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Retrohepatic inferior vena cava reconstruction with saphenous vein patch in advanced stage cholangiocarcinoma

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ABSTRACT

Hepatic resection is the only known curative treatment option in primary and metastatic liver tumors. Unlike other types of malignancies, the response rate to even the best chemotherapy protocols is quite low in liver malignancies. Survival is expressed in months in untreated liver malignancies or in patients with residual tumor after resection. The optimal survival can be achieved only by liver resection with negative surgical margins. In order to increase the number of patients suitable for hepatic resection, techniques such as portal vein embolization, neoadjuvant chemotherapy, two-step hepatectomy, re-do hepatectomy, hypothermic liver perfusion have been developed and newer modalities are still being investigated. Primary liver malignancies like hepatocellular carcinoma and cholangiocarcinoma, and metastatic liver tumors can invade the retrohepatic vena cava due to anatomical proximity. Invasion of either the hepatocaval confluence or vena cava are often considered as contraindications for liver resection due to the risk of intraoperative massive air embolism or hemorrhage. In this article, we present a patient who underwent left hepatectomy together with vena cava resection and reconstruction with saphenous vein patch due to cholangiocarcinoma.

Key Words: Cholangiocarcinoma, inferior vena cava resection, liver, resection

INTRODUCTION

Hepatic resection is the only known curative treatment option for primary and metastatic liver tumors. The 5-year survival rate after liver resection for primary hepatic malignancies, metastatic colon cancer and other non-colon metastatic liver cancer increased to 30% to 50% (1). Life expectancy is expressed in months in untreated hepatic malignancies or in the presence of a residual tumor. Unlike other types of malignancies, the tumor response rate is quite low in liver cancers despite the best chemotherapy regimens. With radiochemotherapy, the mean survival in metastatic colorectal cancer is 24 months, and the survival in hepatocellular and intrahepatic cholangiocarcinoma is around 12 months (1).

The optimal survival can only be obtained by liver resection with negative margins. Therefore, in order to increase the number of patients who are suitable for hepatic resection, many techniques such as portal vein embolization, neoadjuvant chemotherapy, two-stage hepatectomy, re-do hepatectomy, total vascular exclusion, and hypothermic perfusion of the liver have been developed and the search for new options persists (2). Primary liver malignancies such as hepatocellular carcinoma, cholangiocarcinoma and metastatic liver tumors may invade the retrohepatic vena cava due to anatomical proximity. Invasion of the hepatocaval confluence or vena cava are generally considered to be contraindications for liver resection due to intraoperative hemorrhage and massive gas embolism (3). However recently, information on vena cava resection and reconstruction has expanded, despite most of them consisting of case reports. In this article, we present a patient who underwent left hepatectomy together with vena cava resection and reconstruction with saphenous vein patch due to cholangiocarcinoma.

CASE PRESENTATION

A 58-year-old woman was admitted with complaints of abdominal pain, nausea, vomiting and jaundice. Her past medical history did not reveal pathologies. On physical examination, she had tachycardia and tachypnea as well as right upper quadrant tenderness and positive Murphy sign. Laboratory test results were as following: aspartate aminotransferase 200 (N: 5-40 U/L), alanine aminotransferase 180 (N: 7-56 U/L), amylase 150 (N: 60-180 U/L), total bilirubin 12 (N: 0.1 to 1 mg/dL), albumin 3 (N=3.4 to 5.4 g/dL), sodium 123 (N: 135-148 mEq/L), glucose 250 (N: 60-100 mg/dL), hemoglobin 10 (N: 13-18 g/dL), platelet count 465 x 10^3 (N: 150-400 x 10^3), and CA19-9 1000 (N: 0-39 U/mL). On abdominal ultrasound the common bile duct was not visualized, the gallbladder was hydropic with biliary sludge, and intrahepatic bile ducts were dilated in both sides that were more pronounced on the left. The abdominal

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computed tomography revealed a tumoral mass compatible with malignancy in the main bile duct that caused dilatation of intrahepatic bile ducts, more pronounced on the left (Figure 1). As a result of these tests, she was hospitalized with a diagnosis of cholangiocarcinoma. Following nutritional resuscitation, biliary decompression was provided by percutaneous biliary drainage catheter. Her bilirubin levels declined, and additional radiological examinations did not show any distant metastasis. The patient was planned for surgery after obtaining informed consent.

