

The Arterial Supply of Pancreas: Clinical and Anatomical Correlation

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ABSTRACT

Background: The main arterial blood supply to pancreas is provided by splenic, superior (SPDA) and inferior pancreaticoduodenal arteries (IPDA). These arteries are susceptible to anatomical variations which affect the outcome in various embolization and invasive techniques especially involved in management of GI bleed.

Objective: The present study was performed with the objective of streamlining variations of the arterial pattern, classify them and to document the presence of accessory arteries which will aid in success of various surgical and radiological interventions.

Methods: The study was conducted on 23 formalin fixed adult human cadavers during routine dissection meant for educational purposes, conducted over a period of 3 years in the Department of Anatomy, Lady Hardinge Medical College, New Delhi. The origin, course, the branching pattern of splenic as well as superior and inferior pancreaticoduodenal arteries were studied carefully.

Results: The study found 1) normal pattern of SPDA & IPDA in 91.3% & 82.61% of cases 2) trifurcation of GDA into gastroepiploic artery, anterior and posterior SPDA in 4.35% cases 3) origin of right gastroepiploic artery from the anastomotic junction of SPDA & IPDA in 4.35% cases. 4) Multiple IPDA branches & 1st Jejunal branch from a short arterial stump in 13.04% cases. 5) Accessory artery from SMA along with IPDA in 4.35% of cases.

Conclusions: The study has described the rare anatomic variants to enhance the expertise of the operating surgeons, the interventional radiologists to prevent the risk associated with hasty ligation of aberrant or the unusual artery.

Keywords: Superior Pancreaticoduodenal Artery, Inferior Pancreaticoduodenal Artery, Accessory Artery, Pancreatic Arterial Supply

Introduction

The pancreas has both exocrine and endocrine functions; the hormones and the enzymes secreted are indispensable thereby making it a crucial viscera for survival. The organ is endowed with high vascularity which is unique in its way. The pancreas is the only foregut viscera, supplied by both foregut (celiac trunk) and midgut arteries (superior mesenteric artery). The arterial arcade around the head of the pancreas is an important site for celiac-mesenteric anastomosis apart from other collaterals like the arc of Buhler and the arcs of Barkow [1]. The importance of these collaterals also lies in the fact that they enlarge and lead

to aneurysms in case of stenosis or occlusion of the celiac axis [1,2].

The knowledge of variant arterial anatomy in terms of origin, course, and branching pattern is of immense importance for the surgical and radiological interventions required especially during the management of upper GI bleed or during transplant procedures. The arterial route has also been associated with conventional and trans-arterial pancreatic infusion therapies required in patients with pancreatitis and pancreatic cancer [3]. Proficiency in the arterial branches and their variant anatomy is required to avert complications like ischemia, and necrosis of the duodenum and head of pancreas during surgical intervention that will enhance readiness for sudden modifications required in arterial embolization procedures intraoperatively [4-6].

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The present study was undertaken to streamline variations of the arterial arcades present in and around the head and uncinate process of the pancreas.

Materials and Methods

The present study was conducted on 23 cadavers aged between 50-76 years over three years in the Department of Anatomy, Lady Hardinge Medical College, New Delhi. These cadavers were donated to the institution and were later dissected as part of routine undergraduate teaching. The cadavers with a history of abdominal surgery or trauma were excluded from the study. The arterial arcades around the head and uncinate process of the pancreas were carefully dissected and observed.

Results and Observations

Superior Pancreaticoduodenal Artery (SPDA)

In the present study, SPDA was seen as a terminal branch of the gastroduodenal artery (GDA) in (21/23) 91.30% cases as per the standard textbook description [Figure 1]. In (1/23) 4.35% of cases the gastroduodenal artery trifurcated into anterior, posterior superior pancreaticoduodenal branches and rt. gastroepiploic artery. In (1/23) 4.35% of cases the gastroduodenal artery continued as SPDA and the right gastroepiploic artery arose from the anastomotic junction of (anterior divisions) of SPDA & IPDA. In this case, the caliber of anterior branches of pancreaticoduodenal arcades was more to support the right gastroepiploic artery this Rt. GE artery passes through the body of the pancreas to continue on the greater curvature of the stomach. [Figure 2].

