



ISOLATED CAUDATE LOBECTOMY FOR SPIEGEL LOBE NEOPLASMS

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ABSTRACT: Introduction: Caudate lobe, or segment 1 of the liver, is the segment of the liver that occupies the space between the hilar plate and the retrohepatic vena cava. Its peculiar embryology accounts for the unique vascular and biliary anatomy. The location among three major vascular structures (the hepato-duodenal ligament, the vena cava and the hepatic veins cranially), together with its characteristic hypertrophy in case of increased portal system pressure, makes the caudate lobe as one of the most challenging liver segments. Caudate lobe resections for tumor may be performed as isolated segmental resections or associated to major hepatic resections, when other liver segments are involved. We describe here our 14-years experience of 7 cases of isolated caudate lobe resection for tumor.

Patients and Methods: From October 2000 to December 2014 826 patients underwent liver resection at our institution, of which 286 (34.6%) minor resection (wedge resection, sub-segmental resection and segmental resection), 200 (24.2%) right hepatectomy, 260 (31.4%) left hepatectomy, 20 (2.4%) left trisegmentectomy and 60 (7.2%) patient right trisegmentectomy. Of those, 45 (8.3%) had a concomitant caudate lobe resection. In seven patients (0.8%), the tumor was confined to the caudate lobe and an isolated caudate lobe resection was performed. The indication was as follow: 2 patients had Hepatocellular carcinoma (HCC), 3 patients had metastasis (colorectal in two cases and from adrenal gland in one case), 1 adenoma, and one presented with a non-Hodgkin lymphoma. For these patients we analyzed intraoperative data, post operative course and survival.

Results: Five (71.4%) out of 7 patients are still alive after a mean follow up of 8.4 ± 5 years. Two patients died of disease recurrence after 7 months and 8 years, respectively. The mean operating time was 304.8 ± 109.7 minutes and the mean estimated blood loss was 266.6 ± 123.8 ml. There were no intra-operative or post-operative complication. The mean Intensive Care Unit stay was 1.2 ± 0.7 days. Each lesion was localized into the Spiegel lobe, and each patient had at the pathology specimen only one nodule. In all cases the margins were free of tumor.

Conclusions: Isolated caudate lobectomy is a difficult surgical procedure that may be associated with significant intra-operative bleeding and dangerous vascular and biliary injuries. In spite of these difficulties, this procedure can be considered the gold standard treatment for any lesions, benign or malignant, involving and confined to the Spiegel Lobe, especially when is crucial to preserve the remnant parenchyma.

KEY WORDS: Spiegelian lobe, Caudate lobe tumor, Caudate lobe resection, Liver tumor.



INTRODUCTION

The Caudate lobe, or segment 1 of the liver, described by Couinaud et al¹ is characterized by a right and a left dorsal portion. Kumon's caudate lobe anatomical subdivision allows a further separation in three parts: left dorsal segment, named *Spiegelian lobe*; right upper dorsal portion, named *paracaval portion*; and right downer dorsal portion, named *caudate process*².

Located between the posterior surface of the liver and the anterior wall of the retrohepatic inferior vena cava, the Caudate lobe is trapped in a vascular ring made from the hepatic veins in the most cranial portion and from the hepatic hilum and the vena cava in the most inferior aspect. The Caudate lobe wraps around almost completely the vena cava and is localized in close proximity to the biliary ducts and portal/arterial confluences^{3,4}. As it regards its vascularization, the caudate lobe develops both anatomically and temporally separately from the rest of the liver. During the caudate lobe development, multiple small portal branches arise from the right branch and/or left branch and/or bifurcation of the portal vein to supply the entire caudate lobe⁵. The arterial supply usually is provided by the left branch of the proper hepatic artery, and the biliary drainage is mostly into the left biliary duct, although smaller branches may drain into the right biliary duct. Variants of the portal, arterial and biliary standard anatomy are extremely frequent and the blood supply/drainage of the caudate lobe to both the left and the right system are considered a variant more than an anomaly⁴. Venous drainage of the caudate lobe is into the vena cava directly through the short hepatic veins, as well as into the left and middle hepatic veins⁴. This accounts for the hypertrophy that characterizes the caudate lobe in case of post- and sinusoidal portal hypertension.

