A Clinical and Experimental Study on the Management of Portal Vein during Pancreaticoduodenectomy

II. Study of Collateral Circulation after Occlusion of the Main Branch of Portal Vein

By

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As being reported in chapter I, most of the site of transplantation became thrombosed. The animals, however, survived by the formation of collaterals. This finding is coincident with Mizuno's report saying that in dogs, survival of the animal was possible by secondary ligation of the portal vein. According to Child, in a case of carcinomatous infiltration by carcinoma of the head of the pancreas, he was able to perform primary ligation of portal vein with survival. These reports together with the results of the author suggest that extensive operation on pancreaticoduodenectomy is promising in the future. In cases of obstruction of portal circulation, the study of collaterals toward the liver and other organs is an important problem whenever operation on the portal vein is contemplated. 13 cases of transplantation of the portal vein reported in part 1 and 2 cases of total obstruction of portal vein among 4 cases which were autopsied after pancreaticoduodenectomy were studied on the direction of the collaterals.

Collaterals of the Portal System in Dogs Described in Report I

Method: Laparotomy was performed by a midline incision. Gastrolial vein (in dog, it is the vein on the greater curvature of the stomach including most part of the splenic vein and coronary veins) and superior pancreaticoduodenal vein were both cut between ligatures. The portal vein between the point of superior mesenteric vein where the inferior mesenteric vein enters (generally speaking, in dogs, the inferior mesenteric vein enters the superior mesenteric vein, and not into the gastrolial vein as in human) and pyloric vein was completely freed. The ob-

struction occurred in the middle of the main branch of portal vein. Therefore, pyloric vein and the collaterals around the hepatic portal only remains. Venography by x-ray, postoperative gross findings and injection of pigment into the veins were used to study the collaterals.

Results: Collaterals and its incidence are described in Table I.

TABLE I

Collaterals (Obstruction of portal vein)

A. Collaterals towards the liver

(1) V. mesenterica superior—V. pancreaticoduodenalis inferior—V. pancreaticoduodenalis superior—V. portae (hepatic side of graft) (13/13)

(2) V. mesenterica superior—V. pancreaticoduodenalis superior and small veins around graft—venous plexus around bile duct and V. portae—V. portae (hepatic side of graft) or Ve. portae accessoriae. (13/13)

(3) V. gastrolienalis (the greater part) and V. coronaria ventriculi (a part)—V. pancreatica major—V. pylorica—V. portae (hepatic side of graft). (8/13)

(4) V. coronaria ventriculi (a part)—small veins in minor omentum—V. portae (hepatic side of graft). (7/13)

(5) (In adhesions between major omentum and mesenterium) veins of intestine and mesenterium—veins in major omentum (a part)—V. gastrolienalis—(3)—V. portae. (2/13)

B. Collaterals detouring the liver

(6) V. gastrolienalis (a part)—V. coronaria ventriculi or V. gastrica sinistra—Ve. esophageae. (13/13)

(7) Veins around minor omental sac and pancreatic tail—V. suprarenalis media or V. renalis propria sinistra—V. renalis sinistra. (7/13)

(8) V. mesenterica superior and V. mesenterica inferior—net of veins in mesocolon—V. spermatica sinistra and V. renalis propria sinistra—V. renalis sinistra. (11/13)

(9) V. gastrolienalis (a part)—veins in Lig. lienocolica—net of small veins in mesocolon—V. mesenterica inferior—(8). (4/13)

(10) V. haemorrhoidalis superior—V. haemorrhoidalis media—(V. hyogastrica)—V. cava inferior. (13/13)

(11) Net of small veins in mesocolon—small veins in retroperitoneum—V. cava inferior. (1/13)

(12) Small veins in mesocolon—small veins in retroperitoneum—V. spermatica dextra—V. renalis. (2/13)

(13) Small veins in mesenterium—small veins in retroperitoneum—V. renalis dextra. (1/13)

(14) Net of small veins in mesocolon of sigmoideum—small veins in retroperitoneum (or plexus venosus sacrales anteriores)—V. lumbalis ascendens (or V. iliaca communis). (4/13)

(15) (In adhesions between great omentum and abdominal wall) small veins of major omentum—veins of abdominal wall. (3/13)

(1), (2), and (10) were seen in all cases, and (7) & (8), described by Isobe¹¹ were frequently observed. (3) & (4) were both seen in many cases. Not a single case showed esophageal varix. Postoperatively, No. 1 & No. 4 (26) showed intestinal bleeding. After several days, however, bleeding was not found in any case. Fig. 1 (A, B, C, D & E) shows the collaterals obtained by injection of 70% Diodrast into the gastrocoronary vein, gastro-splenic vein, superior mesenteric vein, inferior mesenteric vein, & inferior

Fig. 1

Fig. 1. A. shows the collaterals obtained by injection of 70% Diodrast into the gastrocoronary vein.