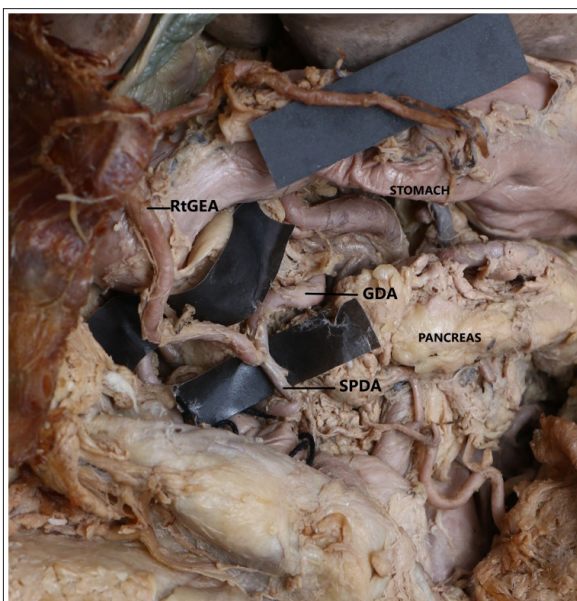


Figure 1: The gastroduodenal artery (GDA) giving off right gastroepiploic artery (Rt GEA) and superior pancreaticoduodenal artery (SPDA).

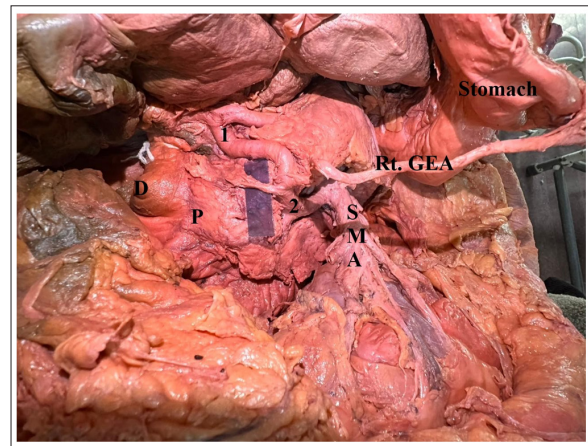


Figure 2: Right Gastroepiploic artery (Rt. GEA) arising from the anastomotic junction of (anterior divisions) of SPDA (1) & IPDA (2). D- Duodenum, P- Pancreas, SMA- Superior mesenteric artery

Inferior pancreaticoduodenal (IPDA)

In the present study, the standard textbook description was seen in (19/23) 82.61% cases i.e. the IPDA arose from the superior mesenteric artery (SMA) and divided immediately into anterior and posterior branches to form arterial arcades with branches of SPDA around the head of the pancreas.

In (3/23) 13.04% cases; a common short arterial stump gave origin to the first branch of the jejunal artery and multiple IPDAs [Figure 3]. These arteries supply the uncinate process and neck and body of the pancreas. Accessory artery was also seen arising from SMA apart from the usual IPDA branch in (1/23) 4.35% cases.

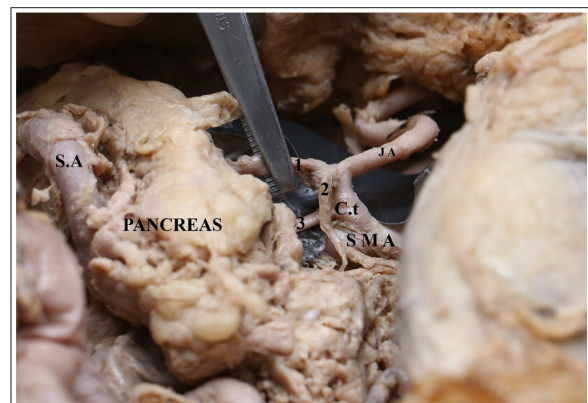


Figure 3: Common trunk (C.t) which gave origin to the first branch of jejunal artery (J.A) as well as multiple IPDAs (1, 2 & 3), S. A- splenic artery, SMA- Superior mesenteric artery

Discussion

The pancreas is richly supplied by dorsal pancreatic arteries, splenic arteries, SPDA and IPDA [7-10]. The head of the pancreas is mainly supplied by arterial arcades formed by branches of SPDA & IPDA while the body and tail are by the splenic artery.

