



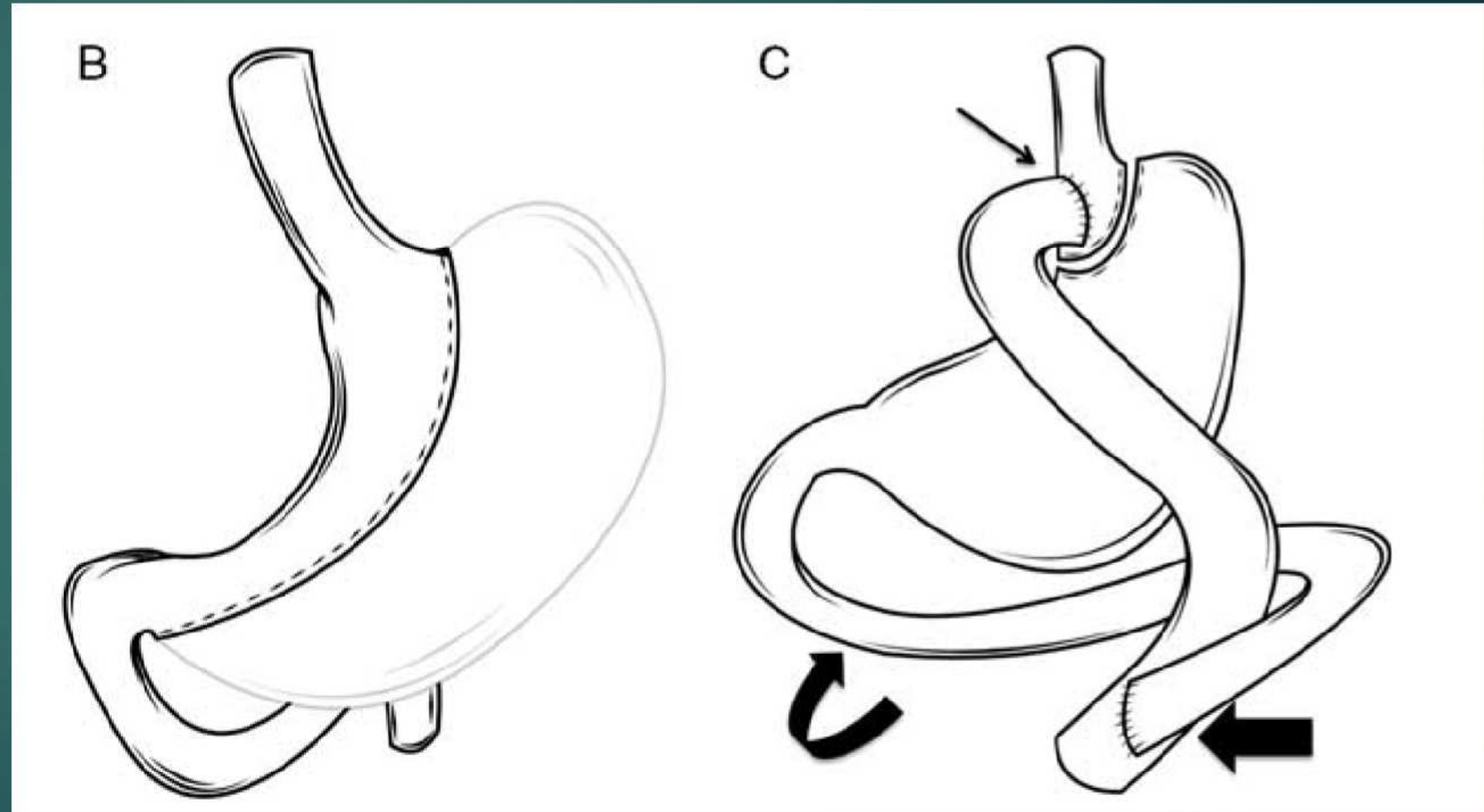
Bariaatriline patsient radioloogias

RIMMAS ŠALKAUSKAS

1. AASTA RADIOLOGIA RESIDENT

Bariaatrilised operatsioonid

- ▶ Mehhanismid
 - ▶ Möödajuhtivad
 - ▶ Restriktiivsed
- ▶ Kõige sagedasemad
 - ▶ Gastric Sleeve
 - ▶ Gastric Bypass
- ▶ Tüsistused
 - ▶ Intraabdominaalsed
 - ▶ Intratorakaalsed

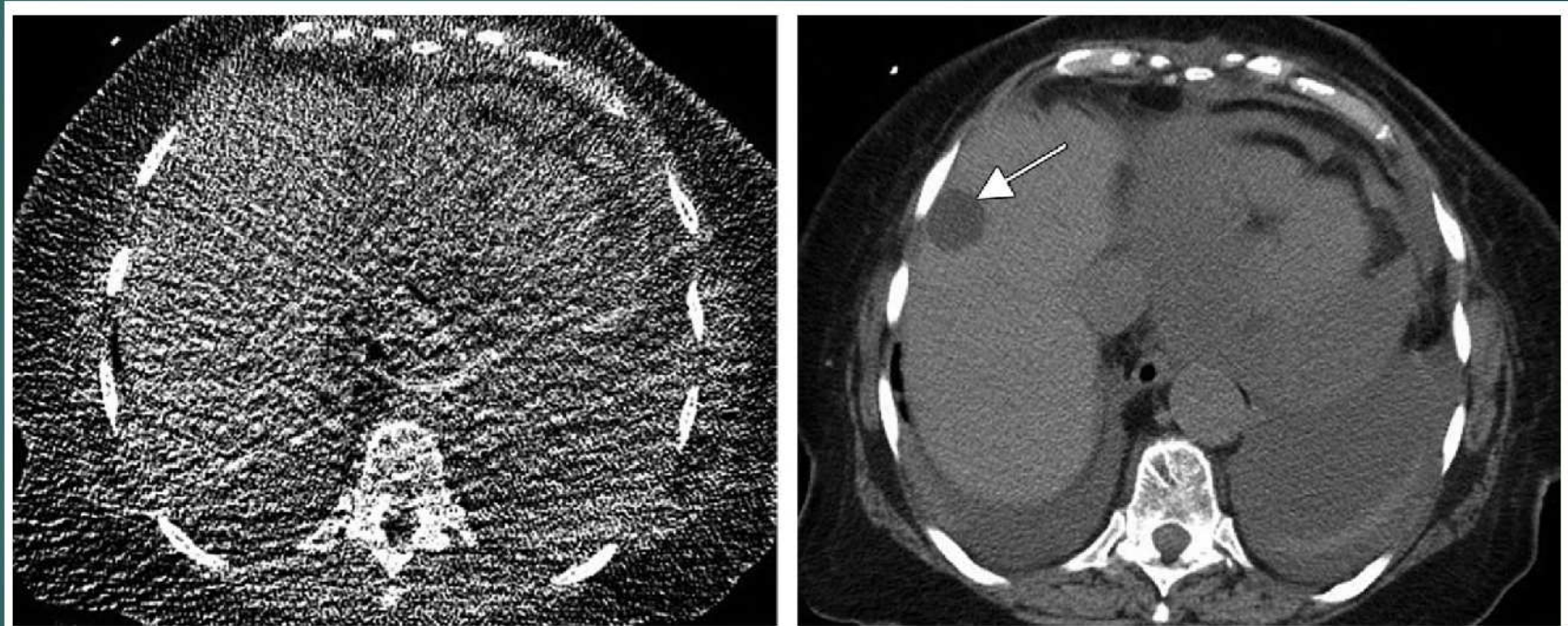


Üldised probleemid CT-s

- ▶ Vajalikud spetsmasinad
 - ▶ Arvestades pt-i **kehakaalu**
 - ▶ Arvestades pt-i **läbimõõtu**
 - ▶ **Scan field of view** liiga väike, sellest artefaktid
 - ▶ Vajalik **kõrgem voltaaz** et vähendada müra
 - ▶ Eraldi rekonstruktsiooni programmid
- ▶ Vajalik rohkem kiiritada
- ▶ Rohked artefaktid
- ▶ Teine kontrastaine dünaamika organismis
- ▶ Probleemidest tulenevad korduvad uuringud

Quantum Mottle ja müra

- ▶ Mida suurem patsient, seda vähem prootoneid jõuab detektorini
 - ▶ Tõsta mA
 - ▶ Tõsta mAs
 - ▶ Liigutustega seotud artefaktid
 - ▶ Alanda pitch'i
 - ▶ Tõsta kVp
 - ▶ Langeb pildi kontrastsus



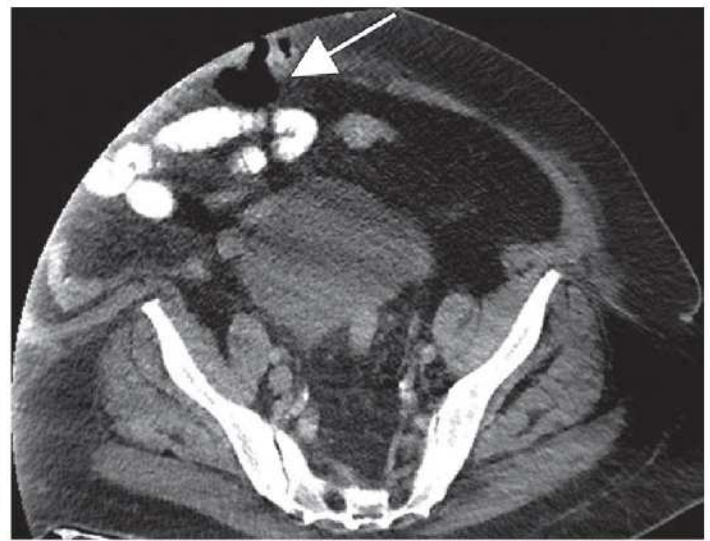
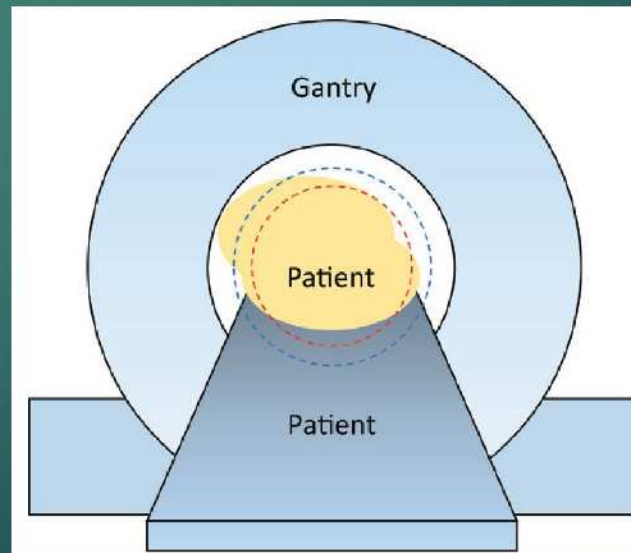
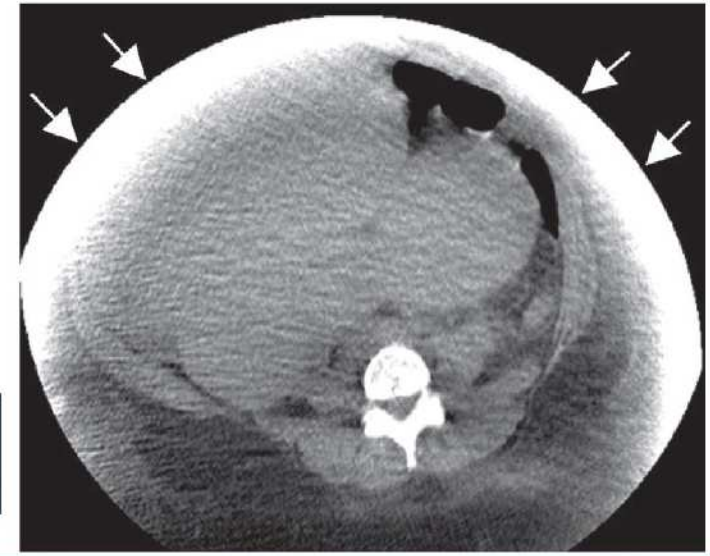
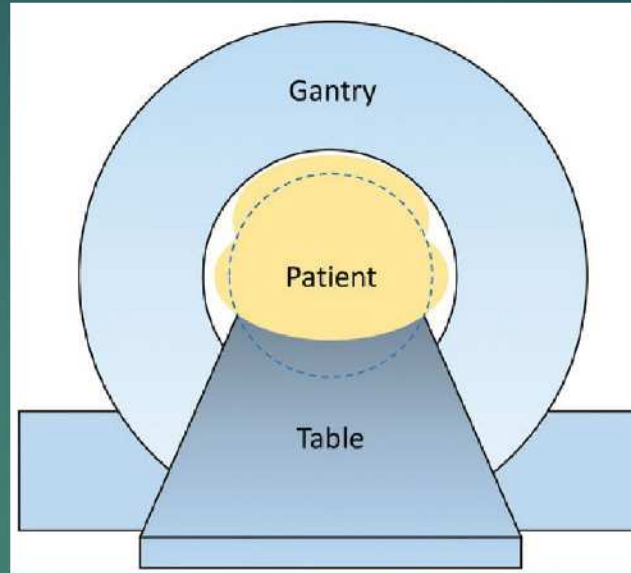
a.

b.

