

# Cadaveric arterial vasculature of the human pancreas

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According to Gallen in 170 A.D., the aorta is the point at which all the arteries branch off. The ventral and dorsal pancreaticoduodenal arteries supply the pancreas head [Figure 1]. The cranial and caudal branches of the gastroduodenal and superior mesenteric arteries (SMA) form arches. The ventral and dorsal superior pancreaticoduodenal arteries (SPDA) from the superior pancreatic artery (anterior superior pancreaticoduodenal [ASPD] and PIPD). The lower roots are characterized by the AIPD and PIPD arteries, which run ahead and behind the pancreaticoduodenal artery.

Winslow described a “double” division of the gastroduodenal artery (GDA) in 1732 and a smaller branch near the SMA separating into two in 1732.<sup>[1]</sup> The duodenal and pancreatic

The head of the pancreas is vascularized by the anterior and posterior pancreaticoduodenal arterial vessels. The splenic artery vascularizes the body and tail. The posterior inferior pancreaticoduodenal artery (IPDA) is found in 95.6% of cases. The Rohilkhand Medical College and Hospital in Bareilly use adult human cadaver specimens for dissection to study the vascular supply to the pancreas. More than a dozen male and female specimens make up the 30 total specimens. The cadavers were between the ages of 35 and 50. The dorsal pancreatic artery (DPA) supplies the posterior surface of the pancreas. In the pancreas, many trivial branches usually arise from the splenic artery as it passes along the cranial margin and supplies the pancreas’ body and tail. This study has shown that these branches were formed by splenic vessels as they travelled along the upper edge of the pancreatic upper edge. It is thought that the dorsal pancreas’ back surface is fed by a splenic artery or the celiac trunk, which originates in the spleen. According to this study, the splenic carriageway does not supply the dorsal DPA. The IPDA.

**KEY WORDS:** Pancreaticoduodenal artery, pancreas, duodenum, splenic vessels

arteries are supplied by two arterial arcades located posterior to the pancreatic head. Even though Testut<sup>[2]</sup> discovered two arches along the posterior-inferior border of the pancreas body and tail, he is best known for naming an inferior pancreatic artery. The SMA, which Testut described as a source of variation, appears to have been divided. In 1899, Wiart described the pancreaticoduodenal arches in detail.<sup>[3]</sup>

When all sources are considered, the dorsal pancreatic artery (DPA) occurs in 79% of cases, according to Falconer *et al.* in their paper “The Architecture of the Blood Vessels in the Region of the Pancreas.” In 11 out of the 27 cases, they discovered pre-pancreatic arcades. According to Michels’ “Blood Supply of Pancreas and Duodenum,” the splenic artery, right hepatic artery, and SMA are all sources of the DPA. Other potential sources include the coeliac artery (celiac trunk [C.T.]) (61%) and the SMA (14%) (22%).

In 1975, Feigl *et al.*<sup>[4]</sup> discovered a new branch or division on the C.T. Here they are in that order:

1. The ascending mesentery artery from the stomach (SMA)
2. An additional artery to the hepatic artery
3. The pancreatic artery is situated in the back of the abdomen.
4. A colic artery

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5. An extra artery to the spleen
6. Superior Membranous Artery Branch
7. The inferior phrenic artery

In their arteriogram of pancreatic and celiac vessels, Gookim and Jung *et al.* explained that 80% of them are pancreatic arteries, the other 80% are pancreatic Magna arteries, the other 84% are caudal pancreas arteries, and the remaining 8% are superior and inferior polar arteries, respectively. According to Bergman *et al.*, the DPA developed from the splenic artery in 37% of patients, the CT in 33%, the SMA in 21%, and the common hepatic artery (CHA) in 8% of cases.<sup>[6]</sup> When the DPA and the middle colic artery (MCA) were anastomosed, the CHA supplied blood to the DPA, connected to the middle colic.

