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Isolated paracaval subsegmentectomy of the caudate lobe of the liver

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Abstract

Background and aims: The caudate lobe of the liver is divided into three subsegments based on the portal blood supply: the Spiegel lobe, the paracaval portion (S1r), and the caudate process. An isolated paracaval (S1r) subsegmentectomy is indicated for a small hepatocellular carcinoma localized within S1r. Because this challenging procedure has not been described, we report the details of successful surgical technique.

Methods: The portal pedicle isolation technique provides easy access to the S1r portal pedicle. A tape is passed along the midline of the anterior surface of the vena cava and its lower end is passed through the caudate parenchyma dorsoventrally to establish a landmark for the left border of S1r. A liver-splitting anterior approach is used to open the interlobar plane widely to the precaval tape. As exposing the vena cava and the root of the right hepatic vein, parenchymal dissection is advanced to the right and then, upward.

Results: The procedure was performed successfully in a 51-year-old man with hepatitis B who had a 2-cm hepatocellular carcinoma in S1r. Blood loss was 645 mL.

Conclusion: An isolated paracaval subsegmentectomy of the caudate lobe can be performed successfully, though it is likely to remain an uncommonly used procedure.

Key Words: caudate lobe of the liver, paracaval portion of the liver, portal pedicle isolation technique, liver hanging maneuver, liver-splitting anterior approach

Introduction

An isolated total caudate lobectomy has been developed since its introduction in the surgical treatment of hilar cholangiocarcinoma [1], despite its technical difficulty and perioperative risk [2-4], also for hepatic tumors localized to the caudate lobe [5-11]. This challenging operation secures complete removal of the tumors, and preserves viable hepatic parenchyma in patients with cirrhotic livers that have poor functional reserve and the potential of developing a second primary.

The caudate lobe, Segment 1 according to Couinaud [12], is divided into three subsegments: the Spiegel lobe (the left portion, S1l), the paracaval portion (the right portion, S1r), and the caudate process (right lower portion, S1c) [13]. Because these three subsegments are supplied by different portal branches (Figure 1), an isolated subsegmentectomy is indicated for relatively small hepatocellular carcinoma localized within an individual subsegment, considering that the main mode of spread is portal dissemination [14,15]. S1l and S1c subsegmentectomies, which may be easier to perform because margins of resection are better defined by the surface anatomy of the liver, have been described by several authors [2,3,9]. An isolated S1r subsegmentectomy, however, has not been reported, probably due to the technical difficulty in gaining access to the paracaval subsegment that is located deep in the liver, behind the overlying Segments 4 and 8 and surrounded by the inferior vena cava (IVC), the right and middle hepatic veins (RHV and MHV), the hepatic hilum, and the right anterior portal pedicle (Figure 1).

The present article reports an isolated paracaval subsegmentectomy of the caudate lobe of the liver using a newly developed technique that combines the portal pedicle isolation technique [16], liver hanging maneuver [17], and liver-splitting anterior approach [5,7,10,11].

Methods

Hepatic inflow control

After cholecystectomy, the left and right portal pedicles are isolated and taped, then the right anterior and right posterior portal pedicles are isolated and taped as well. These tapes are used for selective inflow exclusion during parenchymal dissection. The S1c portal pedicle is isolated to the left of the right posterior portal pedicle behind the hepatic hilum and is preserved. The S1r portal pedicle is isolated at the craniodorsal aspect of the hilar plate. Discoloration of an area 2 to 3 cm in diameter on the diaphragmatic surface of the liver between the roots of RHV and MHV following temporary clamping of the S1r portal pedicle guarantees that identification of the S1r portal pedicle is correct. Intraoperative ultrasonography also can be used to identify the S1r portal pedicle precisely. Only the S1r portal pedicle is ligated and divided, and after this is accomplished, the lower border of S1r is detached from the hilar plate. Outflow control is not necessary unless the central venous pressure is extremely high.

Hepatic mobilization

According to the liver hanging maneuver [17], a tape is passed along the midline of the anterior surface of the IVC and just to the right of the root of MHV and the large caudate vein that directly enters the IVC on its left anterior surface [10,17]. Neither the right lobe nor the left lobe is mobilized; only the precaval portion is mobilized (Figure 2).

Parenchymal dissection

Prior to parenchymal dissection, the lower end of the precaval tape is passed through the caudate parenchyma dorsoventrally at the left edge of the hilar plate to establish a landmark for the left border of S1r, just to the right of the Arantius canal. Using intermittent clamping of the left and right anterior portal pedicles and leaving the right posterior pedicle patent, parenchymal dissection starts from the Cantlie line, via the right and dorsal aspect of MHV, and reaches the precaval tape that is the landmark for the left border of S1r (Figure 2).