Figure 2. Image noise at different settings for tube current–time product and tube voltage. Axial CT images obtained at the level of the liver acquired by using settings of 130 mAs and 80 kVp (a) and settings of 750 mAs and 120 kVp (b). The noise level in b is reduced dramatically, allowing depiction of a low-attenuation liver lesion (arrow). The radiation dose to the patient during the scanning procedure for b was much higher.

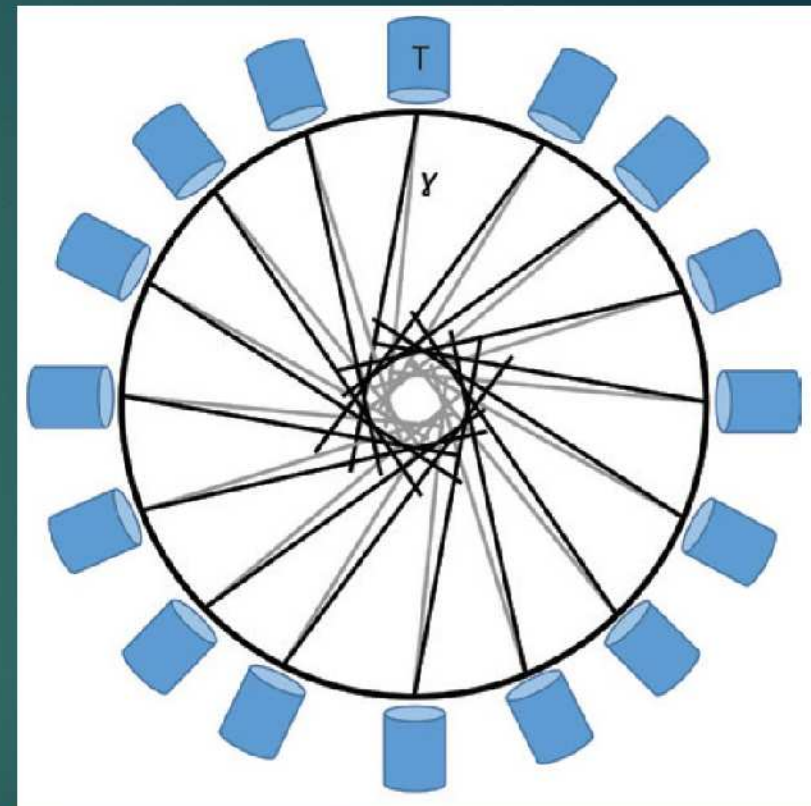
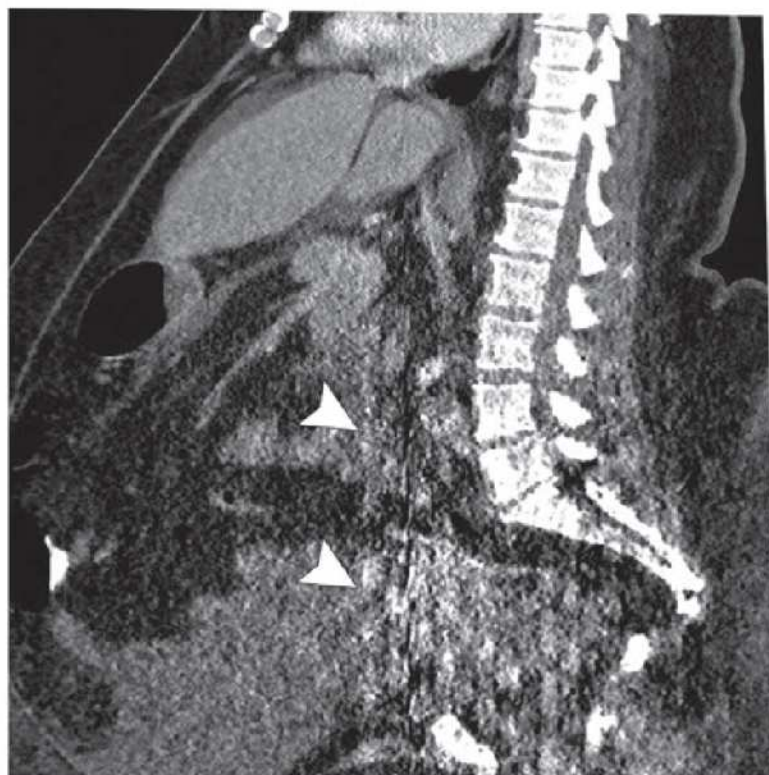
Truncation ja Cropping artefaktid

- ▶ Suurenda **reconstruction field of view**
- ▶ Segab ka PET uuringuid
- ▶ Korrigeerivad algoritmid



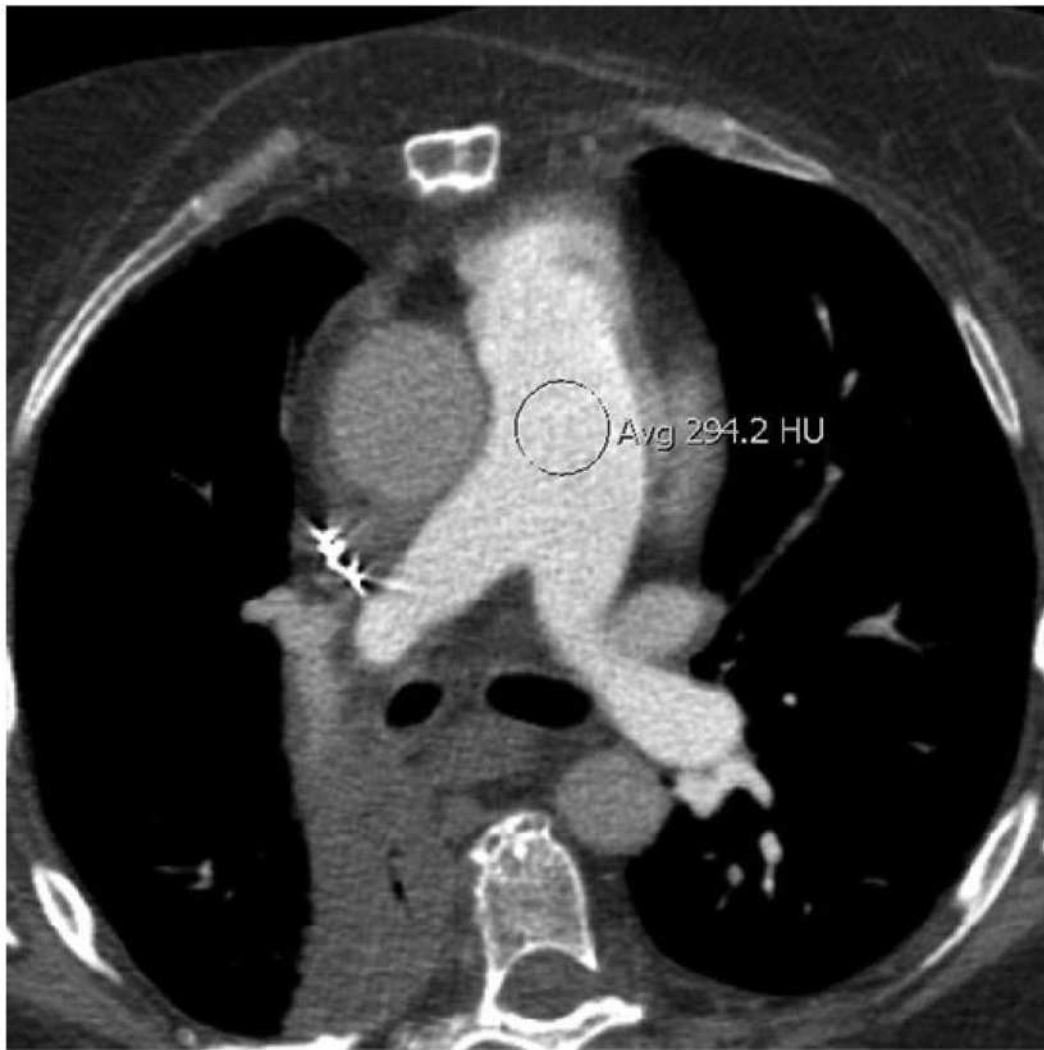
Ring Artifact

▶ Tõsta mA ja või kV

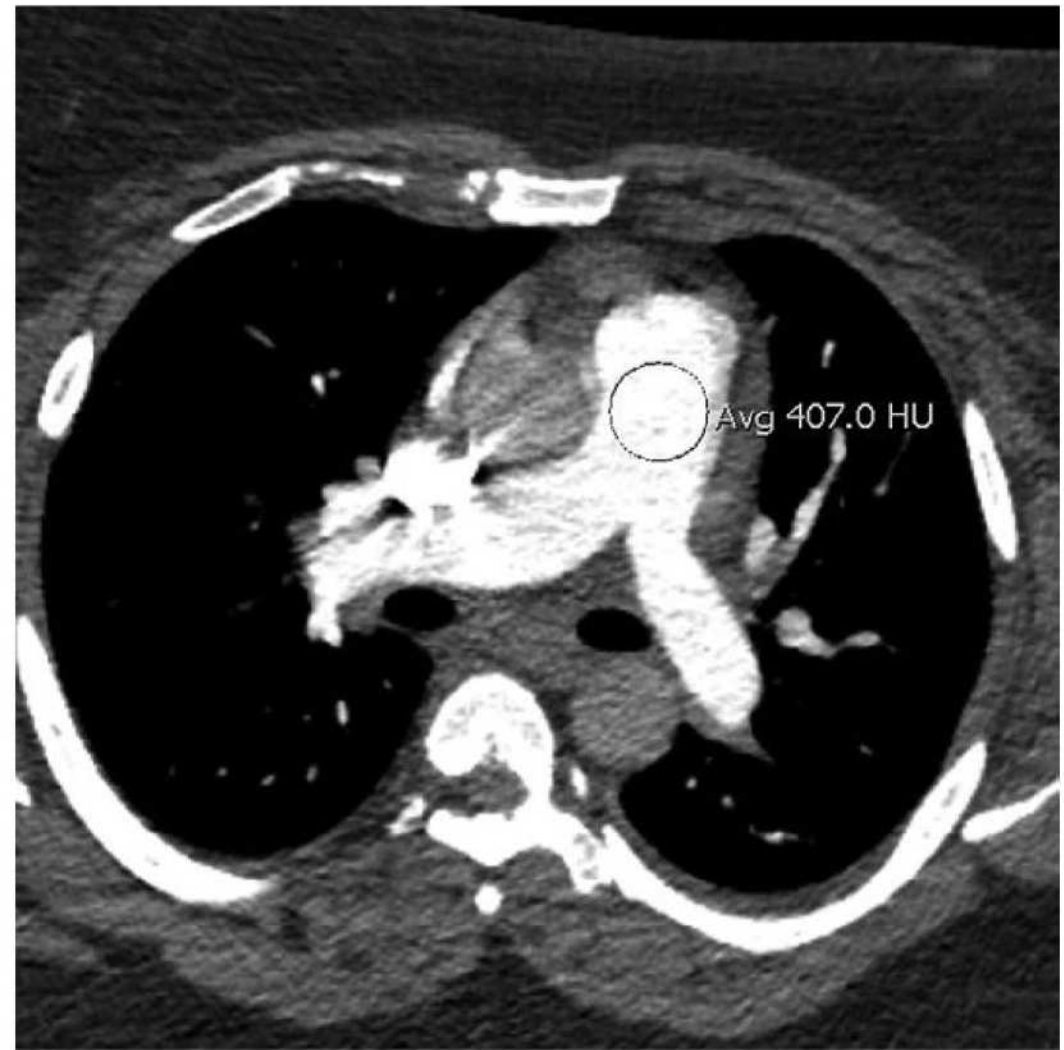


Teised probleemid

- ▶ Kontrastainega seotud
 - ▶ **Vaskulaarsete** struktuuride visualiseerimine – mõjutab reologia ja vere maht
 - ▶ Tõsta inf. kiirust
 - ▶ Tõsta KA kontsentratsiooni
 - ▶ **Parenhümatossete** organite kontrasteerumine
 - ▶ Mõjutab KA maht, mitte infusiooni kiirus
 - ▶ Samas kiirus oluline nt maksa hüpovaskulaarsete kollete visualiseerimiseks
 - ▶ Kiirused standardiseeritud
 - ▶ Düsproportsioon üldise ja „efektiivse“ kehamassi vahel
 - ▶ Liiga suured KA mahud võivad olla ohtlikud
 - ▶ Teine võimalus vaskulatuuri esiletoomiseks – kV alandamine väiksema KA koguse korral
 - ▶ Raske rakendada suure kehakaalu korral



a.



b.

Figure 7. Differences in vascular enhancement at different tube voltages. (a) Axial CT image of a 111-kg (244-lb) 52-year-old woman who received 75 mL of contrast material and was scanned at 120 kVp shows that the attenuation of the pulmonary artery was 294.2 HU. (b) Axial CT image of a 119-kg (262-lb) 47-year-old man who received the same amount of the same contrast material at an identical rate of injection but was scanned at 100 kVp shows that the attenuation of the pulmonary artery was 407.0 HU, approximately 38% higher than the value in a.