Surgical Technique

The patient was placed in the supine position under general anesthesia, and sterile conditions were attained. The abdominal cavity was accessed by a J-shaped incision. On exploration a tumor was detected that originated from the main bile duct, and extended to the left and caudate lobe. The right lobe was found to be slightly more hypertrophic than the left lobe. It was decided to perform resection of the extra-hepatic biliary tract and left hepatectomy in which the caudate lobe was included. After general exploration, retractors were placed. Exposure of the suprahepatic veins was achieved by dissection of falciform ligament and major hepatic veins. The liver hanging maneuver was performed by placing a nasogastric tube with the assistance of a blunt clamp that was introduced in the avascular tunnel located between the inferior vena cava and the liver and progressed to the plane between the right and middle hepatic veins. The hilar dissection was started with dissection of the Calot triangle. Following dissection of cystic duct and artery, the cystic artery was ligated and cholecystectomy was performed. The left hepatic artery and portal vein was ligated preserving hepatic artery and portal vein of the remnant liver. Extra-hepatic biliary tract was transected at the junction with the duodenum. In addition, all the lymph nodes up to the root of the celiac artery were dissected, and were included in the specimen. Liver transaction was completed by following the line of transaction that formed with ligation of the vascular structures by cavitron ultrasonic aspirator (CUSA), accompanied by ligatures and clips. By traction of the left lobe towards patient's left shoulder short hepatic veins that are directly connected from the caudate lobe to the inferior vena cava were ligated. At that stage, it was observed that the tumor has invaded inferior vena cava beneath main hepatic veins. It was decided to include the wall of the vena cava into resection. In order to secure resection and reconstruction, Satinsky clamps were placed to the inferior and superior vena cava. Total hepatic vascular occlusion was achieved with the addition of Pringle maneuver. The primary repair of the defect in the inferior vena cava after the resection of the invaded segment was predicted to cause luminal stenosis, and it was decided to use a saphenous vein patch for reconstruction. A 2.5 x 2 cm in size cadaveric saphenous vein graft was prepared for this purpose. Four 7/0 13 mm prolene sutures were placed in the four corners of the wall of the resected inferior vena cava and the saphenous vein graft (four stitch technique). The new inferior vena cava wall was created with the help of tension-free sutures and saphenous vein graft (Figure 2, 3). The reconstruction of three bile ducts in the remnant liver was carried out in the form of Roux-en-Y hepaticojejunostomy, with insertion of feeding catheters into the bile ducts. The feeding tubes were advanced through the jejunum and anterior abdominal wall, providing drainage of bile outside the abdomen. The operation was terminated after hemostasis.

Figure 1. The abdominal tomography showed bilateral intrahepatic biliary dilation (narrow arrow) and tumoral mass (wide arrow)

Figure 2. View after reconstruction of the inferior vena cava with cadaveric patch saphenous vein greft (arrow)

Postoperative Period

The macroscopic examination of the surgical material revealed an approximately 4 cm in diameter intraductal tumor that was derived from the hilar junction, extending to the caudate lobe (Figure 3). There were no gallstones, and the tumor invaded the inferior vena cava at the level of caudate lobe. There were no satellite metastatic nodules, and the histopathological examination of the surgical specimen revealed moderately differentiated adenocarcinoma and neoplastic glands with dystrophic calcification.

The patient was admitted to the intensive care unit, postoperatively. The patient remained stable, and on the third postoperative day her INR values were within normal limits without replacement therapy and the invasive monitoring catheters were removed. Intravenous infusions of prophylactic antibiotics and proton pump inhibitors were switched to oral forms and the patient was admitted to the surgical ward on the third postoperative day. Oral feeding was started on the fifth post-

operative day. On the 10th postoperative day, when she was planned for discharge, the patient developed massive upper gastrointestinal bleeding and underwent surgery following aggressive resuscitation. The patient developed cardiac arrest at the operating table, the bloody gastric contents were aspirated and she responded to the resuscitation regaining normal cardiac rhythm. The abdomen was accessed by removal of surgical suture materials from the previous operation. On abdominal exploration there was no blood in the distal small intestine, but the stomach was filled with blood. The saphenous vein patch placed in the inferior vena cava was intact and there was no hemorrhage within the abdomen. A gastrotomy was performed that included gastric antrum, pylorus, and anterior wall of the bulbus. When blood in the stomach was removed, a chronic ulcer crater with pulsatile bleeding was observed at the posterior wall of the duodenum. The bleeding was controlled by primary suture. Bilateral total vagotomy and Heinecke-Mikulicz pyloroplasty was performed. The patient was followed-up in the intensive care unit, and her laboratory tests returned to normal values after blood transfusion. However, she failed to regain spontaneous breathing and died on the 22nd postoperative day.