Considerable variations in the vascular distribution (regarding origin, course and distribution) of the head of the pancreas have been confirmed by several authors.

In the present cadaveric study, SPDA arose from GDA and then divided into anterior and posterior branches (91.30% cases). In one case (1/23) 4.35%, the anterior and posterior division of

SPDA arose directly from GDA. Kumar HK et al have reported the origin of anterior SPDA and posterior SPDA from GDA in 100% and 80% of cases respectively [5]. They also observed that the posterior SPDA was absent in one case and in the other two cases, originating from an aberrant right hepatic artery. Bertelli also mentioned the abnormal origin of posterior SPDA from an aberrant right hepatic artery [8].

Motwani et al in their case study found that the anterior branch of SPDA was arising in continuation with the right gastroepiploic artery; they also documented an unusual pancreatic branch arising at the anastomosing site between the right gastroepiploic artery and inferior pancreaticoduodenal artery which is similar to our findings [11].

In the present study, the IPDA was found to have more variant origins than SPDA, which was similar to the findings illustrated by Dmitriev I [12].

The IPDA arose from SMA in 82.61% of cases and from the common trunk with 1st jejunal artery forming a pancreaticoduodenal-jejunal trunk in 13.04% of cases. Kumar H K et al found IPDA in only 73.33% of cases with its origin from SMA in 63.63% and from the pancreatoduodenal-jejunal trunk in 36.36% of cases (5). A common trunk of IPDA with the first jejunal artery has been mentioned in 20-65% of cases by Bertelli [8].

Kotapalli et al observed an additional IPDA which originated from 2nd jejunal branch of SMA [8]. In the present study, the accessory IPDA originated from SMA.

Sanampudi documented an unusual anatomic variant of IPDA during a procedure for upper gastrointestinal bleeding. The authors observed an aberrant IPDA branching pattern, where the posterior IPDA originated from the replaced right hepatic artery and the anterior IPDA originated from the middle colic artery [13].

Various authors have confirmed the variability of pancreaticoduodenal arcades.

A double anterior pancreaticoduodenal arcade was observed by Elzbieta Krakowiak-Sarnowska in their study of pancreaticoduodenal arteries in human fetal development [14].

Some rare arterial collaterals providing collateral blood flow in cases of Coeliac Trunk or SMA occlusion, the Arc of Buhler between Coeliac Trunk and SMA were observed by Kumar H K [5]. The aneurysms may occur in these Arc of Buhler collaterals and rupture of the aneurysms can lead to symptomatic representation of hemorrhagic shock [5].

Previous authors have emphasized on identification of the common pancreaticoduodenal jejunal trunk to avoid ligation of the jejunal artery in surgical procedures on the pancreatic head and various angiographic investigations [5].

Detailed knowledge of the normal and anatomic variants of the pancreatic arterial supply is thus important for the surgical and radiological interventions required especially during management of upper GI bleed. The knowledge of the

rare anatomic variants can help interventional radiologists to plan further treatment for aneurysms and prevent the risk of hemorrhage during surgical procedures.

Declarations

This is an original work conducted in the Department of Anatomy. There are no conflicts of interest among the authors. The study has been undertaken with the intention that it would enhance and add to the existing knowledge.

Ethical Approval

The present study has been conducted on cadavers donated to the Department of Anatomy for teaching and research. The consent form for body donation at the time of pledging for body donation clarifies that the body donated will be for teaching medical students and research purposes.

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Availability of Data and Materials

The data and material have been accessed within the department only.

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Ethics Statement/Ethical Approval: The protocol was approved by the institution Ethics Committee of Lady Hardinge Medical College. The present study is cadaveric study on donated bodies; consent has been already obtained for utilizing the bodies for teaching and research purposes.

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