This, together to its location and to the highly unpredictable vascular anatomy, makes the caudate lobe as one of the most surgically challenging segment of the liver.

From a technical point of view the Caudate lobe can be resected in the contest of a major hepatectomy when other segments of the liver are involved by the tumor, or less frequently by an isolated caudate lobectomy⁶⁻⁸. Even though the first isolated caudate lobe resection was described by Nimura in 1990, not many reports have been generated in literature. We describe here a cohort of 7 patients who underwent isolated caudate lobectomy for liver neoplasm developed and confined in the Spiegelian caudate lobe.

PATIENTS AND METHODS

From October 2000 to November 2014, 7 patients (2 male and 5 female) underwent isolated caudate lobectomy for liver neoplasm. One patient had a hepatic adenoma, 2 patients had colo-rectal liver metastasis, 2 patients had a hepatocellular carcinoma (HCC) (the Child-Pugh score was A6 and B7, respectively), 1 patient had a non-Hodgkin lymphoma and 1 patient had metastasis from adreno-cortical carcinoma.

The pre-operative imaging study of the lesions included Ultrasonography (US), Computer Tomography Scan (CT) and Magnetic Nuclear Resonance (MNR). All the lesions were confined to the Spiegelian lobe, without intrahepatic or extrahepatic dissemination.

The incision preferred was a right subcostal incision with midline extension to the xiphoid process. The resection of the caudate lobe consisted of four major steps: mobilization of the lobe, outflow control by dividing the short hepatic veins behind the lobe, inflow control by dividing the portal triads to the lobe, and division of the hepatic parenchyma between the caudate lobe and the main liver. Intraoperative US was routinely performed in order to rule out intrahepatic metastasis.

Intra-operative data such as blood loss, operating time, intra-operative complications and post-operative outcome were collected and analyzed

Patients affected from malignant neoplasm were followed-up with liver US every three months and total body CT scan every six months.

RESULTS

All 7 cases of isolated caudate lobectomy were accomplished successfully without death and severe complications. Demographic data, operative data, post-operative outcome and tumor characteristics are showed in Table 1. The mean age was 54.7 ± 13.3 years, median 58 years (range: 35-74 years). The mean operating time was 304.8 ± 109.7 minutes, median 309 minutes (range: 195-596 minutes) and the mean intraoperative estimated blood loss (EBL) was 266.6 ± 123.8 ml, median 235 ml (range: 120-500 ml). The mean Intensive Care Unit stay was 1.2 ± 0.7 days, median 1 (range: 0-3 days). The mean hospital stay was 7.3 ± 2 days, median 6 days (range: 6-12). There were no intra-operative (such as injury of inferior vena cava, portal vein or hepatic veins) or post-operative complications (medical or surgical).

All patients were confirmed to have only one nodule at pathology specimen. The mean size was 3.3 ± 2 cm, median 2.5 cm (range 2.3-8.3 cm), the mean surgical margin was of 0.96 ± 0.39 cm, median 1 (range between 0.3-1.6 cm).

Table 1. Demographic data, operative data, post-operative outcome and tumor characteristics.

Pz.	Sex	Age	Operative time (min)	Blood loss (ml)	ICU admission (days)	Hospital Stay (days)	Indication	Mass dimension (cm)	Resection margin (cm)	Complication	Recurrence	Location recurrence	Time to relapse	Alive/died	Follow-up (years)
# 1	F	63	312	n.s.	0	6	Linfoma	2.5	0.9	*	No			Alive	10
# 2	M	35	546	270	3	12	Adrenal metastasis	2.6	1.2	*	Yes	Liver	8 years	Dead	8.7
# 3	F	38	195	120	1	6	Adenoma	8.3	0.3	*	No	Alive	15.5		
# 4	F	50	309	330	1	7	HCC	2.5	1.6	*	Yes	Liver	6 months	Dead	3.5
# 5	F	58	327	180	1	8	Colorectal metastasis	2.4	1.1	*	Yes	Lung, bone	9 years	Alive	10
# 6	M	65	220	500	1	6	HCC	2.7	1	*	No			Alive	2.3
# 7	F	74	225	200	1	6	Colorectal metastasis	2.3	0.6	*	No			Alive	1

One patient with HCC had a previous hepatic resection (left hepatectomy) for the same type of neoplasm, one patient had a previous right hemicolectomy for colon cancer, one patient had a previous right adrenalectomy for cancer. Only 1 patient had a combined procedure (left hemicolectomy) at time of caudate lobe resection.

