The THAI Journal of SURGERY 2008; 29:49-53.
Official Publication of the Royal College of Surgeons of Thailand

Preoperative Portal Vein Embolization before Major Hepatic Resection in Bile Duct Tumor: A Preliminary Report

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Abstract

Introduction: **Major hepatic resections in patients with chronic parenchymal or cholestatic liver diseases are associated with significant morbidity and mortality. Preoperative portal vein embolization to induce hypertrophy of future liver remnant may result in the increase of operative safety.**

Materials and Methods: **The medical records of 8 patients who underwent major hepatectomies after portal vein embolization from 2003 to 2004 were retrieved. Demographic data, technique of portal vein embolization, estimated standard liver volume, post portal vein embolization future liver remnant volume, morbidity and mortality were collected and analysed.**

Results: **Four men and 4 women (average age 56.6 years) with liver diseases including 6 intraductal papillary mucinous tumours of bile duct, 4 benign lesions, 2 malignant lesions and 2 hilar cholangiocarcinoma were included in this study. Left percutaneous transhepatic biliary drainage was performed before right portal vein embolization in 3 cases. Migration of embolized substance to contralateral lobe occurred in 1 case. The average ratio of future liver remnant volume and estimated standard liver volume was 52.75%. Major hepatic resection was performed in all. There was subphrenic collection in 1 case which was successfully treated by percutaneous drainage. No postoperative liver failure or mortality was encountered.**

Conclusions: **Preoperative portal vein embolization before major hepatic resection is safe. Atrophy of the affected lobe makes it easier in mobilization and control of bleeding.**

Introductions

Nowadays, the mortality rate after major hepatic resection in normal liver is lower than 5% because of the improvement in preoperative, intraoperative and postoperative cares.[1] But major hepatic resections in patients with chronic parenchymal or cholestatic hepatic disease may result in inadequate remaining parenchyma and may be associated with significant postoperative liver failure.[2-4]

To overcome this problem, Makuuchi et al. introduced the preoperative portal vein embolization to clinical application in hilar cholangiocarcinoma in 1982 to induce atrophy of the embolized lobe and compensatory hypertrophy of the unembolized lobe

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preoperatively. This may result in the increase of operative safety.[5]

Materials and Methods

The medical records of 8 patients with bile duct tumours who underwent major hepatectomies after portal vein embolization from 2003 to 2004 were retrieved. Demographic data, technique of portal vein embolization, estimated standard liver volume, future liver remnant volume, morbidity and mortality were collected and analyzed.

Results

There were 4 men and 4 women. The average age was 56.6 (46-64) years. Jaundice was found in 6 patients. Average total bilirubin was 8.3 (0.8-31) mg/dl (Table1). Intrahepatic dilatation was demonstrated by computed tomogram in all cases. Left percutaneous transhepatic biliary drainage was performed before right portal vein embolization in 3 cases. Right portal embolization was performed via transileocolic vein under general anesthesia in all. A small incision over the right lower quadrant of the abdomen was made and a catheter was inserted into portal vein via ileocolic vein. After portogram, the right portal vein was selected and embolized (Figure 1). The embolic materials were gelform and coils in 3 and cyanoacylate in 5 cases. Migration of coil to the contralateral lobe occurred in 1 case.

The estimated standard liver volume was calculated. The formula was described by Urata et al[6] (total liver volume = 706.2 × BSA + 2.4). The average estimated standard liver volume was 1158.4 (1,031-1,264) ml. The future liver remnant volume of left liver after right portal vein embolization was calculated from serial transverse computed tomographic scan. The average future liver remnant volume of left liver after right portal vein embolization was 611 (408-793) ml. The ratio of future liver remnant volume to estimated standard liver volume was 52.75% (40.2-63.2%) (Table 2). The average time from right portal vein embolization to hepatectomy was 61 (28-135)

Table 1 Demographics and clinical characteristics of 8 patients with preoperative portal vein embolization

Patient	Age	Sex	Bilirubin (mg/dl)	PTBD	Embolic material	Complication
1	57	F	4.0	-	Coil, Gelfoam	-
2	61	F	0.5	-	Coil, Gelfoam	-
3	57	M	14	+	Cyanoacrylate	-
4	62	F	0.8	-	Cyanoacrylate	-
5	52	F	2.9	-	Cyanoacrylate	-
6	46	M	6.3	+	Coil, Gelfoam	Coil migration
7	54	M	31	+	Cyanoacrylate	-
8	64	M	7.7	-	Cyanoacrylate	-

Figure 1 A Portogram via transileocolic vein before embolization.
B Anterior and posterior branches of right portal vein were embolized with glue.
C Portogram after embolization showed complete occlusion of right portal vein.