In 1977, Park *et al.* published the following description of pancreatic arteries based on the extensive dissection of 45 Korean cadavers.<sup>[7]</sup>

1. In 95.6% of their cases, the ASPD artery (ASPSA) was present. The GDA is the most probable source, accounting for 80% of all cases, while the common trunk accounts for 11%.
2. In 91.1% of patients, the Posterior SPDA (PSPDA) is present. The GDA's central portion accounts for 75.6% of all cases.
3. The PIPA is found in 95.6% of cases. The SMA derives from the same trunk as the AIDA.
4. In 80.7% of people, the anterior inferior pancreatoduodenal artery (IPDA) is present 2.2 the SMA's 1<sup>st</sup> jejunal artery causes per cent of cases.
5. In 82.2% of samples, the ventral and dorsal pancreaticoduodenal arcades are present.
6. The DPA is discovered in 95.6% of cases. In 80% of cases, the splenic artery is the underlying cause.
7. The pancreatic Magna artery is discovered in 95% of cases. It happens 57–58% of the time and 2.2% of the time.
8. The caudal pancreatic artery is found in 86.7% of cases, and the splenic artery is found in 82.2% of cases.
9. In 7.1% of cases, pre-pancreatic arterial arcades are discovered.
10. In 97% of their patients, they discovered the IPDA.

In a comprehensive IV review of the arterial supply of the pancreas in 1015 selective angiography, they observed that the AIPDA arose from the PDA in the majority of cases (C.T. and its branches and SMA). The GDA, DPA, CHA, and right phrenic artery are the four principal arteries that supply the head of the pancreas. According to Bertell *et al.*, all four major arteries of the hepatic system, the CHA, SMA, and an auxiliary right hepatic artery, originating from the SMA.<sup>[8,9]</sup> The DPA gives out four arteries: the hepatic, splenic, left gastric, and a fourth DPA.<sup>[10]</sup>

In this case, the SMA was connected to a branch of the DPA. The SPDA and the DPA join to form the ventral and dorsal pancreaticoduodenal arcades. As a result, because the IPDA, a branch of the SMA,<sup>[11]</sup> was missing, the DPA supplied most of the pancreas. According to this study, the C.T. comprises four components: the hepatic artery, the left gastric artery, and the

splenic artery. Deepthinath *et al.* found no IPDA in a 60 years old male cadaver.<sup>[12]</sup> The proximal section of the splenic artery is to blame when the massive DPA fails to compensate for the lack of an IPDA.

### Arterial Supply of the Pancreas

The celiac axis and SMA provide abundant vascular supply to the pancreas via named and unnamed arteries.

#### IPDA

The IPDA is formed by the SMA or its jejunal branch in the upper third of the duodenum. Ventral and dorsal divisions are standard. The anterior branch of the pancreatic artery travels to the right of the pancreas head to anastomose with the AIDA. The posterior branch and the PSPDA, which runs from the lower pancreas head to the upper pancreas head, form an anastomosis. Both units supply the pancreatic head, its uncinated process.

#### The SPDA

In most cases, the SPDA is doubled. This artery is a branch of the GDA that transports blood to and from the pancreas and the duodenum. It connects with the ventral division of the IPDA and sends branches to the pancreatic head. At the top of the first half of the duodenum, the GDA gives rise to the posterior artery. It passes behind the first section of the duodenum and the common bile duct on the right. After crossing the common bile duct in the pancreas, the artery continues posteriorly to the pancreas head. An anastomosis is observed between the dorsal division of the IPDA and the duodenum wall, which penetrates the wall. The SPDA is divided to supply the head of the pancreas and the 1<sup>st</sup> and 2<sup>nd</sup> parts of the duodenum.<sup>[13]</sup>

### Pancreatic Branches

From their origins, they supply the gland directly. They are most abundant in the neck, body, and tail—the splenic artery, which runs along the upper margin of the gland. A dorsal branch splits into right and left branches as it descends behind the pancreas. It can be delivered via the SMA, the MCA, the hepatic artery and the celiac artery. A minor, unidentified branch arises from the SMA and the retroperitoneal vessels. Small arteries typically line the inferior and superior margins of the gland, either in a deep groove or embedded within the gland's tissue. When the gland's parenchyma is damaged during excision, ligation is required, resulting in extensive bleeding.