Roux-en-Y Gastric Bypass; norm leid

- ▶ Maost jääb väike poch 15-20 ml

▶ Läbivalgustus

- ▶ Enne **scout** et visualiseerida staplerjoooni
- ▶ Ristikäärsoole ees/taga
 - ▶ Kui taga, ära aja stenoosiga segi
- ▶ Läbivalgustus kuni kontrastaine jõuab „puutumata“ jejunumisse
- ▶ **Jälgi kontrastainet algusest peale**, sest pärast raske asjadest aru saada

▶ Abdominaalne CT

- ▶ P.o koos i.v kontrastainega eelistatud
- ▶ **Vajalik visualiseerida kõike**
 - ▶ **Pouch**
 - ▶ Ülejäänud magu
 - ▶ See ei ole abstsess
 - ▶ Roux ling
 - ▶ Jejunojejunaalne anastomoos
 - ▶ Biliopankreatiline ling

Figure 1

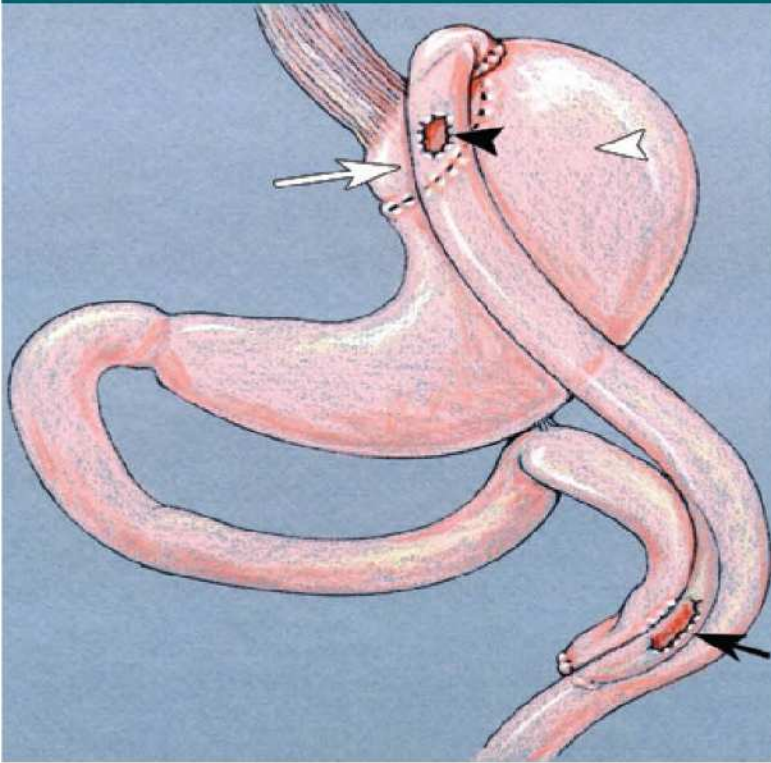


Figure 1: Diagram shows normal surgical anatomy after Roux-en-Y gastric bypass. A staple line partitions the stomach into a small fundal pouch (white arrow) and a much larger excluded stomach (white arrow-head). The jejunal Roux limb is joined proximally to the fundal pouch via a gastrojejunal anastomosis (black arrowhead) and distally to the biliopancreatic limb via a jejunojejunal anastomosis (black arrow). (Reprinted, with permission, from reference 12.)

Figure 2

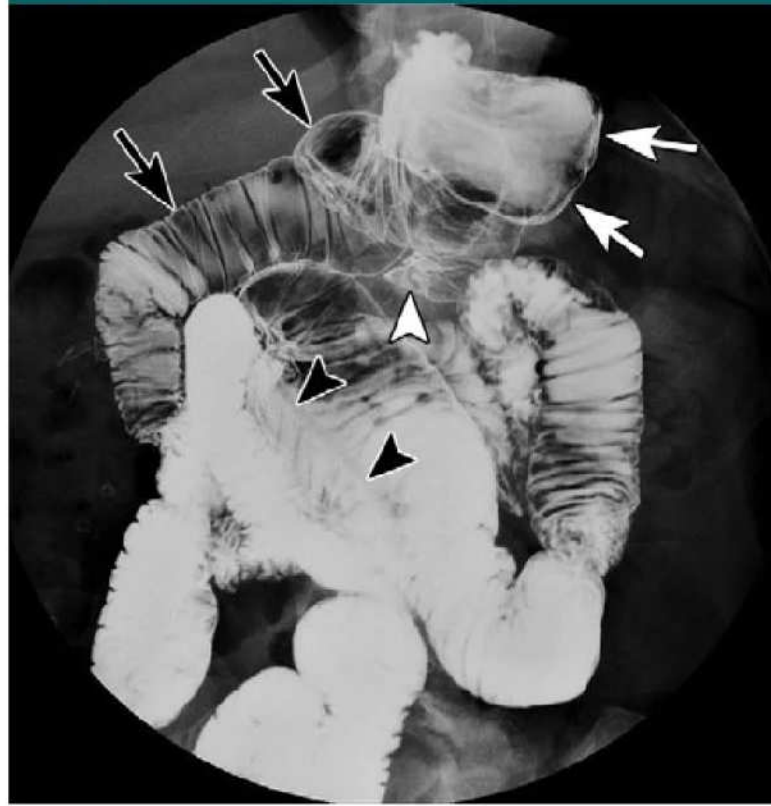


Figure 2: Normal imaging findings after Roux-en-Y gastric bypass. Supine spot image from single-contrast upper GI barium study shows opacified gastric pouch (white arrows), with barium entering Roux limb (black arrows) and blind-ending jejunal stump (white arrowhead). Note widely patent side-to-side jejunojejunostomy (black arrowheads) visualized in profile. Gaseous distention of small bowel loops resulted from aerophagia (not administration of effervescent agent).

Figure 3

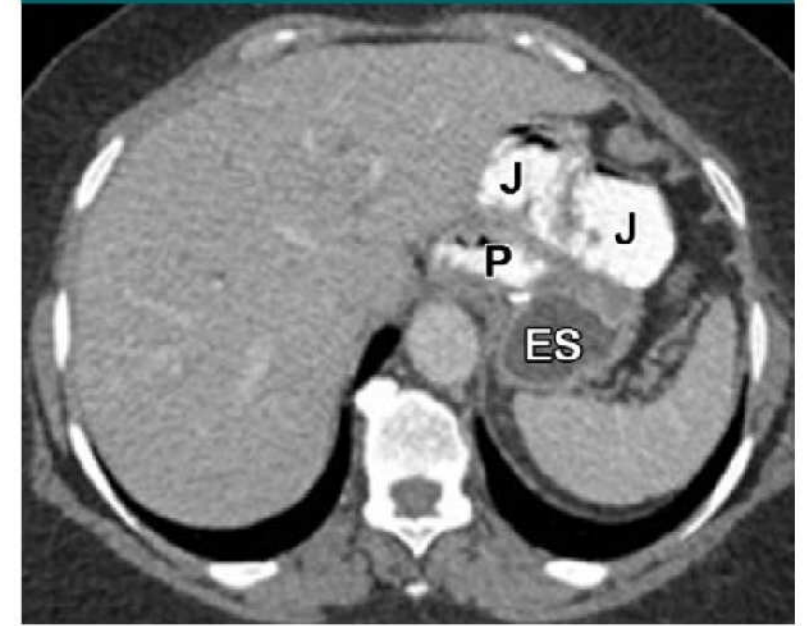


Figure 3: Normal appearance of Roux-en-Y gastric bypass at CT. Axial CT image after oral and intravenous contrast material administration shows small gastric pouch (*P*) separated by staple line from excluded stomach (*ES*) laterally. Jejunal Roux limb (*J*) is anastomosed to gastric pouch anteriorly. Note oral contrast material opacifying pouch and Roux limb, whereas excluded stomach is not opacified.

ness (14,15). Identification of the gastric pouch, gastrojejunal anastomo-

Tüsistused 1

▶ Lekked

- ▶ Tavaliselt 10 päeva peale operatsiooni
- ▶ 69-77 % gastrojejunaalse anastomoosi juures
- ▶ Sepsise pilt, SLS üle 120 x/min
- ▶ Läbivalgustus selili veeslahustava kontrastiga, seejärel vajadusel baarium
- ▶ Diferentseerida lekke ja staplerjoone dehistsentsi vahel (hiljem fistula formatsioon)

▶ Striktuurid 3-9 %

- ▶ Arenemiseks vaja tavaliselt 4 nädalat ja rohkem
- ▶ Oksendamise anamnees, oksendamise tüüp
- ▶ Läbivalgustusel pigem oblique pilt et vältida summatsioone

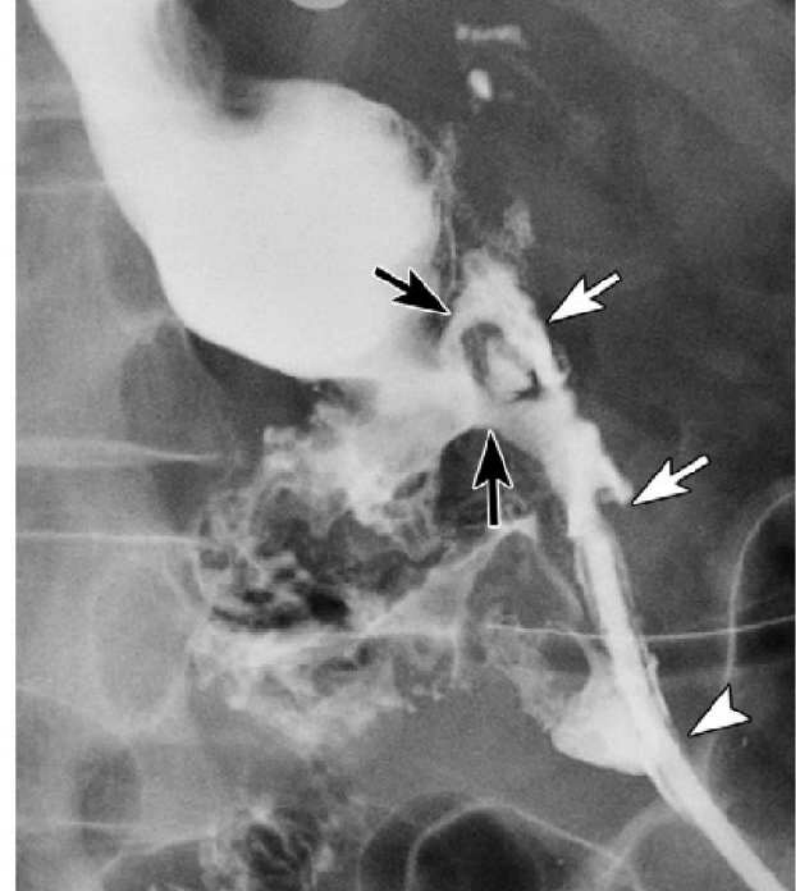


Figure 4: Roux-en-Y gastric bypass with postoperative anastomotic leak. Supine spot image from upper GI examination with water-soluble contrast material shows focal extravasation from left lateral aspect of gastrojejunal anastomosis into two short tracks (black arrows) and adjoining extraluminal collection (white arrows). Note contrast material passing through and around drain (arrowhead) that communicates with inferior aspect of this collection.



Figure 5: Roux-en-Y gastric bypass with postoperative anastomotic leak at CT after oral but not intravenous contrast material administration. Axial CT image shows extravasated contrast material in perisplenic space (*L*), indicating a postoperative leak. Note jejunal Roux limb more medially (*J*).

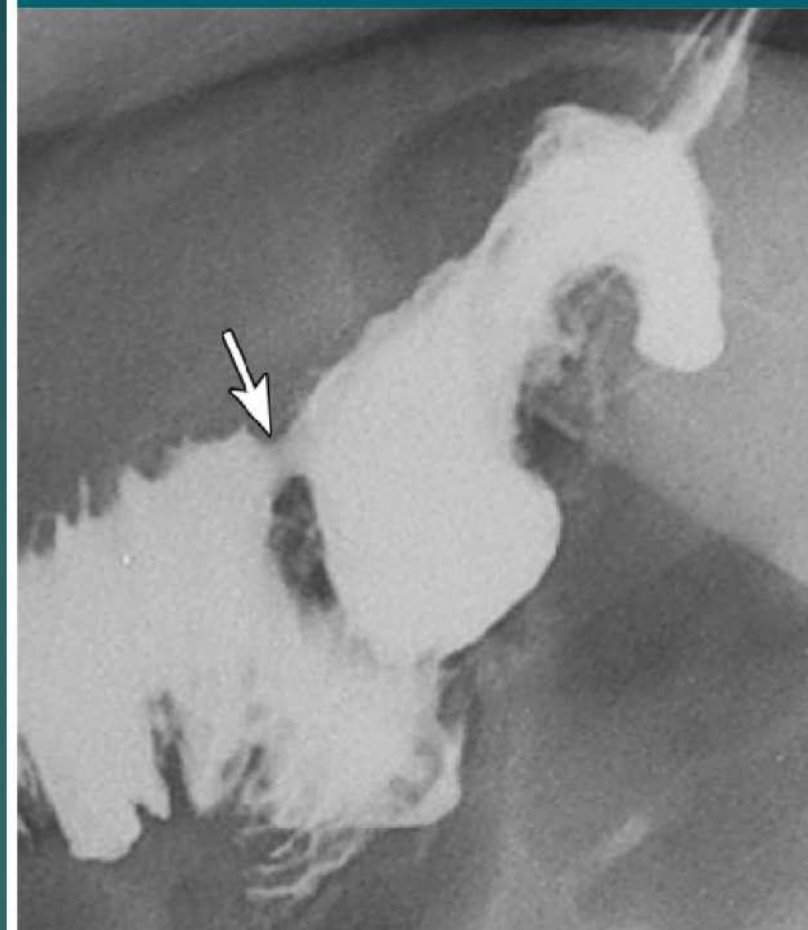


Figure 6: Roux-en-Y gastric bypass with anastomotic stricture. Steep right posterior oblique spot image from single-contrast upper GI barium study shows gastrojejunal anastomosis in profile, enabling visualization of a tight anastomotic stricture (arrow). This stricture was not visible on supine spot images because of overlap between lower end of gastric pouch and upper end of jejunal Roux limb that obscured anastomotic region.