Table 2 Time interval to hepatectomy, liver volume, operative procedures, pathology and complication

Patient	Interval from PVE to hepatectomy (days)	Estimated standard liver volume (ml)	Future liver volume (ml)	FLV/ESLV (%)	Operative procedure	Pathology	Complication
1	59	1,148.5	587	51.10	ER + C + BR	IPMT(M)	-
2	60	1,041	408	40.20	R + BR	IPMT(B)	-
3	37	1,142.7	693.2	60.70	ER + BR	Hilar CHCA	Subphrenic collection
4	51	1,031	529	51.30	ER + BR	IPMT(B)	-
5	28	1,169.2	496	42.50	R + T	IPMT(B)	-
6	135	1,230	777.1	63.20	ER + BR	IPMT(M)	-
7	39	1,264	793	63.10	ER + C + BR	Hilar CHCA	
8	80	1,241	607	50.10	R + BR	IPMT(B)	-

EX, extended right hepatectomy; C, caudate lobectomy; BR, extrahepatic bile duct resection; T, t-tube choledochostomy; IPMT, intraductal papillary mucinous tumor of bile duct; M, malignant; B, benign

Figure 2 A CT scan before portal vein embolization
B CT scan after right portal vein embolization showing atrophy of right liver and compensatory hypertrophy of left liver.

days. Intraoperatively, there was obvious atrophy of right liver and compensatory hypertrophy of left liver in all cases (Figure 2, 3). Operative procedures included extended right hepatectomy, caudate lobectomy, extrahepatic bile duct resection and enterobiliary anastomosis in 2 cases, extended right hepatectomy, extrahepatic bile duct resection and enterobiliary anastomosis in 3 cases, right hepatectomy, extrahepatic bile duct resection and enterobiliary anastomosis in 2 cases and right hepatectomy and t-tube choledochostomy in 1 case. Postoperatively, subphrenic collection in 1 case was successfully treated by percutaneous drainage. No postoperative liver failure or mortality was encountered.

Pathological findings included hilar cholangio-

Figure 3 Intraoperative findings showing atrophy of right liver and compensatory hypertrophy of left liver

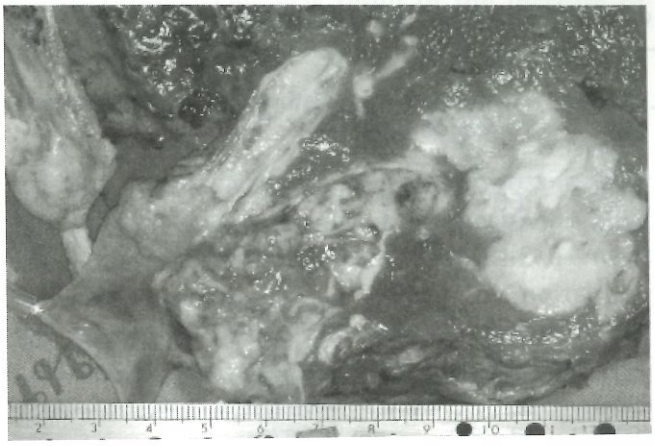

Figure 4 Surgical specimen shows intraductal papillary mucinous tumor over the hilar and the adjacent mass of invasive papillary cholangiocarcinoma

carcinoma in 2 patients and intraductal papillary mucinous tumour of the bile duct in 6 patients, of which 4 of them were benign adenoma and another 2 were associated with mass forming invasive papillary cholangiocarcinoma (Figure 4).

Discussion

Hepatectomy is the standard treatment for resectable primary and secondary liver tumor. Major hepatectomy in normal liver parenchyma rarely causes postoperative liver failure.[7] However, in diseased liver postoperative liver failure may be a significant problem. Portal vein embolization before major hepatectomy resulting in atrophy of embolized lobe and compensatory hypertrophy of unembolized lobe was first introduced by Makuuchi in 1982. At present, many centers prefer to perform preoperative portal vein embolization before major hepatectomy.

In this study, portal vein embolization was performed via ileocolic vein under general anesthesia. All of the patients could tolerate the procedure well. There was no serious complication except for migration of coil to left portal vein in one case. This migrated coil could be pushed into portal vein of segment 4. The ratio of future liver remnant volume to estimated standard liver volume in this case was 63.2%. Surgery which included extended right hepatectomy, extrahepatic bile duct resection and enterobiliary anastomosis was performed later without any complication.

Preoperative portal vein embolization are currently applied in the followings: 1) a ratio of future liver remnant to estimated standard liver volume being less than 25% and 40% in normal and diseased liver respectively, 2) two-stage hepatectomy in bilobar liver metastasis, 3) hepatectomy and pancreaticoduodenectomy.[7-12] The average ratio of future liver remnant to estimated standard liver volume after right portal vein embolization in our study was 52.75% (40.2%-63.2%). We could perform major hepatectomy in all cases. The operative procedures went on smoothly; right lobe atrophy made mobilization and control of bleeding very much easier for resection. There was no liver failure or mortality. One case of subphrenic collection was encountered which was successfully treated percutaneously.

Conclusions

Preoperative portal vein embolization ensures the remnant liver function after major hepatic resection. Atrophy of hepatic lobe to be resected also facilitates the mobilization and control of bleeding during the resection.

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