Recurrence occurred in 3 (42.8%) out of 7 patients after 6 months, 8 and 9 years respectively. One patient, who underwent caudate lobe resection for colo-rectal liver metastasis, had lung and bone recurrence. The patient is currently on chemotherapy. One patient, who underwent liver resection for HCC had liver recurrence. One patient, who underwent liver resection for adreno-cortical carcinoma liver metastasis had liver recurrence.

One patient, who underwent caudatectomy for HCC, was transplanted for decompensated cirrhosis after 1 year. Five (71.4%) patients out of 7 patients are still alive after a mean follow-up time of 8.4±5 years, median 10 years (range: 0.6-15 years). Two patients died of recurrence of the primary tumor after 3.5 years and 8.7 years, respectively.

DISCUSSION

The caudate lobe or segment I of the liver presents some anatomical characteristics that make this segment different from the rest of the hepatic segments. Due to its direct drainage in to the vena cava this portion of the liver is subject to hypertrophy in case of portal hypertension. For these reasons the caudate lobe represents one of the most challenging segments to approach from a surgical point of view⁹⁻¹¹. Mortality rates reported after this procedure range from 5.3 to 14%^{9,10}. According to the involved area three possible locations can be involved by the lesion: the Spighelian lobe, the paracaval portion, and the caudate process. Lesions localized into the paracaval portion or into the caudate process are associated with a higher rate of vena cava infiltration and consequently to a lower possibility of obtaining safe resection margins. For this reason lesions associated to these portions of the caudate lobe are often associated to vascular reconstruction and to major hepatectomy in order to obtain better resection margins.

As recently reported by Gendong Tian et al¹² the kind of approach to the caudate lobe widely differs according to the location, the diameter, and the type of lesion. Small and/or benignant lesion originating from the Spigelian lobe can be approached from the left side, without any mobilization of the right liver. Similarly when this kind of lesion originates from the caudate process, a right side approach can be performed. On the other



hand a bilateral approach is necessary for wide neoplasms or for malignant diseases, when a wide free resection margin is needed and thus the entire caudate lobe needs to be resected. Gendong Tian et al. reported 16 cases of isolated caudate lobectomy, performed successfully without complications. In his experience left side approach was adopted in two cases (12.5%), right side approach in three cases (18.75%), and both sides approach in 11 cases (68.75%).

Hawkins et al¹³ reported a significant higher risk of post-operative mortality in patients who underwent a major vascular reconstruction (20% vs. 2.5%, $p < 0.002$). Yamamoto et al¹⁴ described the surgical treatment of caudate lobe metastasis originating from the paracaval portion. Of 7 patients, 3 underwent isolated caudate lobectomy, while in 4 patients the caudate lobectomy was associated to a major hepatectomy. Moreover, 6 patients out of 7 had vascular infiltration and underwent a vascular reconstruction. Four out of 7 patients were alive at five years. Vascular infiltration is less likely in lesions involving the Spiegelian lobe. In our series only one patient required a partial caval resection secondary to an adrenal tumor infiltrating the vena cava. For the same reasons none of our patients required a combined major hepatic resection in order to ensure a safer resection margin. Furthermore, none resection margin was infiltrated by neoplasm.

CONCLUSIONS

The isolated caudate lobectomy is a difficult surgical procedure that may be associated with significant intra-operative bleeding and dangerous vascular and biliary injuries. For this reason a careful preoperative radiological assessment should be aimed to exactly localize the lesion in the caudate lobe and thus direct the surgical approach to this segment. A complete liver mobilization is extremely helpful in the exposure of the caudate lobe that should be mobilized in both left and right aspect of the vena cava.

In most cases when only the Spiegelian lobe is involved, an isolated caudate lobe resection can be possible with safe resection margins and should be considered the resection of choice especially when the parenchyma is affected by an underlying disease.

CONFLICT OF INTERESTS:

The Authors declare that they have no conflict of interests.

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