Turning the left edge of S1r ventrally and to the right, the anterior surfaces of the IVC and the root of the RHV are exposed, and the hepatic parenchyma behind the hilar plate is dissected between S1r and S1c. Then, parenchymal dissection is continued upward between S1r and S8 along the left aspect of the right anterior portal pedicle. Hepatic dissection is completed after parenchymal division between S1r and S7 (Figure 3).

Results

A 51-year-old man with hepatitis B underwent an isolated paracaval subsegmentectomy of the caudate lobe of the liver for a 2-cm hepatocellular carcinoma localized within S1r (Figure 2). Radical resection was successfully performed with an operative time of 510 min and a blood loss of 645 mL. No blood transfusion was necessary. The postoperative course was uneventful except for a temporary bile leak that ceased spontaneously in a few days. The patient is alive and well without recurrence 3 years after surgery.

Discussion

Subdivision of the caudate lobe is a controversial topic. Couinaud has subdivided the caudate lobe into a left part (Segment 1) and a right part (Segment 9) using the overlying MHV as the landmark [18,19]. The ventral part of Segment 9, (Segment 9b), includes the caudate process. We adopted Kumon's subdivision classification system of S1l, S1r, and S1c [13] because we felt it was more logical to separate the paracaval portion and the caudate process based on their portal blood supply (Figure 1).

We have developed a new successful technique for an isolated paracaval (S1r) subsegmentectomy of the caudate lobe that combines the portal pedicle isolation technique [16], liver hanging maneuver [17], and liver-splitting anterior approach [5,7,10,11]. The portal pedicle isolation technique permits selective inflow control during parenchymal

dissection and provides easy access to the S1r portal pedicle as a single unit within its fascial sheath [8]. We do not feel it is possible to dissect the fragile vessels supplying S1r individually. Although there may be two or more portal pedicles of S1r, careful dissection of the entire hilar plate enables surgeons to identify them.

There are three approaches to the caudate lobe in general: the left dorsal [2,8], the right dorsal [2,4,6,8], and the liver-splitting anterior approach [5,7,10,11]. Compared with the dorsal approaches, the liver-splitting anterior approach provides a better operative field by opening the interlobar plane widely. Combining this technique with the liver hanging maneuver, as modified to provide a landmark for the left border of S1r, facilitates parenchymal dissection and access to the IVC, and reduces the need for hepatic mobilization to the precaval area, whereas wide mobilization of the whole liver is necessary when the dorsal approaches are used. Limiting dissection preserves the large caudate vein that enters the IVC directly and is the main outflow of S11. Yanaga [8], however, mentioned the risk of increased blood loss during hepatic dissection and parenchymal damage in the anterior approach. Although blood loss was relatively modest in the present case, parenchymal damage may be problematic, especially due to the parenchymal congestion that may occur following division of MHV tributaries. The liver-splitting anterior approach via the right side of the MHV [10], compared with that via the left [5,7,11], creates a wider operative field, especially between the roots of the RHV and MHV, where the top of S1r lies (Figure 3). This was our rationale for adopting the anterior approach via the right side of MHV to resect S1r. For complete removal of S1r parenchyma, the root of MHV should be exposed dorsally up to the confluence with the left hepatic vein (Figure 1).

Parenchymal congestion, however, may be greater when the large caliber MHV tributaries from Segments 5, 6, or 8 are divided. When hepatic venous flow is absent and portal flow is reversed by intraoperative color Doppler ultrasonography, and discoloration

develops following temporary clamping of the hepatic artery [20], preservation or reconstruction of the MHV tributaries should be considered unless the size of the congested area is negligible.