The present study is because surgeons are currently concerned about the usefulness of surgical attacks on the pancreas. The success of such operative treatments may depend partly on an understanding of specific vessels that reach the gland.<sup>[13]</sup>

## MATERIALS AND METHODS

Adult human cadaver specimens are dissected at the Rohilkhand Medical College and Hospital in Bareilly to study the vascular supply to the pancreas. All 30 samples have been collected,

25 male and five female. Corpses ranged in age from 35 to 50. To expose the vasculature of the pancreas, the anterior abdominal wall is opened by making the following incisions by using instruments as shown in [Figure 2].

**Incisions**

1. An incision is made from the xiphoid process around the umbilicus to reach the pubis.
2. A transverse incision from the umbilicus to the right and left sides of the abdomen, as far as the body will allow.

**Steps**

1. Upper abdominal wall flaps should be reflected upwards and laterally, while lower abdominal wall flaps should be reflected downwards and laterally.
2. The viscera of the abdomen, except the kidneys and

suprarenal glands, is surgically dissected. The pancreas and the arteries that supply it are exposed when the parietal peritoneum of the posterior abdominal wall is removed.

All arteries that supply the pancreas’s head, body and tail have been thoroughly studied.

**Observations**

The superior and IPDA supply the pancreas’ head and neck. The splenic artery’s pancreatic branches provide the entire body and tail. The pancreatic ducts are linked together by a large artery known as pancreatic Magna. The dorsal pancreatic branch is sometimes generated from the splenic artery or the C.T.

The following findings are made in this study:

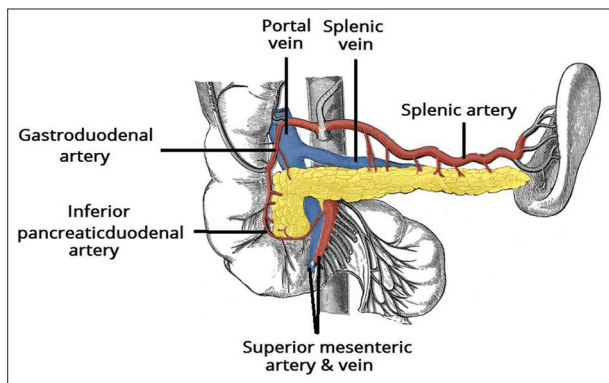
**SPA**

In most cases, this artery arises from the GDA and divides into ventral and dorsal branches connecting to the IPDA’s anterior and posterior branches. The hepatic artery sometimes supplies the PSPDA.

The ventral and dorsal branches of the IPDA were anastomosed with matching branches from the IPDA, revealing a common trunk in all 28 specimens. The posterior branch of specimen No. 11 originated from the GDA and was discovered in the trench between the pancreas head and the duodenum. The GDA gives rise to an anterior branch of the SPDA, which runs between the pancreas head and the duodenum on the anterior side. The posterior branch of specimen No. 26’s pancreaticoduodenal artery emerged and passed through the groove between the pancreas head and the duodenum.

