CASE REPORT

Coexistent rare hepatic artery variants as a pitfall during embolization: dorsal pancreatic artery mistaken for gastroduodenal artery

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ABSTRACT
We present a 39-year-old patient with massive duodenal bleeding ulcer. The patient had multiple variants in his hepatic arterial anatomy that led us to erroneously embolize the dorsal pancreatic artery presuming it to be the gastroduodenal artery. Due to this erroneous presumption, our patient continued to have upper gastrointestinal bleeding. Repeat angiogram was performed, during which the actual gastroduodenal artery was recognized and embolized. To our knowledge, this rare combination of anatomic variants in the hepatic artery as a pitfall during gastroduodenal artery embolization leading to inadvertent embolization of the dorsal pancreatic artery has not been described in the literature.

Key words: • therapeutic embolization • dorsal pancreatic artery • gastroduodenal artery • complications • duodenal ulcer

Variations are extremely common in the celiac and hepatic arteries. These variations have important implications in surgery and interventional radiology. Although single isolated variation in a vessel of interest may be easy to recognize, the presence of multiple coexistent variants in the same artery may be confusing. This is especially true when one is hard-pressed for time in a hemodynamically unstable patient, a scenario where an agitated patient adds to the problem by giving rise to poor quality angiographic images. This may lead to unwanted interventions performed in these arteries that may end in devastating complications. We present here unique anatomic variants of the hepatic artery. Familiarity with such anatomic variants is important to avoid inadvertent embolization as described in our report.

Case report

We present the case of a 39-year-old man with history of duodenal ulcer causing hematemesis and hematochezia. The patient was referred to us for embolization of his bleeding duodenal ulcer after two failed attempts of epinephrine injections (40 mL of 1:10,000 each time). His hematocrit was 19% despite the infusion of eight units of blood in the last 24 hours; heart rate was 120/min and blood pressure was 126/70 mmHg with vasopressors.

A common hepatic arteriogram using a 5 F RC2 catheter (Cook, Bloomington, Indiana, USA) showed early bifurcation of the common hepatic artery (CHA) (Fig. 1a). No active bleeding could be seen; however, we noted significant vasoconstriction of the visualized branches of the common hepatic artery. A short descending arterial branch was seen arising from the right hepatic artery, which we thought was the gastroduodenal artery (GDA), although its origin was located more medially (Fig. 1b). Superselective angiogram of this artery did not reveal active bleeding. The branching pattern of the artery did not quite look like the GDA; still, since no other vessel looked closer to its appearance in a desperate attempt to salvage the patient's life, we decided to embolize the artery. We used five 3 x 2 mm Tornado coils (Cook) and one 2 x 6 mm Tornado coil. Follow-up angiogram showed complete occlusion of the embolized artery. A superior mesenteric arteriogram was performed. No bleeders were seen. The patient was sent back to the medical intensive care unit with the sheath sutured to the groin as we were not sure whether the artery embolized was the GDA.

As feared, over the next 2 hours, the patient's blood pressure and hematocrit dropped below the preprocedural values, and his hematocrit measured 15%. The patient was brought back immediately to the angiography suite. Careful analysis of these images as well as those from the previous study made us realize that the GDA was probably arising from the left hepatic artery (Fig. 2a). On further careful analysis of the previ-