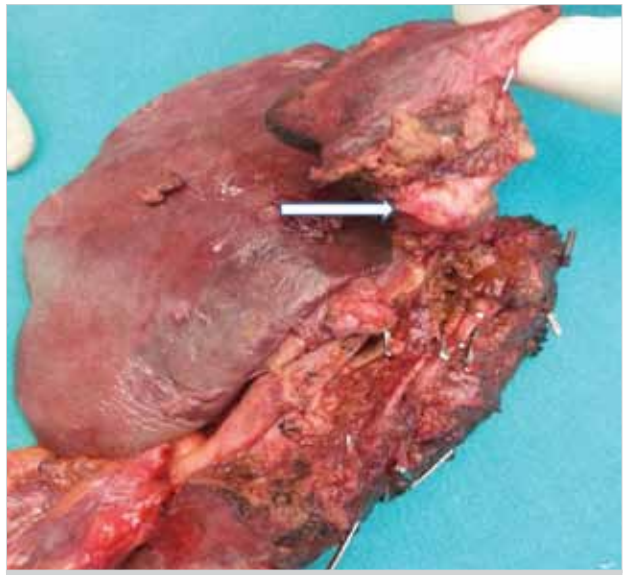

Figure 3. View after resection of the tumoral masss invading the inferior vena cava (arrow)

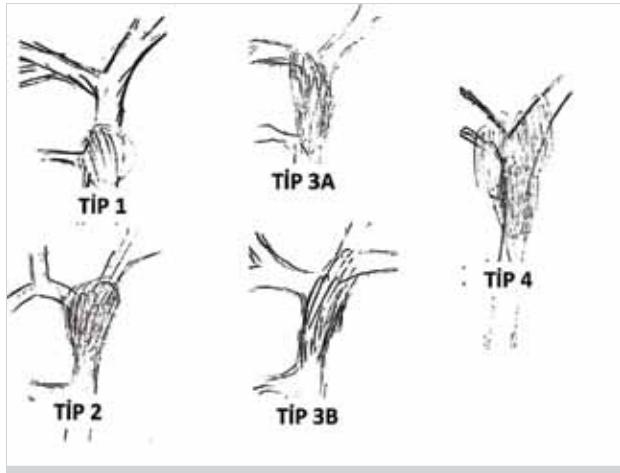

Figure 4. Bizmuth-Corlette Classification: Type 1: Tumor located below right and left main hepatic ducts; Type 2: Tumor located at the confluence; Type 3A: Tumor involving the main hepatic duct and any right duct; Type 3b: Tumor involving the main hepatic duct and any left duct: Type 4: Multifocal or single, involving the complete right and left hepatic ductal system

DISCUSSION

Malignancies arising from intrahepatic and extrahepatic biliary epithelium are referred as cholangiocarcinoma. Although the etiology of cholangiocarcinoma is not clear, there are situations like primary sclerosing cholangitis, and common bile duct cysts where its incidence is increased. There is male predominance in cholangiocarcinoma associated with obstructive jaundice. There is usually deterioration of laboratory data consistent with obstructive jaundice and increased levels of tumor markers such as CA19-9 and CEA are very useful in both preoperative diagnosis and postoperative monitoring. The benefits of radiotherapy and chemotherapy are still controversial, and the only treatment option that effects survival in cholangiocarcinoma is surgery with negative margins (R0). In untreatable cholangiocarcinoma, life expectancy is known to vary between 4 and 8 months. The contribution of procedures such as palliative stent placement for biliary decompression on life span is very limited (4).

Diagnosis and resectability rates of cholangiocarcinoma have increased significantly with the advances in the field of radiology. The main purpose of preoperative imaging is determining the possibility of resection and its borders. Patients are evaluated for tumoral invasion within the biliary tract, vascular invasion, lobar atrophy, metastasis and peritoneal deposit. Surgical treatment is planned by classifying cholangiocarcinoma with the Modified Bismuth Corlette classification according to tumor spread within the biliary tract.

An R0 resection may be provided in Bismuth Type 1 and Type 2 patients by isolated bile duct resection, whereas the most appropriate treatment option for Bismuth Type 3 and Type 3B tumors is hilar bile duct resection in combination with right or left hepatectomy (Figure 4). Hilar resection with hepatic resection for advanced stage hilar cholangiocarcinoma provided significant benefits in terms of long-term survival rates, local and distant organ recurrence. Prognostic criteria influencing survival for cholangiocarcinoma include not only R0 resection, but also presence of caudate lobectomy, histological grade, perineural invasion, lymphovascular invasion, tumor depth, lymph node involvement, classification and stage (5).