Tüsistused 2

▶ Marginaalne haavand

- ▶ 3-13%
- ▶ GJ anastomoosi läheduses
- ▶ Valu, hemorraagia

▶ Jejunaalne isheemia

- ▶ Submukoosa turse, hemorraagia
- ▶ Roux lingus – struktuurid
- ▶ „target sign“
- ▶ Haavandid

▶ SBO

- ▶ 5%
- ▶ **Tüüp A** – Roux ling lai
- ▶ **Tüüp B** – BP ling lai + isoleeritud magu lai – lihtsamini diagnoositav CT-s, „closed loop“
- ▶ **Tüüp C** – mõlemad lingud laienenud

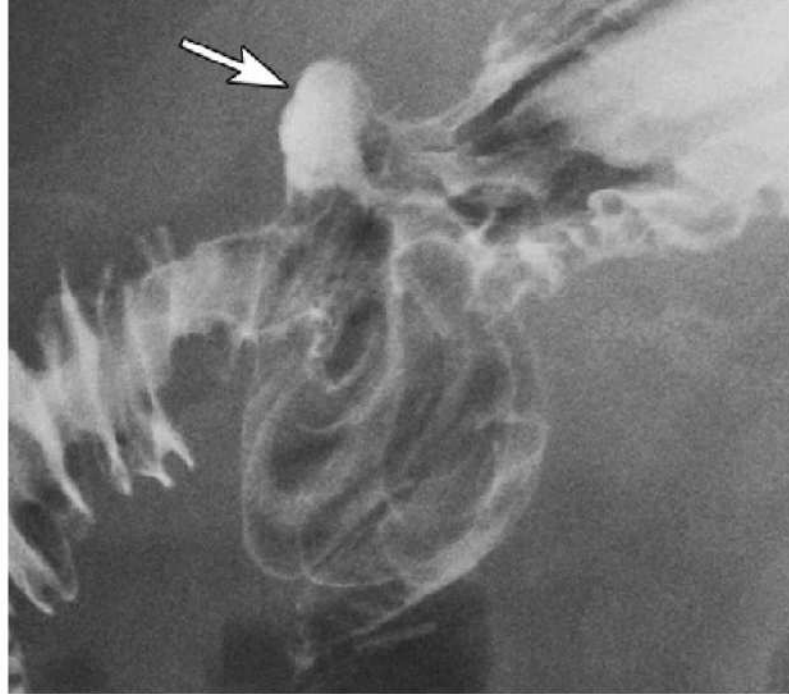


Figure 7: Roux-en-Y gastric bypass with marginal ulcer. Supine right posterior oblique spot image from single-contrast upper GI barium study shows discrete ulcer niche (arrow) in jejunal Roux limb abutting gastrojejunal anastomosis. This patient presented with abdominal pain and melena.

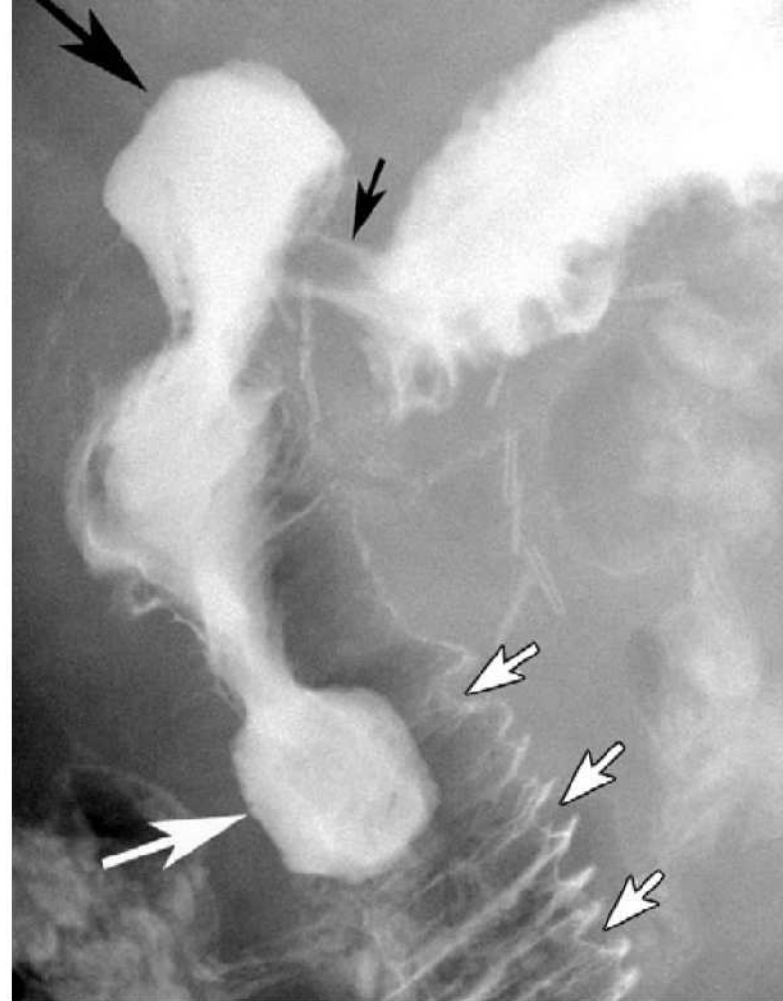
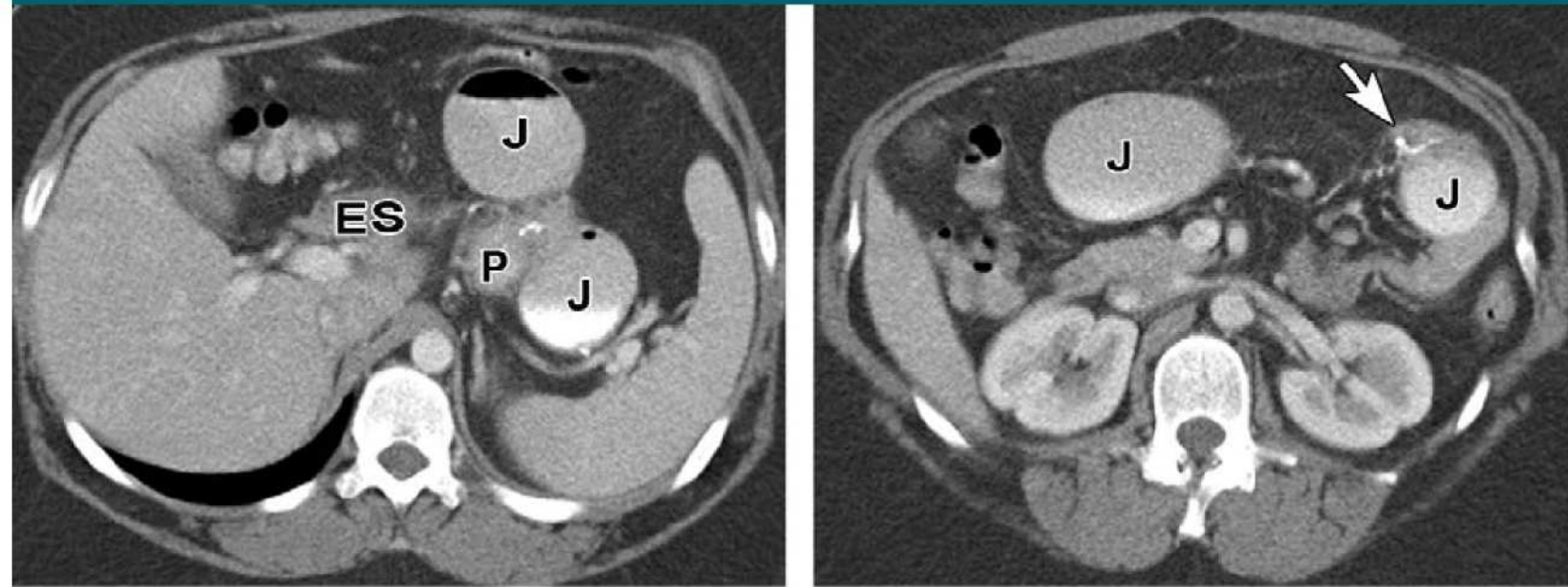


Figure 8: Roux-en-Y gastric bypass with giant jejunal ulcers. Supine right posterior oblique spot image from single-contrast upper GI barium study shows giant ulcer (large black arrow) in jejunal Roux limb abutting gastrojejunal anastomosis (small black arrow) and second giant ulcer (large white arrow) more distally in Roux limb. Note thickened, spiculated folds (small white arrows) in adjacent small bowel.

Figure 9



a.

b.

Figure 9: Roux-en-Y gastric bypass with obstruction of jejunal Roux limb at CT. (a, b) Axial CT images after oral and intravenous contrast material administration show dilated gastric pouch (P) and jejunal Roux limb (J) extending into left midabdomen, with abrupt transition due to obstruction at jejunojejunal anastomosis (arrow). The excluded stomach (ES) is decompressed.

Figure 10

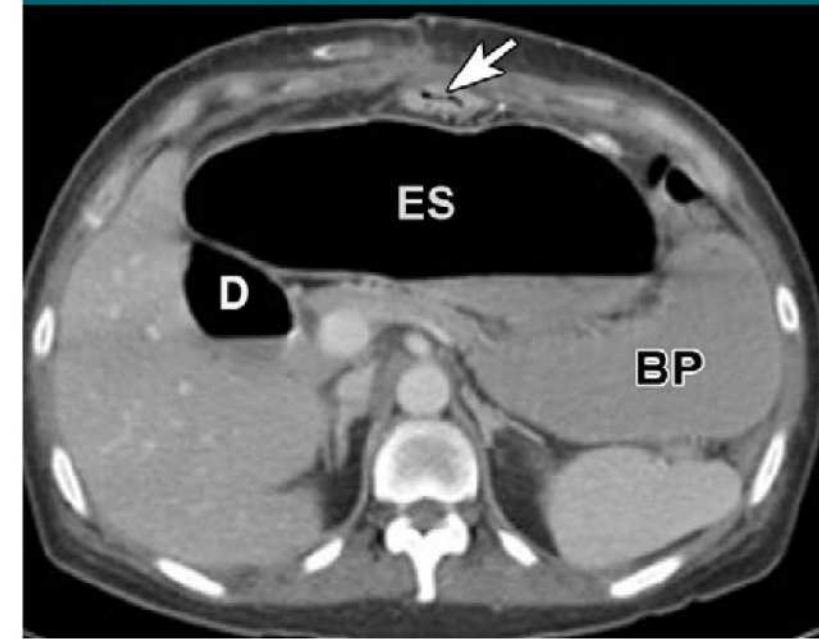


Figure 10: Roux-en-Y gastric bypass with obstruction of biliopancreatic limb. Axial CT image after oral and intravenous contrast material administration shows a dilated, gas- and fluid-containing excluded stomach (ES), duodenum (D), and biliopancreatic limb (BP). The excluded stomach should be collapsed after Roux-en-Y gastric bypass. Recognition of surgical anatomy and collapsed jejunal Roux limb (arrow) is essential for establishing the diagnosis of this closed-loop obstruction.