**IPDA**

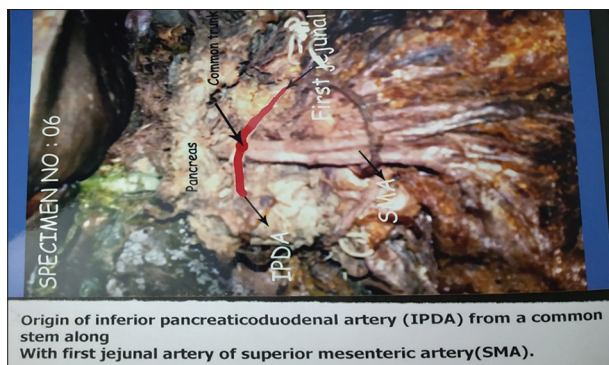
The is the first branch of the SMA and sometimes may arise from the 1<sup>st</sup> jejunal branch. The artery divides into ventral and dorsal branches as it passes along the upper margin of the third part of the duodenum, where it anastomoses with its corresponding SPDA branches and then ascends into the pancreatic-duodenal groove to form the ventral and dorsal arches. In 27 specimens, the SPDA artery and the SMA were anastomosed to form ventral and dorsal arterial arcades in the fissure between the pancreas head and the duodenum. This artery, like the 1<sup>st</sup> jejunal branch, arose from the SMA’s left side near the lower margin of the duodenum’s horizontal region. The ventral and dorsal branches of the SPDA were anastomosed. In specimen No 6, this artery arose as a common trunk along with first jejunal branch from the left side of the superior mesenteric artery near the lower margin of the horizontal part of the duodenum. Later it divided into anterior and posterior branches and anastomosed with the corresponding branches of the superior pancreaticoduodenal artery [Figure 3]. The IPDA of No. 26 had a direct anastomosis with the SPDA, which arose from the SMA at its upper margin in the third part of the duodenum. The IPDA 2<sup>nd</sup> jejunal branch emerges from the ascending pancreas’s 2<sup>nd</sup> jejunal branch. The IPDA is absent in specimen No. 14.



**Figure 1:** Showing arterial supply of pancreas



**Figure 2:** Showing instruments which are used in study



**Figure 3:** Showing origin of IPDA





**Figure 4:** (a and b) Showing origin of dorsal pancreatic artery from the bifurcation of coeliac trunk. CT: Coeliac trunk, SP: Splenic artery, CHA: Common hepatic artery, DPA: Dorsal pancreatic artery

### Splenic Pancreatic Branches

Tiny artery branches that normally flow directly into the pancreas from their origin. It is most common in the neck body and tail of the pancreas. The main pancreatic duct and its larger counterpart is supplied by the arteria pancreatica Magna, which runs alongside it. According to the current study's findings, the splenic artery, which runs along the pancreas' upper border and supplies the organ's neck, body, and tail, becomes a source of pancreatic branches. The number of branches ranged from three to five.

### Abnormal Pancreatic Branches

The posterior surface of the pancreas is provided by the DPA, which can arise from the splenic artery or the C.T. The transverse pancreatic artery (TPA), a left branch of the DPA, supplies blood to the body and tail of the pancreas. The DPA was observed when the C.T. split into hepatic and splenic arteries in specimens 3 and 18. This artery entered the pancreas from the back [Figures 4 and 5].

In specimen 11, an outgrowth of the GDA was observed in the pancreatic head. This artery passes near the pancreas's lower margin before terminating in the organ's tissue (the TPA). A branch of the GDA reached the pancreas's interior and terminated thereafter following the pancreas's lower border. In specimen 14, a division of SMA splits off from the uncinated process at 2.5 cm to the left. A single branch followed the pancreas's bottom edge. After passing beneath the peritoneum, an anastomosis was formed between the second branch and the left branch of MCA. The left colic



**Figure 5:** (a and b) Showing origin of SPDA from GDA

branch of the inferior mesenteric artery is missing in this specimen. The third branch split into right and left branches as it descended. The right and left colic arteries are anastomosed with the common trunk. The inferior pancreatic artery is also missing from this specimen [Figures 6].

## DISCUSSION

According to conventional textbooks, the gland is fed by the SPDA, IPDA, and pancreatic branches of the splenic artery, as well as a few other smaller vessels. Anatomically and radiologically, differences in artery supply have been extensively studied. The SPDA and IPDA supply blood to the pancreas' head and neck via ventral and dorsal anastomoses. The body and tail are supplied by the splenic artery. The pancreatic duct and the arteria pancreatica Magna are the two largest branches. The splenic artery or C.T. can give rise to a dorsal pancreatic branch that can supply the pancreas's posterior side.