- B. into gastro-splenic vein.
- C. into superior mesenteric vein.
- D. into inferior mesenteric vein.
- E. into inferior haemorrhoidal vein.

haemorrhoidal vein, respectively.

Collaterals in Occlusion of Portal Vein in Human Beings

The collaterals in occlusion of portal vein were studied by macroscopic findings and injection of pigment. Those which showed obstruction of portal vein are described as follows:

Case 1. Harada. 48 years old. Woman. Operative diagnosis: carcinoma of the head of the pancreas.

The patient died by carcinomatous peritonitis occurring after pancreaticoduodenectomy. Anastomosis of splenic vein and superior mesenteric vein was completely obstructed by the recurrence of carcinomatous infiltration. The patient lived half a year after the operation.

Case 2. Endo. 52 years old. Man. Operative diagnosis: carcinoma of the bile duct.

The patient died by multiple abscess in the whole liver and suppurative cholangitis after the operation. Stenosis occurred at the sutured wall of the portal vein at the point where the splenic vein entered. Thrombus was found and obstructed the lumen of the portal vein. The patient lived 4 months after the operation.

Both cases showed ascites without intestinal congestion.

A) Collaterals toward the liver

a) A fairly large branch from gastrocoronary vein entered the portal vein at the hepatic porta through the lesser omental sac.

b) 2-3 branches entered the posterior wall of the portal vein through the retroperitoneum.

B) Collaterals detouring the liver

c) Slight dilatation of the coronary vein in the remaining portion of the stomach was noticed. They entered the esophageal vein and no varix was noticed in the esophagus.

d) Many new collaterals from the branch of superior mesenteric vein entered the inferior mesenteric vein through the mesocolon. New blood vessels which entered the left proper renal vein by the surrounding tissue of the left kidney or by the left spermatic vein were also seen in the mesocolon of the descending colon.

e) Superior haemorrhoidal vein entered the hypogastric vein by the middle haemorrhoidal vein.

f) Branches of superior mesenteric vein and veins in the retroperitoneum were connected with each other, and entered directly into the inferior vena cava.

g) Collaterals from the superior mesenteric vein entered the right colon of the right hepatic flexure.

h) Several veins which were slightly dilated were connected with the colon and great omentum which were firmly adhered with the peritoneum.

i) No congestion was seen in the intestine. The intestine was rather atrophic.

SUMMARY

The collateral circulation is established within 1–2 weeks in experimental animals after obstruction of the portal vein. These animals had no operation except on splenic vein and superior pancreaticoduodenal vein. In patients subjected to pancreaticoduodenectomy for carcinoma of the pancreas or bile duct, the collateral formation was relatively limited by resection of the tumor with half of the stomach, most part of the duodenum, half of the pancreas and common bile duct. As already being shown by Edwards,²⁾ accessory portal veins in human beings are important in establishment for collaterals toward the liver. It seems important to preserve the vessels around the hepatic portae as far as no carcinomatous infiltration exists. Though (12), (13) & (14) in table I are not described in the literature, they do not seem to play an important role as portal collaterals. Veins described by Retzius¹⁾ is important when superior mesenteric vein is obstructed. (9) seems to have been built by the pressure difference of the bed of gastrosplenic vein and mesenteric veins during the operation. The collateral vessels (superior haemorrhoidal vein middle haemorrhoidal vein—venules in the pelvis-spermatic vein) described by Retzius were not discovered by the author.

The collaterals (a) Portal vein -paraumbilical vein in the abdominal wall, i.e. Caput Medusae; (b) Sappey's vein³⁾ -diaphragmatic veins did not appear. The reason that varix in the esophagus was not noticed is probably due to the small amount of blood flow in the esophageal vein, because the veins leading to it are cut at the operation when the portal vein is transplanted.

CONCLUSION

1. Collaterals in occlusion of portal vein was studied on the survival dogs described in chapter I and clinical cases autopsied after pancreaticoduodenectomy.

2. 2–3 new collaterals were described in experimental animals. Of them (12), (13) & (11) seems to play an important role in case of obstruction of superior mesenteric veins in human beings. In autopsied cases, these collaterals were found.

3. Collaterals are established 1–2 weeks after occlusion of portal vein in healthy animals.

4. No esophageal varix was found in both experimental dogs and clinical cases which underwent pancreaticoduodenectomy. Ascites were not remarkable in animals.

References

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 - 3) MacCallum, A textbook of pathology, 1st Ed., W. B. Saunders Co., Phil. & Lond., 1917, p. 315.
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