The gastroduodenal artery: Radiological anatomy, imaging and endovascular intervention

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Learning objectives

Purpose:

• To provide an overview of the radiological anatomy and variants of the gastroduodenal artery (GDA)
• To highlight the indications, procedure and outcome of endovascular intervention of the GDA

Background

• The GDA is an important structure, and knowledge of the anatomy and variants are vital for radiologists, surgeons and gastroenterologists alike. A multidisciplinary approach is often required for the treatment of GDA haemorrhage, which is a major cause of morbidity and mortality with a variety of causative pathologies e.g. pancreatitis, peptic ulceration, malignancy, trauma. The GDA itself has been used in the repair of hepatic artery trauma or for hepatic artery reconstruction in Whipple’s procedure. We demonstrate the anatomy of the GDA using radiological imaging and present cases with a range of pathologies, highlighting the role of endovascular intervention in each case.

Imaging findings OR Procedure details

Anatomy:

• The coeliac trunk arises at the level of the T12 vertebra and, in 65-75% of people, gives rise to: - Left gastric artery - Splenic artery - Common hepatic artery (CHA)
• In 75% of people, the CHA gives rise to the GDA and the right gastric artery
• The GDA may also arise from the left hepatic artery (4-11%), right hepatic artery (7%) or superior mesenteric artery (SMA) via a replaced hepatic trunk (4-11%)
• In the event of separate origins of the left and right hepatic arteries, the GDA typically arises from the branch supplying the left lobe of the liver
• The GDA passes posteriorly to the first part of the duodenum, lying anteriorly to the pancreas and to the left of the common bile duct, hence explaining its involvement in duodenal and pancreatic pathologies
• At the lower border of the duodenum, the GDA divides into: - Right gastroepiploic artery - Superior...
pancreaticoduodenal artery • Anastomoses between branches of the SMA and coeliac artery are frequent and variable, emphasising the need for selective examination of both main arteries when performing endovascular intervention involving the GDA
• Figure 1 shows a normal configuration in which coeliac axis arises from aorta and gives rise to the CHA, from which the GDA emerges • Figure 2 shows the GDA giving rise to the right gastroepiploic artery, which runs along the greater curvature of the stomach • Figure 3 shows an anatomical variant in which the coeliac axis arises from the proximal SMA

**Cases:**

Case 1 • A patient with a history of excess alcohol consumption presented with haematemesis and melaena. Endoscopy revealed 4 duodenal ulcers but attempts to control bleeding were unsuccessful • Angiography via left CFA (common femoral artery) approach showed the coeliac axis arising from the proximal SMA (figure 3) • The hepatic artery was of reduced calibre distally in keeping with background cirrhosis • Extravasation was evident from a slender attenuated GDA (figure 4) which was coiled to good effect (figure 5)

Case 2 • A patient with chronic pancreatitis was found to have a pseudocyst at the head of the pancreas (figure 6) • A repeat CT several days later demonstrated a 1.6cm pseudoaneurysm (figures 7,8), originally thought to originate from an aberrant CHA arising from the SMA. The pseudoaneurysm compresses the second part of the duodenum and bile duct • Angiography (figure 9) demonstrated a pseudoaneurysm arising from a tiny GDA near its origin from the CHA, confirmed to be arising from the SMA • Attempts were made to deploy a stent graft via the left axillary approach, but a stable position could not be achieved without damage to the CHA and the procedure was abandoned

Case 3 • A patient with cryptogenic liver disease presented with melaena. Endoscopy revealed the stomach to be full of blood from an ulcer in the 2nd part of the duodenum. • Angiography via right CFA (figures 10,11) did not identify a bleeding site, but a decision was made to embolise the GDA with multiple microcoils (figure 12) The patient subsequently represented with a further upper GU bleed. Repeat angiography demonstrated frank extravasation (figure 13) from extensive collateral vessels, none of which were possible to selectively catheterise. The GDA remained excluded from the circulation. No further intervention was performed

Case 4 • The patient was admitted with an upper GI bleed, with endoscopy failing to treat the bleeding duodenal ulcer • CT angiography was performed (figures 14,15). This demonstrated extensive intraperitoneal and retroperitoneal free gas, thought to have arisen as a result of injection at endoscopy. A small area of active extravasation was identified within the duodenum, arising from the GDA. • Selective CHA angiography via right CFA access demonstrated an irregular GDA which was undergoing spasm. This was embolised to occlusion using multiple coils (figure 16)

Case 5 • A patient with an upper GI bleed was found to have a pyloric ulcer on endoscopy • Angiography via right CFA access did not identify a bleeding point, although the GDA ran close to the pylorus and hence was selectively catheterised (figure 17) and coiled (figure 18)

Case 6
This patient was found to have pancreatic carcinoma involving the coeliac axis (figure 19). Pre-operative embolisation was performed two weeks before surgery, to facilitate inferior collateralisation from SMA branches to enable resection of the malignancy. Angiography (figure 20) revealed a GDA heavily dominated by the CHA supply, with no retrograde opacification evident on SMA injection. The CHA was embolised with microcoils which projected into the upper GDA (figure 21).