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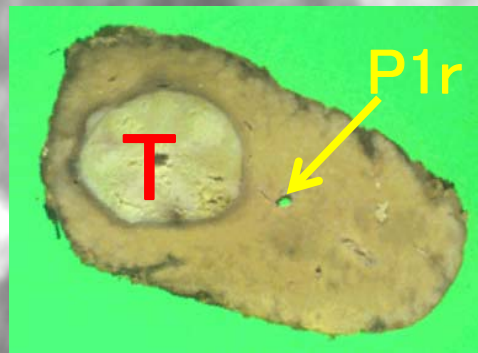
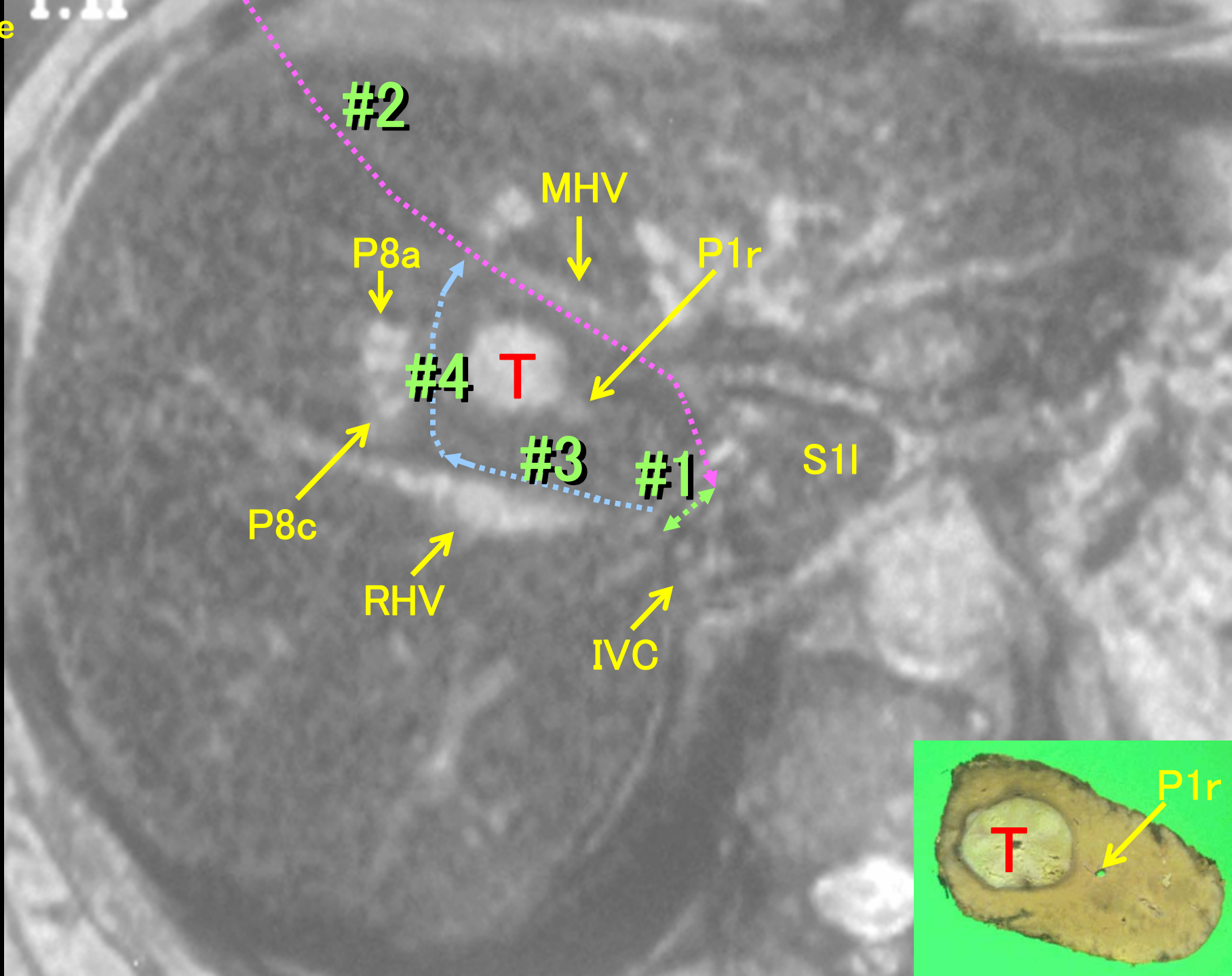
Figure legends

Figure 1. Schematic illustration showing the subsegments of the caudate lobe and the surrounding structures.

Figure 2. A cross-sectional magnetic resonance imaging (MRI) shows the route of an isolated paracaval subsegmentectomy of the caudate lobe of the liver. IVC, inferior vena cava; RHV, right hepatic vein; MHV, middle hepatic vein; S11, Spiegel lobe; T, tumor; P1r, portal branch of the paracaval subsegment; P8a and P8c, portal branches of the ventral and dorsal part of Segment 8; #1, Precaval mobilization of the caudate lobe; #2, Liver-splitting anterior approach to the IVC via the right side of MHV; #3, Exposure of the anterior surfaces of IVC and RHV; #4, Parenchymal dissection along the right anterior portal pedicle; Inset, Cut surface of the surgical specimen corresponding to the MRI slice.

Figure 3. An operative photograph taken after completion of the isolated paracaval subsegmentectomy of the caudate lobe. The interlobar plane is widely opened and the inferior vena cava (IVC), middle hepatic vein (MHV), and right hepatic vein (RHV) are exposed. Gra, right anterior portal pedicle; HDL, hepatoduodenal ligament.

Figure 2



Figure

3