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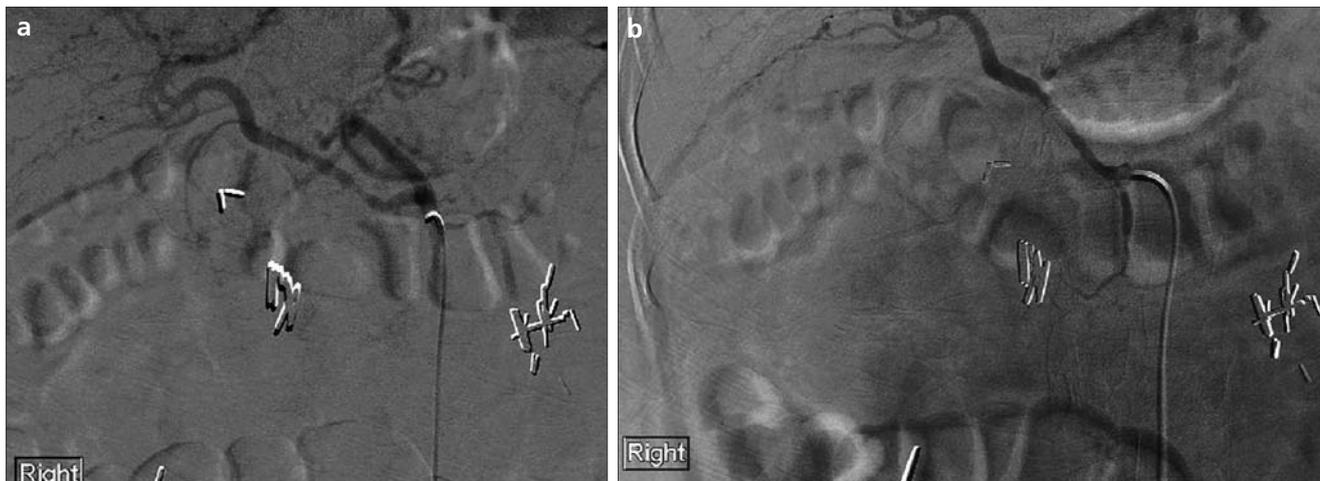
Figure 1. a, b. A 39-year-old man with recurrent massive duodenal ulcer bleed. First episode of embolization. Images were not of optimum quality as patient was not able to hold breath since he was agitated during the entire procedure. Selective angiogram of the hepatic artery **(a)** shows bifurcation of common hepatic artery immediately after its origin. A branch arising from the left hepatic artery in 8 o'clock position was not realized as being the actual gastroduodenal artery as it lacked the typical configuration. The branching pattern was obscured in this relatively non-specific injection. Superselective angiogram of the right hepatic artery **(b)** shows a descending branch arising just after its origin, which represents the dorsal pancreatic artery. It was thought to represent a variant gastroduodenal artery although it arose much more medially and was smaller. Narrowing at the proximal end of the artery was thought to represent vasoconstriction produced by the recent epinephrine injections at endoscopy.
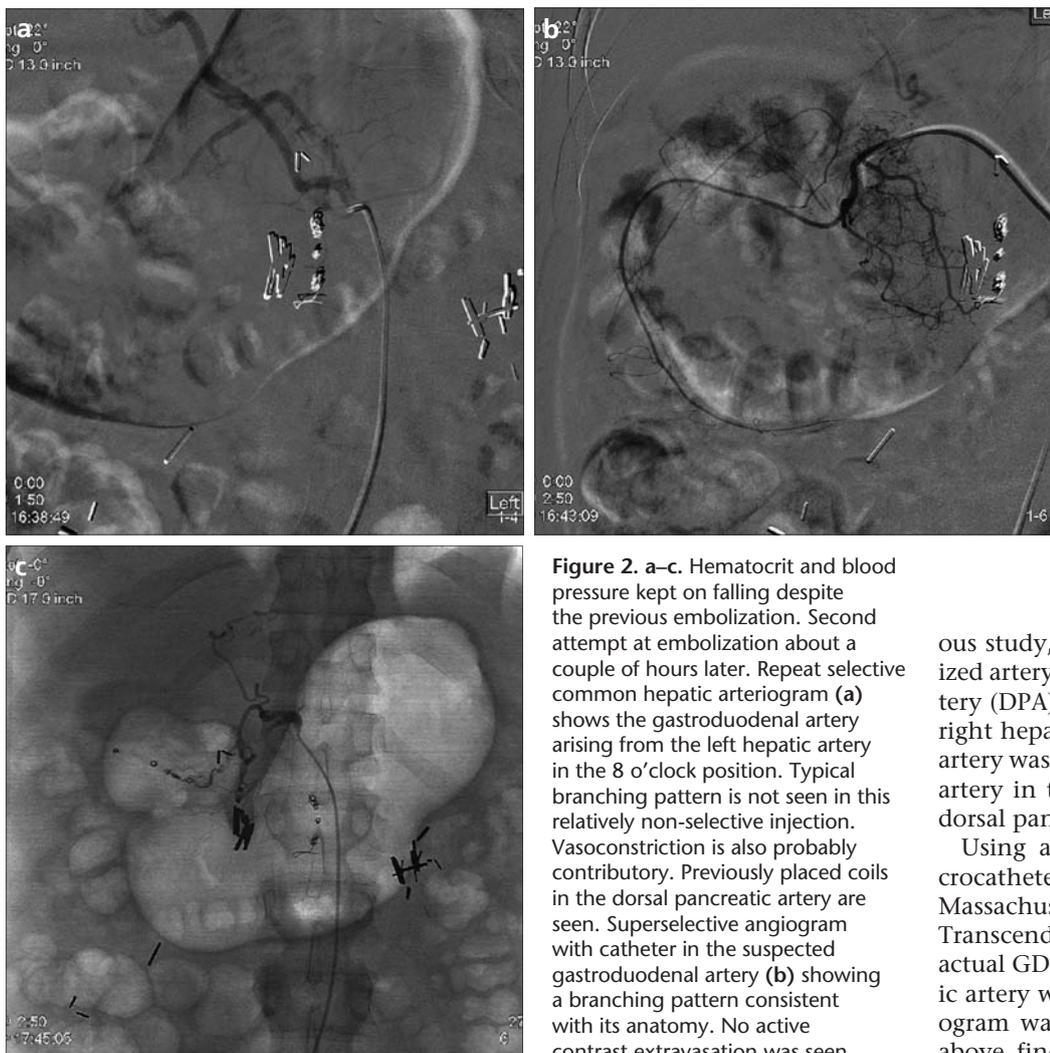