Tüsistused 3

▶ Sisemised songad 3%

- ▶ Sagedased laparoskoopia korral
- ▶ Tavaliselt hilisemas perioodis
- ▶ Songaväratiks
 - ▶ Mesocolon
 - ▶ Peensoole „aken“
 - ▶ Peterseni song



- Laienenud sooled ülakõhus
- Songaväratil läbinud lingud maost kraniaalsemal
- Mesenteeriumi soonte keerd „whirl sign“
- Mesenteriaalse rasva infiltratsioon
- Treiz nihutatud ettepoole ning paremale

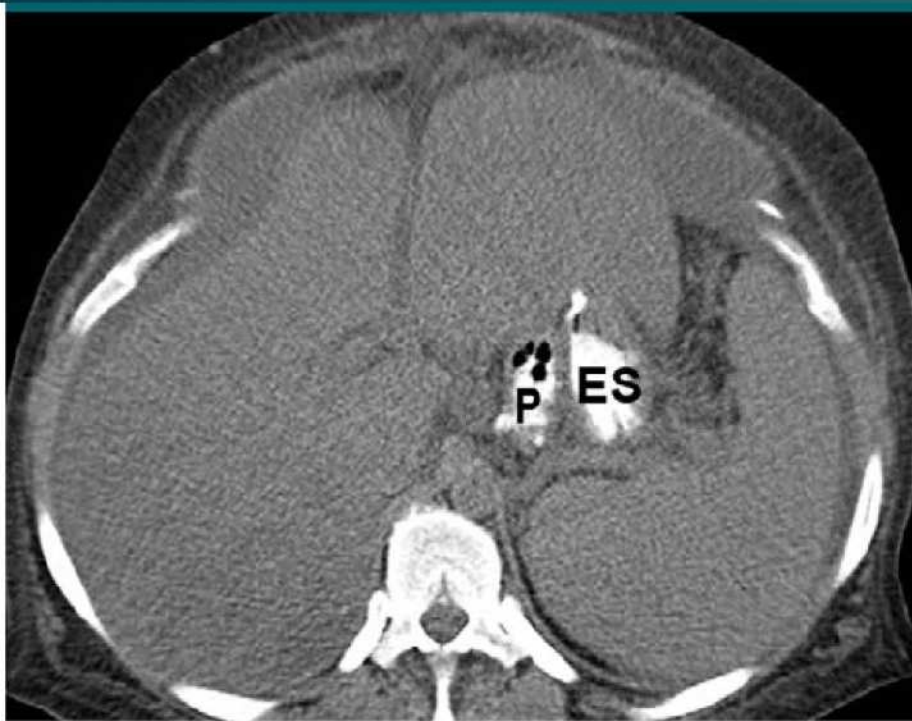
▶ Tavaliselt staplerjoon vasakul keskkõhus

- ▶ Liigub vasakule ülesse
- ▶ Liigub paremale keskele

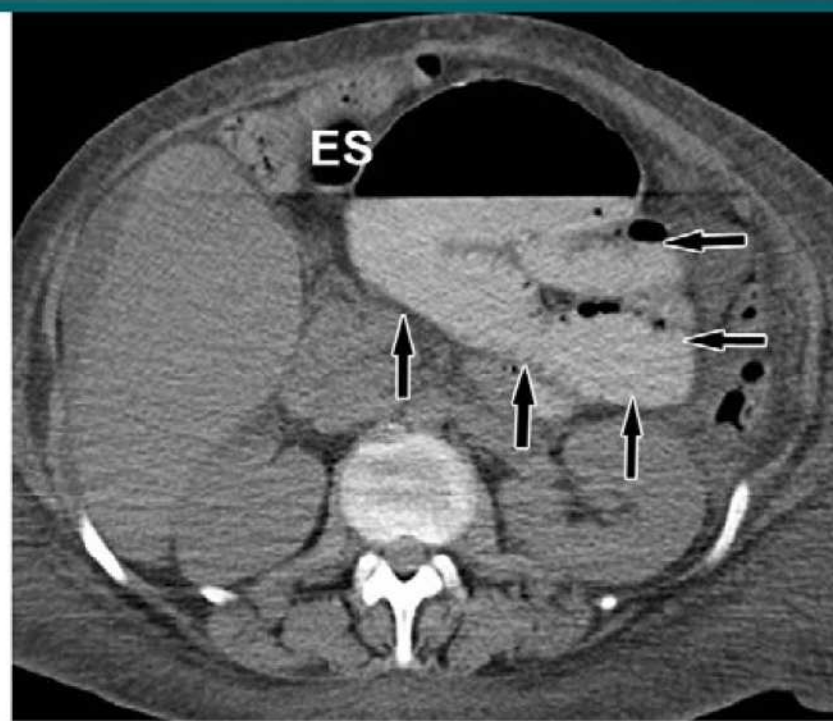
▶ Tavaliselt peensoolelingude konglomeraat vasakul keskkõhus 90%

- ▶ Kahtlusta, kui on konglomeraat vasakul mesokoolonist üleval

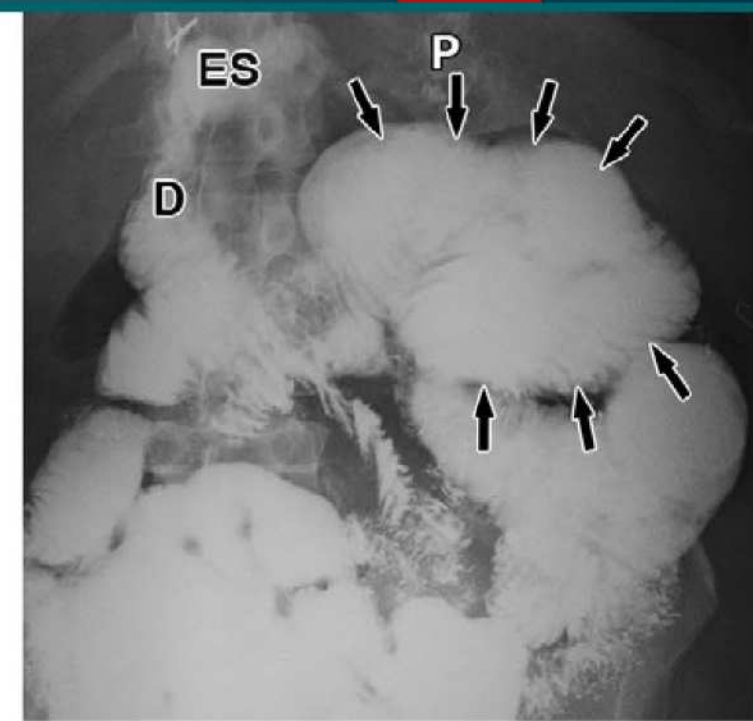
▶ Atüüpiline veresoonte muster



a.



b.



c.

Figure 11: Roux-en-Y gastric bypass with obstructing internal hernia. **(a, b)** Axial CT images after oral but not intravenous contrast material administration show a collapsed gastric pouch (*P*) and excluded stomach (*ES*). Note dilated, clustered small bowel loops displaced into left upper quadrant (arrows) with resulting SBO. **(c)** Overhead radiograph from small bowel follow-through in same patient also shows clustered, dilated, and displaced small bowel loops in left upper quadrant (arrows), displacing other bowel. The excluded stomach (*ES*) and duodenum (*D*) are opacified as a result of retrograde flow of barium via jejunojunostomy. This patient had a surgically proved transmesocolic internal hernia.



A



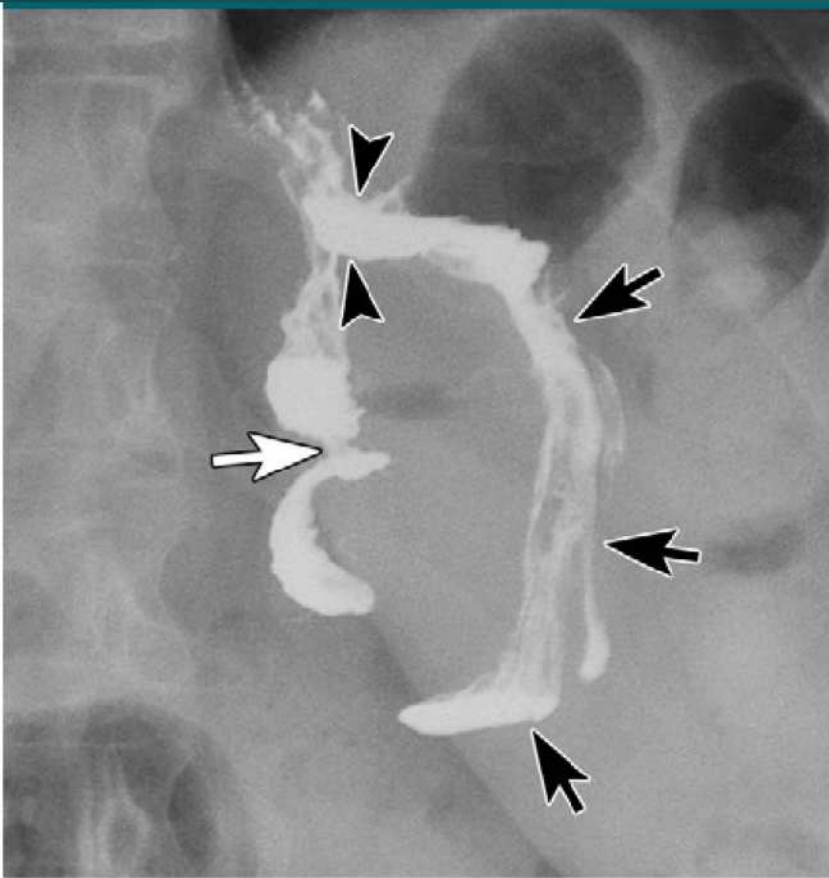
B

Fig. 15. Internal hernia after total gastrectomy.

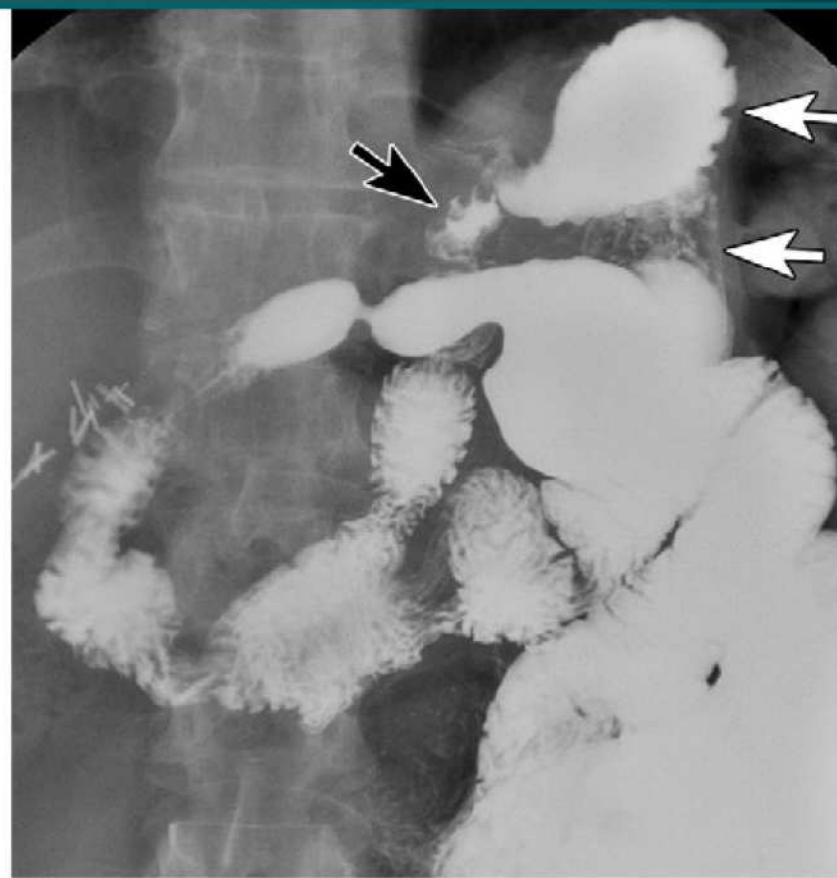
A. Axial CT image obtained at postoperative 1-year shows protrusion of small bowel (arrowheads) into anterior abdominal cavity passing between superior mesenteric artery (black arrow) and distal mesenteric arterial branches (white arrows), so-called **mushroom sign**. **B.** On coronal CT image, decreased caliber of superior mesenteric vein with beaked appearance (arrow), and extensive mesenteric congestion (*) are also seen. Laparotomy reveals Petersen's hernia.

Tüsistused 4

- ▶ Invaginatsioon
 - ▶ Alguspunktiks **jejunojejunaalne staplerjoon**
- ▶ Mao staplerjoone rekanalisatsioon või fistuli formeerumine
 - ▶ Lävivalgustuse ajal hoolega jälgida kontrastaine liikumist (tavaliselt baarium)
 - ▶ **Kas väljalülitatud magu täitub ante- või retrograadselt**
- ▶ Kehakaalu taassuurenemie
 - ▶ Kontrolli alati gastrojejunaalset anastomoosi läbimõõtu

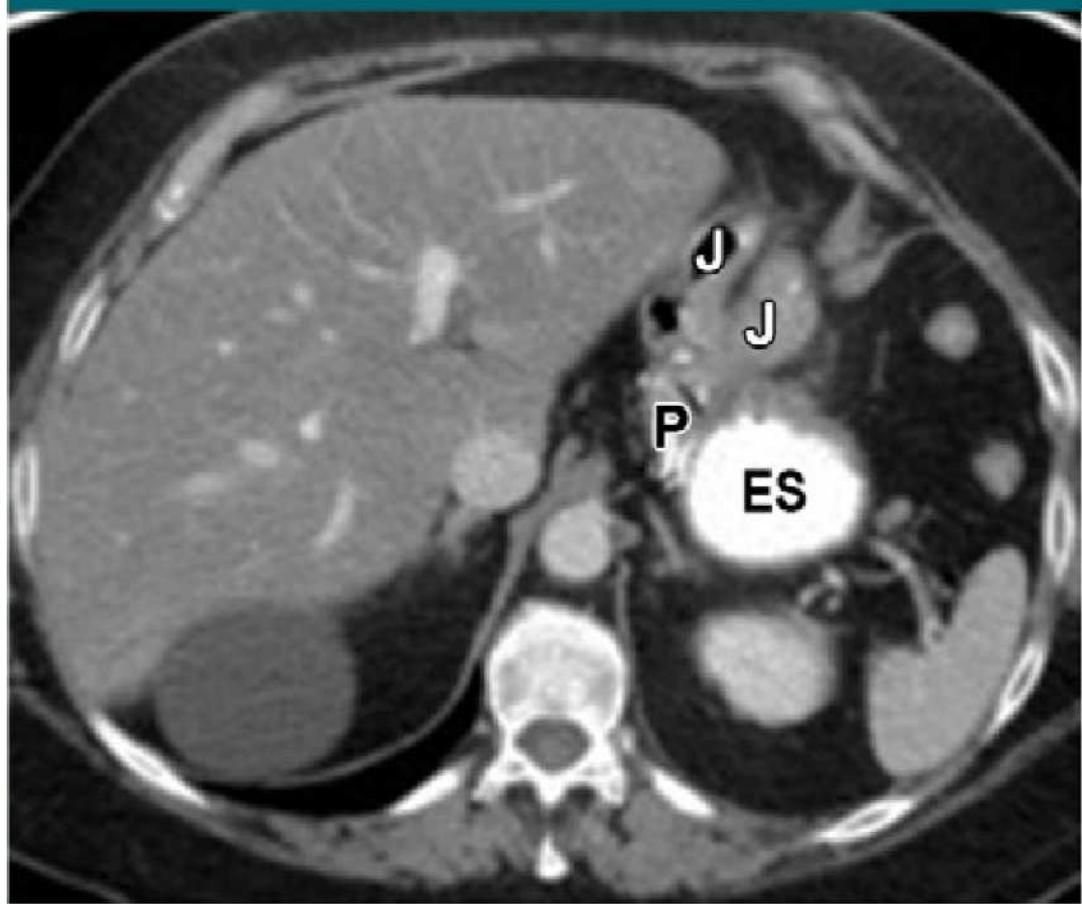


a.



b.