### The SPDA

The SPDA, according to Snell and Sahana. Last, McGregor *et al.*, arises from the GDA and splits into ventral and dorsal branches that anastomose with the IPDA. SPDA was originated, split into ventral and dorsal branches, and anastomosed with corresponding branches of the IPDA in all 28 specimens studied in this study. Researchers have discovered a different conclusion than what was previously reported. Both the ventral and dorsal branches of the SPDA (numbers 11 and 26) diverged from the GDA before joining the anterior and posterior branches of the IPDA. This, according to Gray *et al.*, is an inconsistency.



**Figure 6:** Showing absent of inferior pancreaticoduodenal artery. 1. Common trunk from SMA, 2. Transverse branch to body of pancreas, 3. Left colic artery, 4. Middle colic artery

### The IPDA

According to Snell, a branch of the IPDA connects to the pancreaticoduodenal artery via an anastomosis with the similar anterior and posterior branches of the IPDA that originate from the SMA. The SMA was divided into two anterior and two posterior branches, which were then anastomosed with the pancreaticoduodenal artery's corresponding arteries to form one continuous vessel. This discovery corresponded to the above-mentioned authors' descriptions. In specimen no. 06, the IPDA developed as a shared trunk with the first jejunal branch from the left side of the SMA<sup>[14,15]</sup> toward the bottom margin of the horizontal region of the duodenum. As a result of this anastomosis, the SPDA was split into anterior and posterior branches.<sup>[16]</sup>

This discovery has been described by Shed and Shapiro, Orazioli and Bushanini, Bushanini *et al.*<sup>[17,18]</sup> The IPDA is missing in the No. 14 specimen. Similar findings were made by Wittae *et al.*<sup>[16]</sup> In specimen NO 26, the SPDA artery and the IPDA were anastomosed. The second jejunal branch produced a second IPDA branch, which travelled to the pancreas.<sup>[19]</sup>

### Pancreatic Branches from the Splenic Artery

According to Gray *e al.*, research, the splenic artery has numerous small branches that supply the pancreas' body and tail. This study discovered that pancreatic branches were formed from splenic vessels as they travelled along the superior margin of the pancreas, supplying its neck, body, and tail. This is in direct opposition to what the authors of the aforementioned works have stated. Keith Moore stated that one to ten branches were possible, Skandalkies stated that two to ten branches were possible, and Jonas stated that three to five branches were possible. The number of splenic artery branches found in this study ranged from 3 to 5, which is within the authors' range.<sup>[20]</sup>

### Branches that Provide Abnormal Nutrients to the Pancreas

#### DPA

According to Grey *et al.*, this artery originates from the splenic artery, or C.T., and supplies blood and nutrients to the pancreas.

The TPA, which is part of the dorsal artery, supplies the pancreatic body and tail. The DPA is formed when the C.T. splits into two arteries in specimens No: 3 and No: 18. This artery entered the pancreas from the back. These findings corroborate what the authors have stated. According to this study, the splenic artery doesn't give rise to the DPA.

According to Woodburne *et al.*, the TPA is the left branch of the DPA that continues close to the lower pancreas boundary and supplies blood to the body and tail. Pancreatic transverse branches (specimens 11 and 26) emerged from the GDA and followed the pancreatic lower border until they reached the pancreatic substance. The path and supply to the pancreas differ from the authors' descriptions above.

### CONCLUSION

There are 30 specimens in this investigation. The group is made up of 25 men and five women. There were cadavers ranging in age from 35 to 50. In the pancreas of twenty-four patients, there were arteries feeding the pancreas, including pancreatic branches of the spleen. In specimen number 3, the DPA emerged when the C.T. split into the hepatic and splenic arteries. The IPDA and the 1<sup>st</sup> jejunal branch from the left side of the SMA originated from a single trunk in specimen no. 6. In specimen no. 11, the GDA formed the posterior branch of the SPDA. In Specimen 14, the inferior pancreatic artery is missing. In specimen number 18, the was divided into hepatic and splenic vessels, resulting in the formation of this artery. This artery entered the pancreas from the back. In specimen number 26, a branch of the SPDA emerged near its origin.

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