Figure 2. a–c. Hematocrit and blood pressure kept on falling despite the previous embolization. Second attempt at embolization about a couple of hours later. Repeat selective common hepatic arteriogram **(a)** shows the gastroduodenal artery arising from the left hepatic artery in the 8 o'clock position. Typical branching pattern is not seen in this relatively non-selective injection. Vasoconstriction is also probably contributory. Previously placed coils in the dorsal pancreatic artery are seen. Superselective angiogram with catheter in the suspected gastroduodenal artery **(b)** showing a branching pattern consistent with its anatomy. No active contrast extravasation was seen. Superselective angiogram showing complete embolization of the gastroduodenal artery with multiple coils in situ **(c)**. Note medial coils from the previous embolization.

ous study, we realized that the embolized artery was the dorsal pancreatic artery (DPA) which was arising from the right hepatic artery. No corresponding artery was seen arising from the splenic artery in the expected location of the dorsal pancreatic artery.

Using a 3.1-F Renegade Hi-Flo microcatheter (Boston Scientific, Natick, Massachusetts, USA) and a 0.014-inch Transcend wire (Boston Scientific), the actual GDA arising from the left hepatic artery was catheterized and an angiogram was performed confirming the above findings (Fig. 2b). Again there was no contrast extravasation but his vital signs were deteriorating and there

was also repeat hematochezia. Therefore we decided to embolize the gastroduodenal artery. A gastroepiploic artery angiogram was performed and three 3 x 2 mm Tornado coils were then deployed in the artery. The microcatheter was then withdrawn into the GDA which was embolized using one 4 x 2 mm Tornado coil, two 4 x 4 mm AZUR coils (Terumo, Somerset, New Jersey, USA), two 2 x 3 mm Cook stainless steel coils and six 3 x 4 mm Cook stainless steel coils. Follow-up angiogram showed total embolization of the GDA (Fig. 2c), and the procedure was terminated.