Figure 12: Roux-en-Y gastric bypass with breakdown of staple line. **(a)** Supine spot image from single-contrast upper GI barium study shows focal disruption of proximal end of staple line, with barium passing from gastric pouch laterally into excluded stomach (black arrows) via gastrogastric fistula (arrowheads). (White arrow = gastrojejunal anastomosis.) **(b)** Subsequent supine spot image from same study shows extensive filling of jejunal Roux limb, with barium also opacifying biliopancreatic limb and excluded stomach (white arrows) secondary to retrograde filling via jejunojejunal anastomosis. As a result, it is difficult to differentiate staple line disruption from retrograde filling of excluded stomach on this image. (Black arrow = barium in gastric pouch.)



a. b.

Figure 13: Roux-en-Y gastric bypass with staple line breakdown diagnosed at CT. **(a)** Axial and **(b)** coronal CT images after oral and intravenous contrast material administration show contrast material opacifying gastric pouch (*P*) and excluded stomach (*ES*) without opacification of duodenum (*D*), findings highly suggestive of staple line breakdown. When contrast material is also identified in duodenum and biliopancreatic limb, however, a barium study may be required to differentiate staple line disruption from retrograde filling of excluded stomach (*J* = jejunal Roux limb).

Laparoscopic Sleeve Gastrectomy

- ▶ 75-80 % maost resetseeritakse, u 100 ml jääb alles
- ▶ Lävivalgustus
 - ▶ Laieneb antrumi suunas
 - ▶ Varasemas postop perioodis peristaltika loid – baariumi retensioon
- ▶ CT
 - ▶ Võib olla sleeve + bypass combo

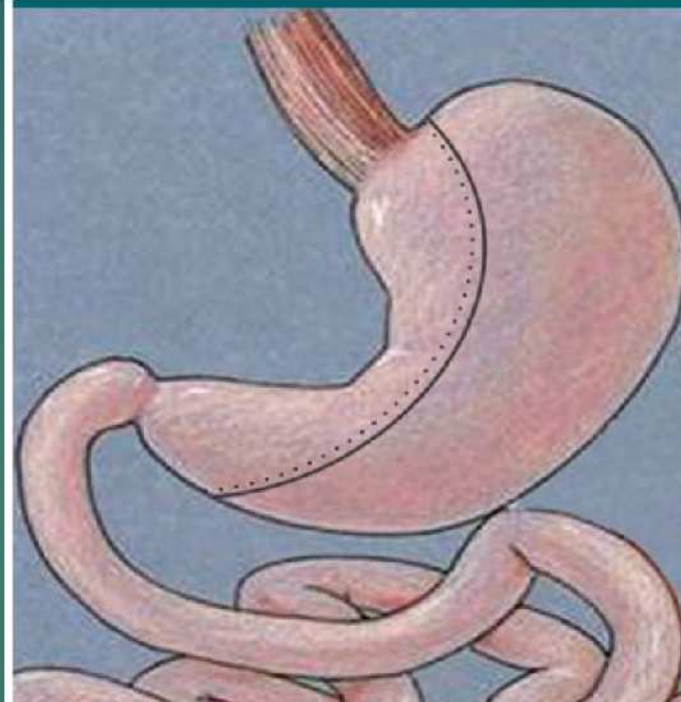


Figure 21: Diagram shows normal surgical anatomy after laparoscopic sleeve gastrectomy. Note how stomach is resected along greater curvature of fundus, body, and proximal antrum, producing a narrow, banana-shaped pouch along lesser curvature.



Figure 22: Normal imaging findings after sleeve gastrectomy. Supine spot image from single-contrast upper GI barium study shows tubular narrowing of gastric pouch (arrows) secondary to resection of greater curvature of proximal and mid stomach. Note relatively abrupt widening of gastric antrum, which is preserved.

Figure 23

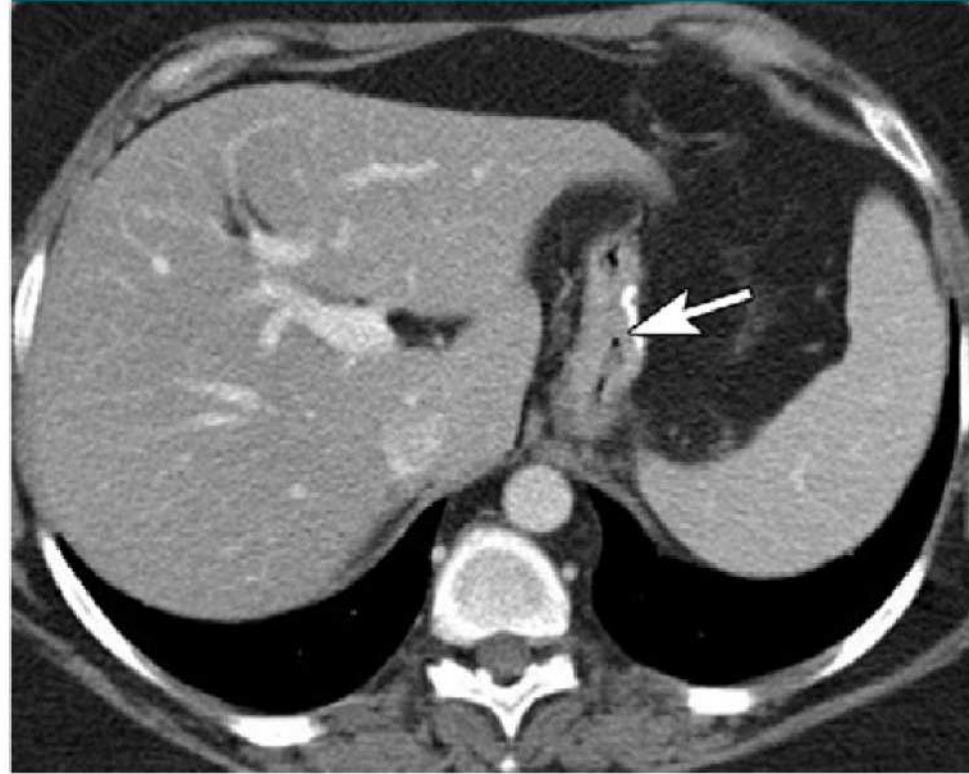


Figure 23: Normal appearance of sleeve gastrectomy at CT. Axial CT image after oral and intravenous contrast material administration show a small-caliber, tubular stomach after resection along greater curvature. Note surgical suture line (arrow). There is prominent fat attenuation in surgical bed.

Tüsistused

▶ Lekked

- ▶ Kõigepealt veeslahustav, siis baariumiga
- ▶ u 1 %, sageli proksimaalses osas
- ▶ Pikk staplerjoon suurendab riski

▶ Takistused

- ▶ Staplerjoone kootumine

▶ Mao laienemine

- ▶ 4.5 %
- ▶ Vähene kaalulangus, kaalu tõus
- ▶ Puoch ei ole enam „banaanitaoline“

▶ GERD

- ▶ GS tõstab riski
- ▶ 1 aasta möödudes jälgitav 20% haigetel
- ▶ Paremini detekteeritav läbivalgustuse ajal

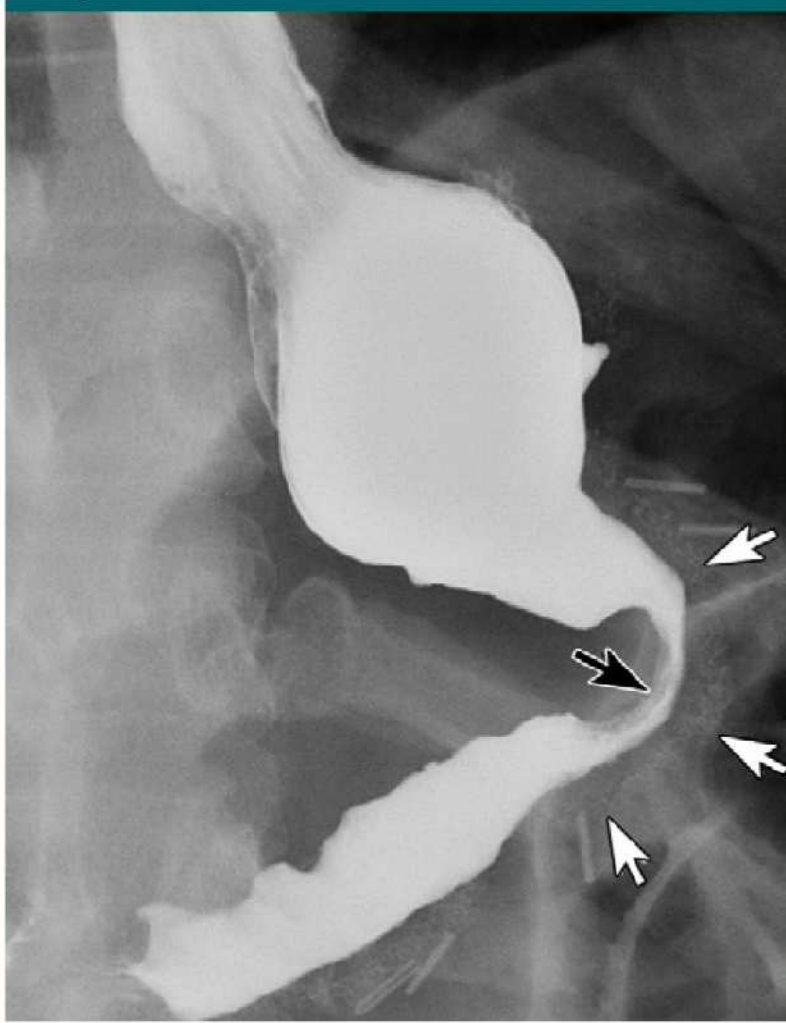
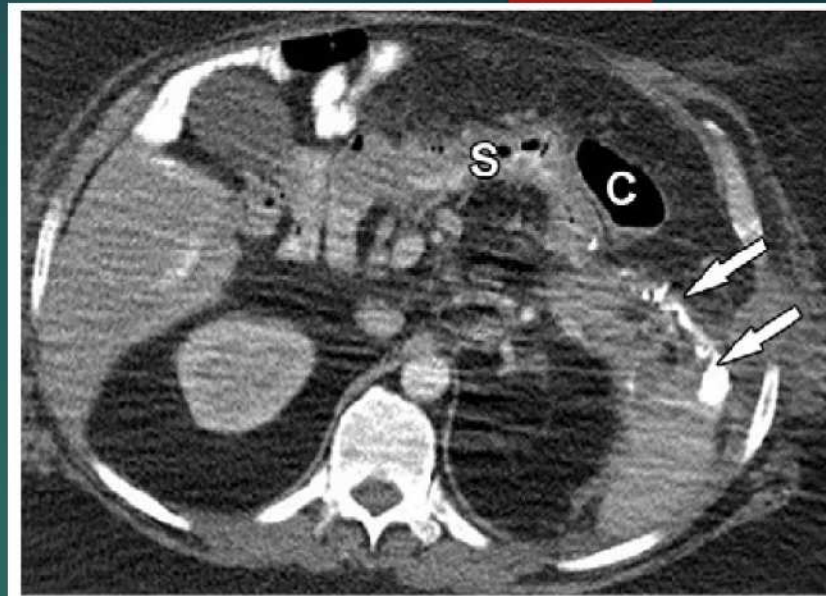
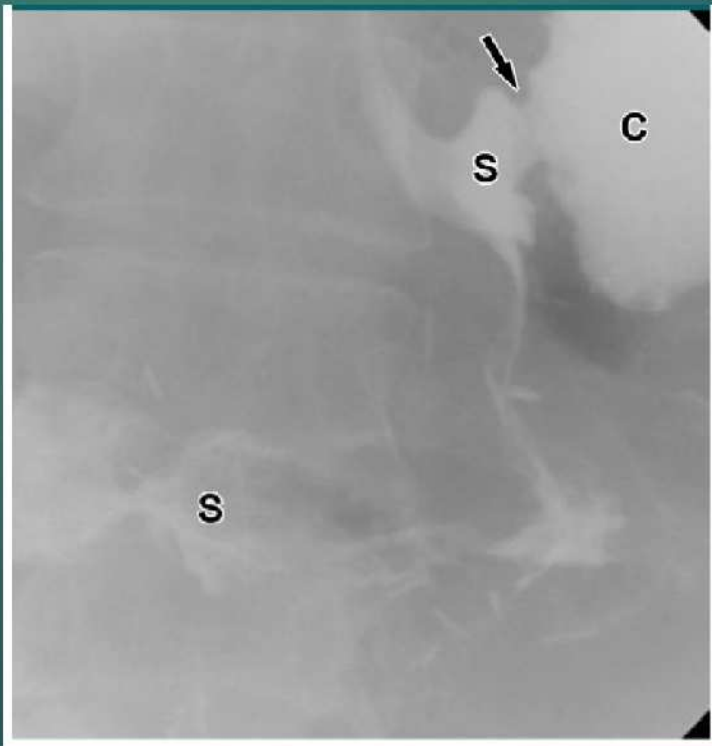
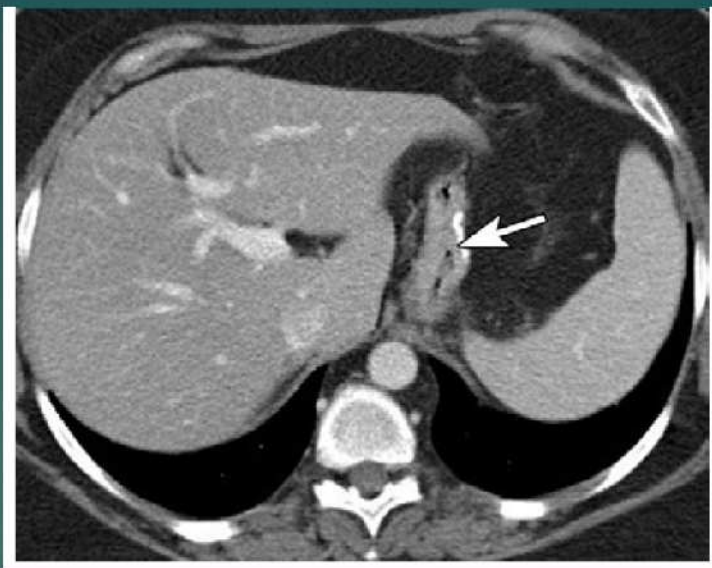