The most interesting prognostic factor is caudate lobectomy. Early spread to the caudate lobe is often seen in hilar cholangiocarcinoma due to the biliary drainage of the caudate lobe that is in proximity to hilar junction. The caudate lobe is held responsible for early and late-term recurrence of cholangiocarcinoma. Sugiura defined clinical utility of caudate lobe resection for the first time (6). In a study by Mizumoto et al. (7) the 5-year survival rate was detected as 46% in patients with caudate lobectomy, in contrast to 12% of those who did not undergo such resection. Another feature of the caudate lobe is its anatomical proximity to inferior vena cava. Any malig-

nancy located in the caudate lobe may have direct invasion to the inferior vena cava. In cholangiocarcinomas located at or extending to the caudate lobe the optimal survival can be achieved only with R0 resection, and if the inferior vena cava is invaded the vena cava inferior should be included in the resection specimen. Currently, with the help of conventional imaging methods, the possible relationship between vena cava and the tumor can be preoperatively detected and the surgical team can alter surgical strategy accordingly. If the tumor invasion of the inferior vena cava is below the hepatic veins and there is sufficient area for partial clamping, clamping and reconstruction can be carried out without interruption of usual blood flow of the liver.

Most centers complete hepatic transection before clamping the inferior vena cava and carry out the reconstruction of the inferior vena cava after transection. An alternative procedure is clamping and reconstruction first followed by liver transection, as described by Madariaga et al. (8). All surgical strategies are based on keeping the liver ischemia time as short as possible. The normal liver can easily tolerate portal vein clamping for 60 to 90 minutes, however in cholangiocarcinoma where biliary obstruction is accompanied by secondary liver damage portal clamping time should be kept as short as possible. That is why the technique described by Madariaga et al. (8) is not popular. If the inferior vena cava can be separated from the liver by hanging maneuver, both transection of the liver and reconstruction of inferior vena cava can be reliably performed. In all cases where reconstruction of the inferior vena cava is intended, the primary aim is mobilizing the liver away from the inferior vena cava as much as possible. Nevertheless, mobilization of large tumors growing expansively, or invading the diaphragm may not be possible. In such cases, first completion of liver transection by the anterior approach and reaching the inferior vena cava is another surgical strategy. In advanced hepatic malignancies invading hepatocaval confluence, the retrohepatic vena cava and portal vein, in-situ hypothermic perfusion or ex-vivo dissection techniques have also been described in the literature (9).

Different treatment methods have been described for reconstruction following resection of inferior vena cava. If the resection margin is shorter than 2 cm reconstruction with primary repair is possible. However, in vena cava resections larger than 2 cm primary repair is likely to cause luminal stenosis. Therefore, in resections larger than 2 cm in width, the inferior vena cava wall can be repaired by autologous saphenous vein, facial peritoneum or heterogeneous materials (3, 8). In cases with long-segment involvement, invasion of half of the vena cava wall or in cases where there is thrombus within the lumen of the vena cava reconstruction after total resection is possible. Autologous vein grafts have obvious advantages in terms of infection and thrombosis, however, their use for long-segment or totally resected vena cava reconstruction is not technically possible. In these cases, synthetic grafts are often preferred. Dacron® is a synthetic vascular graft that was frequently used in the past but currently it is not preferred due to high rates of thrombosis and stenosis. Currently, reinforced synthetic polytetrafluoroethylene (PTFE) grafts are preferred because they can withstand the pressure of the abdominal organs for longer periods (10).

In our case, there were no findings suggesting extension of the tumor to the caudate lobe or the inferior vena cava in preoperative radiographic imaging studies. We detected involvement of the inferior vena cava intraoperatively after transection of the liver. Since the invasion was at the left lateral wall of the inferior vena cava, we did not experience any problems or signs of invasion during the liver hanging maneuver. We included the inferior vena cava involvement, which we detected in the last stage of resection, within resection borders in order to obtain negative surgical margins. The resected wall of the vena cava was wider than 2 cm and primary repair was likely to cause stenosis, therefore reconstruction was carried out with cadaveric saphenous vein patch. The patient was categorized as Bismuth type 3b, according to both intraoperative findings and evaluation of the surgical specimen. The patient died due to surgery-induced secondary stress factors rather than primary complications of a major surgical procedure. The development of massive upper gastrointestinal bleeding despite the known medical measures in the postoperative period raised the issue of performing routine preoperative endoscopic procedures in order to determine potential ulcers.

CONCLUSION

The longest survival time in cholangiocarcinoma can only be achieved with negative surgical margins. In experienced centers, vascular invasion of cholangiocarcinoma can be managed safely by using autologous, synthetic or cadaveric vascular grafts. Especially in cases where primary repair of the inferior vena cava can lead to stenosis, saphenous vein graft can be easily used for reconstruction purposes.

Informed Consent: Written informed consent was obtained from patient who participated in this case.

Peer-review: Externally peer-reviewed.

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