical picture suggests appendicitis, but no diagnosis is yet established.

What alternative congenital lesion belongs in the differential?

Concentrate on the position of the ileum and possible inflammation.

Case B — reasoning

Inflamed Meckel diverticulum can resemble acute appendicitis.

- Meckel diverticulum is located in the distal ileum.
- Inflammation, ulceration or obstruction can produce abdominal pain.
- Clinical overlap mandates an anatomical differential rather than a single-symptom diagnosis.

Case C — obstructive symptoms

An adult develops cramping abdominal pain, vomiting and evidence of a small-bowel transition point. No gastric bleeding is reported.

Must a Meckel-related obstruction involve gastric ectopia?

Separate structural mechanisms from acid-mediated mechanisms.

Case C — reasoning

No. Mechanical complications can be independent of ectopic gastric acid.

- A congenital remnant may create a fibrous band.
- A diverticulum can serve as a lead point for intussusception.
- Obstructive anatomy, not mucosal heterotopia, is the key causal mechanism.

Case D — incidental operative finding

During an unrelated operation, a short antimesenteric ileal pouch is seen. The patient has never had relevant gastrointestinal symptoms.

Does the finding alone compel resection?

Consider absolute benefit, competing operative risks and evidence uncertainty.

Case D — reasoning

No universal management rule follows from incidental discovery.

- Most Meckel diverticula never cause symptoms.
- A recent systematic review supports individualized risk–benefit assessment.
- The patient's operative setting and lesion characteristics change the decision.

Integrated clinicopathologic model

Embryologic persistence → true ileal diverticulum



Possible ectopic gastric or pancreatic mucosa



Acid injury OR mechanical complication OR no symptoms



Bleeding, abdominal pain or incidental detection

Different mechanisms yield different clinical outcomes.

Differential reasoning: Two right-sided abdominal lesions

Meckel diverticulum

True congenital distal-ileal diverticulum

Possible ectopic gastric mucosa

Bleeding or mechanical obstruction may coexist

Acute appendicitis

Involves the vermiform appendix

Not a vitelline-duct persistence lesion

Clinical overlap in inflammatory presentations

Five diagnostic traps to avoid

- Confusing prevalence ($\approx 2\%$) with lifetime symptomatic proportion ($\approx 4\%$).
- Calling a true diverticulum a muscular-wall-deficient pseudodiverticulum.
- Assuming every lesion contains gastric tissue or causes bleeding.
- Treating a negative Meckel scan as exclusion of every diverticulum.
- Assuming every right lower quadrant pain syndrome is appendicitis.

Consolidated pathology messages

- Meckel diverticulum is a congenital true diverticulum of antimesenteric ileum.
- Incomplete involution of the vitelline duct is the defining developmental mechanism.
- Ectopic gastric mucosa may injure adjacent ileum and cause bleeding.
- Obstruction and inflammation provide alternative symptomatic pathways.
- Typical anatomy and the clinical phenotype guide recognition.

References

Robbins, Cotran & Kumar. Pathologic Basis of Disease. 11th ed. 2026; Chapter 17, pp. 684–686, 701, 734.

SNMMI/EANM Practice Guideline for Meckel Diverticulum Scintigraphy 2.0. J Nucl Med Technol. 2014;42:163–169.

Yan P, Jiang S. Tc-99m scan for pediatric bleeding Meckel diverticulum: meta-analysis. J Pediatr (Rio J). 2023;99:425–431.

An J, Zabbo CP. Meckel Diverticulum. StatPearls. NCBI Bookshelf NBK499960.

Yagnik VD et al. Should an Incidental Meckel Diverticulum Be Resected? Clin Exp Gastroenterol. 2024;17:147–155.