Figure 25: Sleeve gastrectomy with stricture and obstruction. Supine spot image from single-contrast upper GI barium study shows short segment of marked narrowing (black arrow) in gastric pouch. Also note dilation of stomach and esophagus proximally. (White arrows = staple line abutting greater curvature.)



b.

Figure 24: Sleeve gastrectomy with postoperative leak. **(a)** Supine spot image from upper GI examination with water-soluble contrast material shows focal leak (arrow) from proximal stomach laterally into extraluminal collection in left upper quadrant (*C*). (*S* = gastric sleeve.) **(b)** Axial CT image after oral and intravenous contrast material administration shows tubular stomach (*S*), with extraluminal collection (*C*) of gas and extravasated contrast material (arrows) in left upper quadrant due to postoperative leak.

Intratorakaalsed komplikatsioonid

- ▶ Enamus söögitoruga seotud
- ▶ Postop (päev-nädal), tavaliselt lekked rindkerre
- ▶ Varased (kuud)
- ▶ Hilised

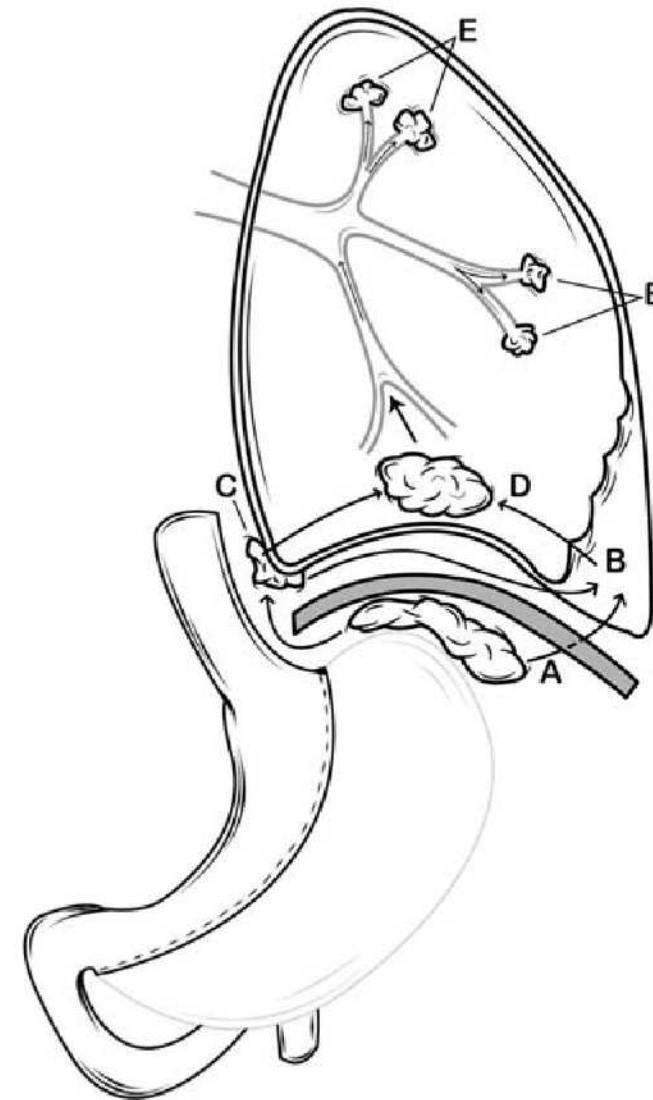
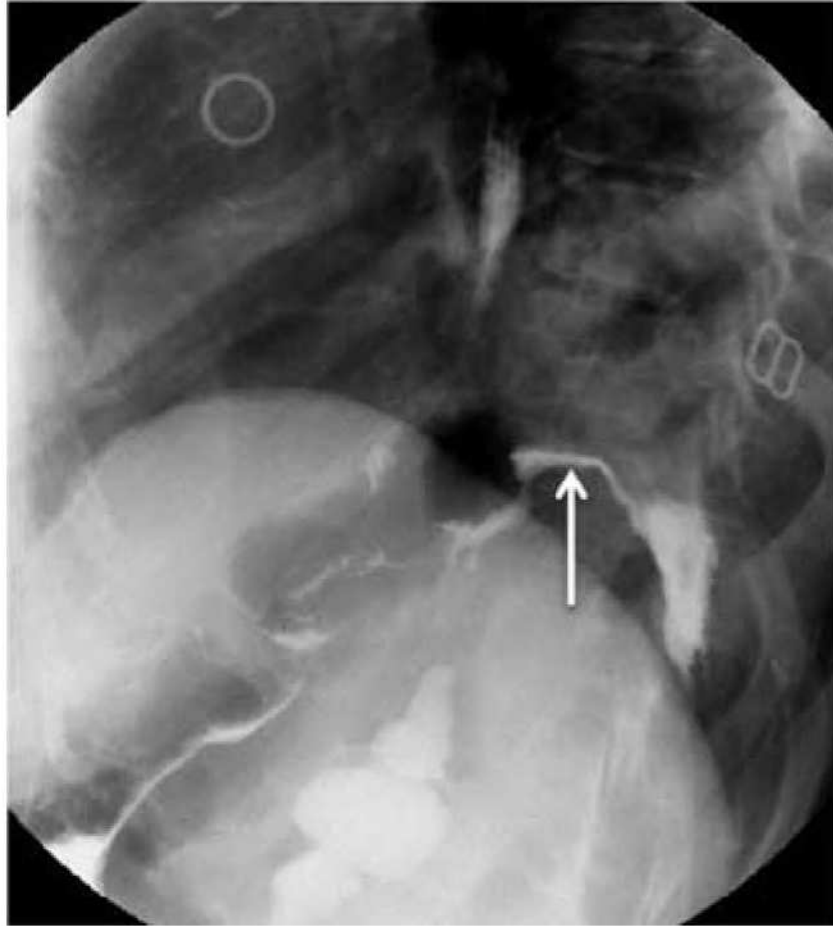


FIGURE 5. Potential mechanisms of spread of postbariatric abdominal infections into the thoracic cavity. Infections can spread transdiaphragmatically (A) into the pleural space (B) or through the diaphragmatic hiatus (C). Ultimately, these infections can progress to involve the underlying lung parenchyma (D) with intrapulmonary spread of infection to additional alveoli via retrograde transit through the bronchi (E).

Postop. Tüsistused (Päevad-nädalad)

- ▶ Tavaliselt **lekked rindkerre 10 päeva jooksul**, 70% GJ anastomoosist
- ▶ Levik läbi diafragma hiatuse, transdiafragmaalselt
- ▶ GS 1%, Bypass 5%
- ▶ Sepsise kliiniline pilt
- ▶ Manifisteerumine:
 - ▶ Empüeem
 - ▶ Gastropleural fistula, visualiseeritav harva
 - ▶ Pneumoonia
 - ▶ Kopsu abstsess
- ▶ Lävivalgustusel võimalik fistuli trakti visualiseerimine

A



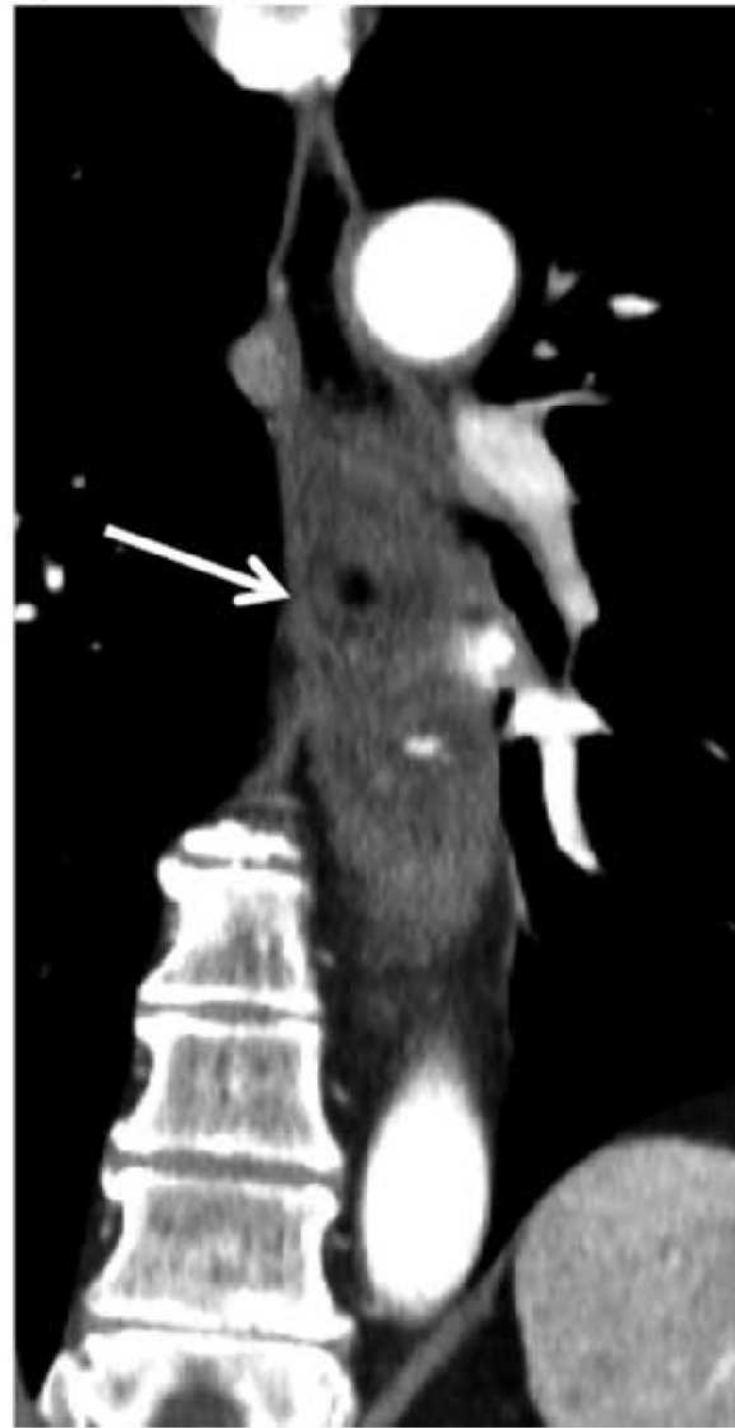
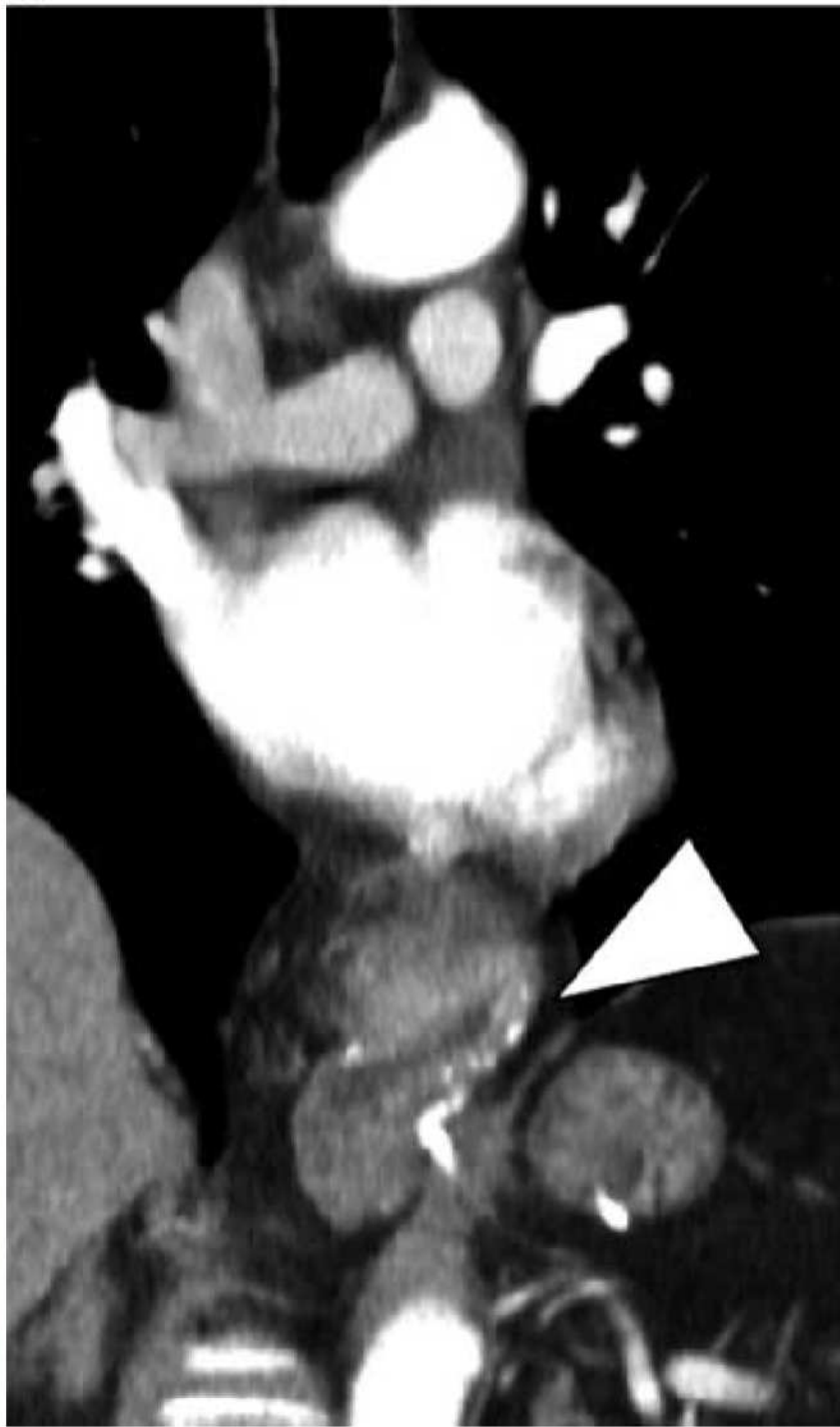
B