**Case 7**
A patient with a several month history of weight loss and epigastric pain presented acutely with haematemesis and melaena. Endoscopy revealed an enormous ulcer in the first part of the duodenum, subsequently found to be benign. Angiography revealed a large GDA which supplies an unusually prominent leash of vessels to the proximal duodenum (figure 22), with no evidence of extravasation. The GDA was embolised using coils, obliterating all but the proximal 2cm. It was subsequently noted that a very small vessel arising from the proximal GDA (figure 23) continued to supply an abnormal blush of exuberant proximal duodenal vascularity. No further intervention was performed as bleeding had stopped, although the option to place a covered stent graft in the CHA was considered in the event of a rebleed **Case 8**.
This patient had radical resection for glucagonoma, with partial heptectomy, splenectomy and partial pancreatectomy. Endovascular coiling of the GDA had been performed several days previously due to the presence of an organising haematoma. Repeat CT demonstrated a new 16mm saccular pseudoaneurysm at the point where the hepatic artery gives rise to the GDA, thought to be caused by a surgical drain (figures 24, 25). This was confirmed on selective hepatic angiography (figures 26, 27). Via a right CFA approach, a 6 x 30mm wall graft was placed, successfully excluding the pseudoaneurysm (figure 28).

**Case 9**
A patient with an upper GI bleed had angiography via right CFA which revealed torrential haemorrhage from the GDA into the duodenum (figure 29). Wires and catheters passed straight through into the lumen of the duodenum. Distal embolisation was not therefore possible but the GDA was coiled proximally (figure 30) leading to cessation of haemorrhage, confirmed on delayed angiography at 10 minutes. **Case 10**
This patient presented with bleeding from a pyloric ulcer which could not be controlled endoscopically. Coeliac angiography via right CFA access revealed irregularity of the GDA (figure 31), considered due to erosion from the known ulcer. Coil embolisation was performed, confirming cessation of flow in the abnormal GDA (figure 32).

**Images for this section:**
**Fig. 1:** Angiographic anatomy: yellow - coeliac axis; red - splenic artery; green - CHA; blue - GDA
Fig. 2: Angiography of the GDA: green - CHA; blue - GDA; pink - right gastroepiploic artery
Fig. 3: Coeliac axis (yellow) arising from SMA (black)
**Fig. 4:** GDA extravasation

**Fig. 5:** GDA coils
Fig. 6: Pseudocyst at head of pancreas
Fig. 7: Pseudocyst containing pseudoaneurysm
Fig. 8: Pseudocyst containing pseudoaneurysm
Fig. 9: Pseudoaneurysm arising from GDA
Fig. 10: Coeliac angiography
Fig. 11: SMA angiography
Fig. 12: Coiled GDA
Fig. 13: Coiled GDA with collateralisation
Fig. 14: CT angiography, sagittal. The bleeding point is indicated by the yellow line.
Fig. 15: CT angiography, axial. The bleeding point is indicated by the yellow line.
Fig. 16: Coiled GDA
Fig. 17: Selective GDA angiography
Fig. 18: Coiled GDA
Fig. 19: Axial CT image showing pancreatic carcinoma involving the coeliac axis
Fig. 20: Angiography showing the GDA
Fig. 21: CHA coiling, projected into upper GDA
Fig. 22: Large GDA with leash of blood vessels
**Fig. 23:** Coiled GDA

**Fig. 24:** Axial CT image showing the course of the surgical drain towards the pseudoaneurysm
Fig. 25: Axial CT image showing the course of the surgical drain towards the pseudoaneurysm
Fig. 26: Angiography demonstrating the pseudoaneurysm
Fig. 27: Angiography demonstrating the pseudoaneurysm
Fig. 28: CHA stent
Fig. 29: Coeliac angiography showing torrential haemorrhage
**Fig. 30:** Coiled GDA
Fig. 31: Angiography showing GDA irregularity
Conclusion

• Radiological intervention involving the GDA is a potentially life-saving procedure, and understanding of the anatomy, variants and pathologies is essential

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