There was no further episode of hematemesis and hematochezia over the course of the next three days. The patient did not suffer any acute upper abdominal pain to suggest acute pancreatitis, and his serum amylase values were normal over the post procedure period until the day of discharge.

Discussion

Bleeding is a serious complication of duodenal ulcers and the gastroduodenal artery or one of its branches is the most common culprit. Endoscopic hemostasis is well established as the first-line treatment of bleeding duodenal ulcers. The primary technical success rate is reportedly 90% in most studies (1). However, recurrent bleeding has an incidence of about 10–30%. Most of these patients are high-risk patients having multiple co-morbidities and are therefore unsuitable for major surgery. In such patients, embolization is the treatment of choice if endoscopic hemostasis fails (2).

Empiric embolization often becomes necessary for gastrointestinal hemorrhage. About 10–20% of patients with upper gastrointestinal bleeding can have an angiographically occult bleeding. A hemorrhage rate of 0.5–1.0 mL/min is required before it can be visualized with angiography. In a recent study Padia et al. concluded that in patients with acute upper gastrointestinal hemorrhage arterial embolization is equally effective whether there at angiography is contrast extravasation or not (3). Thus empiric embolization of the GDA/left gastric artery (LGA), which account for most of the upper gastrointestinal hemorrhages, is strongly advocated. GDA is the artery of choice for empiric duodenal hemorrhages while LGA is for gastric hemor-

rhages. Accurate knowledge of normal anatomy and its variants is essential for empiric embolization.

Variations in the celiac and hepatic arterial anatomy are extremely common and quite diverse. Celiac trunk is a wide ventral branch of the aorta, which classically divides into LGA, CHA and splenic artery (SA). This pattern is found in about 65–75% of individuals (4). LGA is usually the first branch. LGA is usually the smallest and SA is the largest celiac branch. CHA is intermediate in size between LGA and SA (5).

The classic hepatic arterial anatomy, with CHA arising from the celiac trunk and dividing into GDA and proper hepatic artery, which in turn branches into the right and left hepatic arteries, is seen in 55% of individuals, as reported in previous studies (6). Early division of CHA into the right and left hepatic arteries as in our case is seen in only 2% of individuals (7).

GDA is usually the first major branch of the hepatic arterial system, which arises from CHA and courses vertically inferiorly. It arises from a celiac artery branch in 89% of individuals, most commonly from CHA in 75%, the right hepatic artery in 6%, or the left hepatic artery in 4% of individuals (7). In the remaining 11% of individuals, it arises either from a replaced or accessory hepatic artery, from the superior mesenteric artery (SMA) or from the aorta.

DPA is the largest pancreatic artery and a major source of blood supply to the pancreas. It usually arises from SA (40%), celiac artery (22%) CHA (20%) or SMA/aorta (14%) (7). To our knowledge, the incidence of it arising from the right hepatic artery is not described in literature, suggesting that it is rare, probably much less than 4%.

We demonstrated three variations in our case: early bifurcation of CHA (2%), GDA arising from the left hepatic artery (4%), and DPA arising from the right hepatic artery (less than 4%). To the best of our knowledge, the coexistence of these three variations has not been previously mentioned in the literature. The literature also does not mention whether they can be associated with each other or not; but if not, by multiplying the individual incidences, the probability of finding such a rare combination would be less than 0.000032%.

Several other cases of inadvertent complications have been described by Schenker et al. in their retrospective review of 163 patients (8). One procedure was aborted after a failed coil embolization of LGA resulted in the embolization of two unstable coils into splenic branches (the patient survived without major complications); another patient, who died 11 days after surgical vagotomy and pyloroplasty for failed transcatheter embolization of GDA, had his procedure complicated by inadvertent embolization of the right hepatic artery (8).

The above-mentioned very rare combination of variants was not recognized on our initial procedure. This led to the erroneous embolization of DPA, presuming it to be GDA. Familiarity with such rare variants, a high index of suspicion and experience are all keys to avoid such pitfalls.

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