FIGURE 6. A and B, Gastropleural fistula after RYGBP. Upper GI study image in lateral projection (A) in a patient who had undergone a recent RYGBP shows a fistulous tract (arrow) from the gastrojejunostomy anastomosis to the left pleural space with pooling of contrast in the posterior pleural space. Coronal image from postcontrast chest CT (B) shows the presence of left empyema and left lower-lobe lung abscess (arrows).

Varased tüsistused (kuud)

- Tavaliselt anastomoosi struktuuridest
- **GERD** → **ösofagiit** →
 - Söögitorus muutused CT-s
 - GERDiks kuldne standart läbivalgustus
- **Söögitoru motiilsuse häired** →
 - → **Aspirats. pneumoonia**
 - CT-s pneumoonia pilt ± muutused söögitorus
 - Tüsistunud pneumoonia tunnused
- Mao pouchi herniatsioon harva
 - Aeglustunud pouchi/ söögitoru tühjenemine



Hilised tüsistused

- ▶ Söögitoru motiilsuse häire – dilatatsioon – **Pseudoahalaasia**
 - ▶ Laienenud söögitoru
 - ▶ „bird beak“ sign
- ▶ **Bronheктаasiad, Interstitsiaalsed kopsu haigused**
 - ▶ Tavaliselt kroonilise GER korral
 - ▶ 0.5-30%
 - ▶ **Korduvad asümptomaatilised mikroaspiratsioonid**
 - ▶ CT
 - ▶ Peribronhiaalne tihenemine alguses kopsude alaväljades

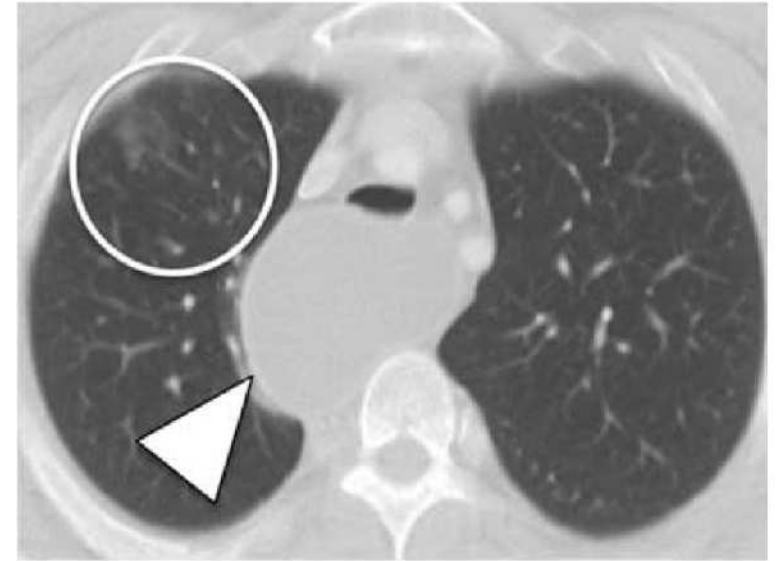


FIGURE 11. Aspiration pneumonia after LAGB. A patient who had undergone LAGB with marked dilation of the esophagus (arrowhead) presented with dysphagia and chronic cough unresponsive to 2 rounds of antibiotics. Note patchy ground-glass and tiny, ill-defined nodular densities in the anterior right upper lobe (circle). This was felt to be from recurrent aspiration pneumonia.



B



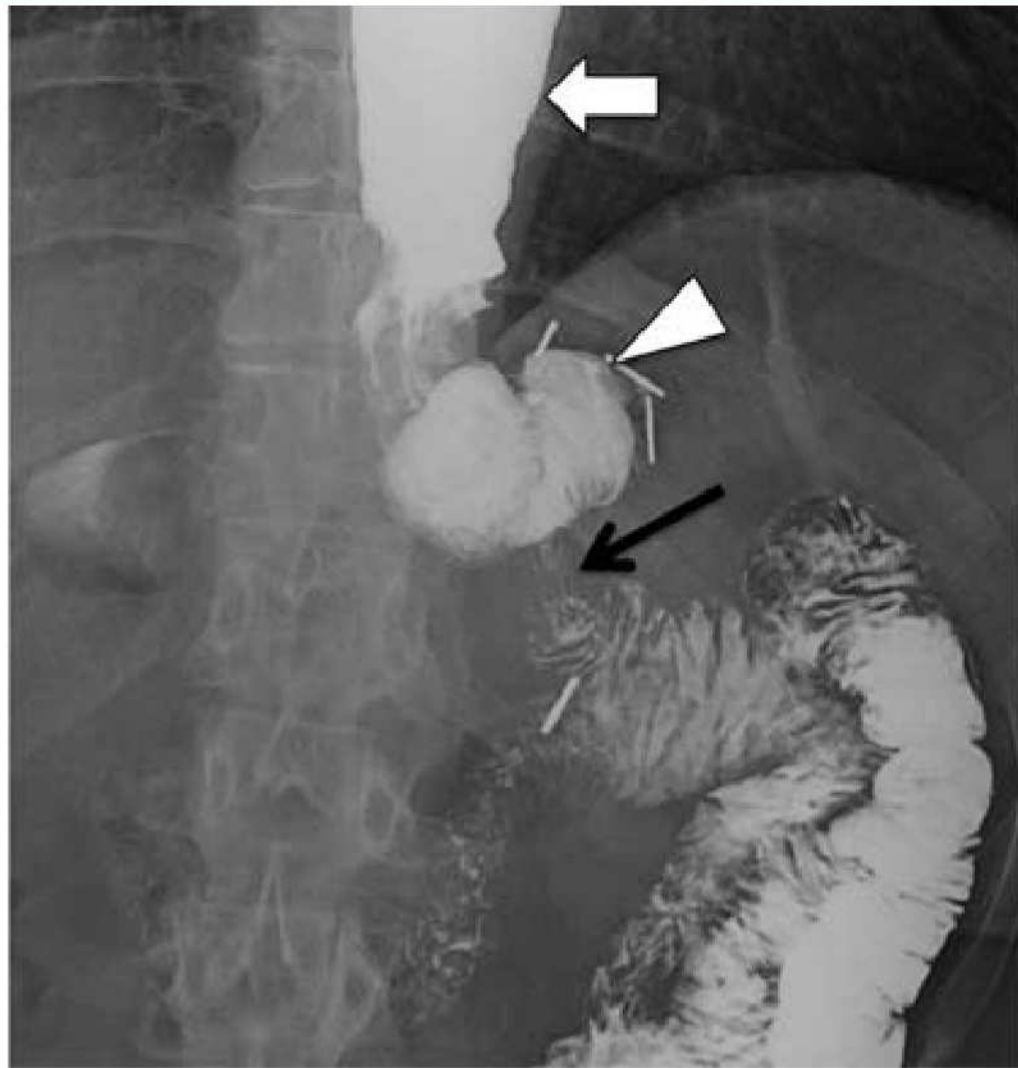


FIGURE 9. Gastric pouch dilation after RYGBP. Upper GI study in a patient status post-RYGBP demonstrate significant dilation of the gastric pouch (arrowhead) and esophagus (white arrow) with narrowing at the gastrojejunostomy (black arrow), consistent with postoperative anastomotic stricture.

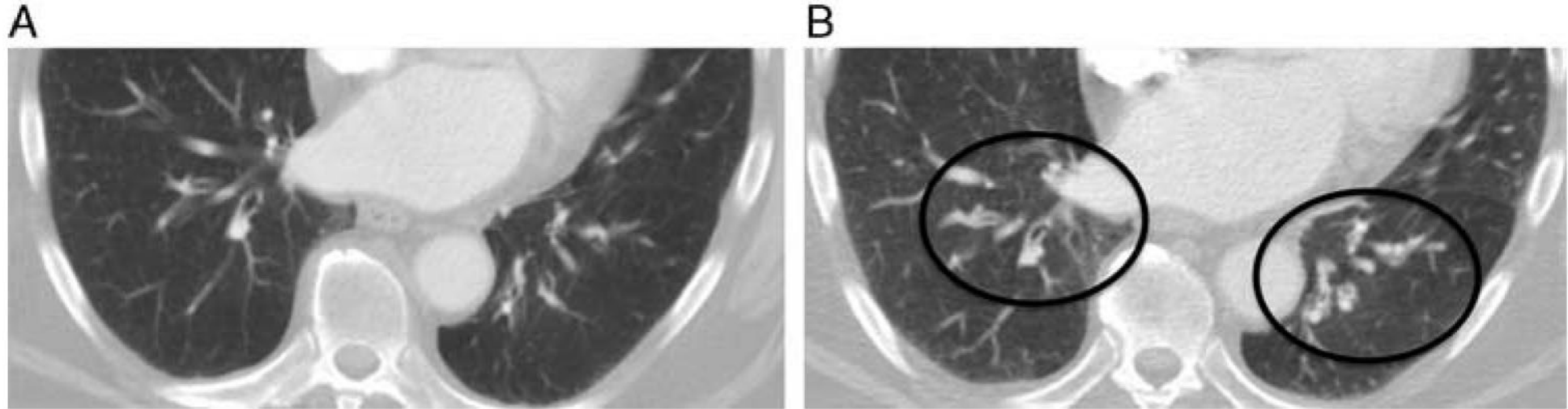


FIGURE 15. A and B, Aspiration bronchitis after LAGB. A 60-year-old woman with a history of LAGB and development of increasing dyspnea and chest pain 2 years after surgery. Baseline scan (A) demonstrates no significant abnormality. Repeat CT scan (B) shows development of new mild peribronchial thickening in the lower lobes (circles).

Kokkuvõte

- ▶ Ülekaaluliste patsientide hulk ↗
- ▶ Ole kursis põhiliste bariaatriliste kirurgiliste protseduuridega
- ▶ Uuri, millal oli operatsioon tehtud
- ▶ Ole kursis bariaatria intraabdominaalsete tüsistustega
- ▶ Pea meeles, et intratorakaalsed tüsistused on harvad, kuid võimalikud
- ▶ Samuti võimalikud kroonilised muutused kopsudes kroonilisest asümptomaatilisest aspiratsioonist

Kasutatud kirjandus

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▶ **Aitäh tähelepanu eest!**