

Lesson of the Month

Trisectionectomy for large hepatocellular carcinoma using the liver hanging maneuver

A. Nanashima^{*}, Y. Sumida, T. Abo, H. Takeshita, S. Hidaka, T. Sawai, T. Yasutake,
T. Nagayasu

*Division of Surgical Oncology, Department of Translational Medical Sciences,
Nagasaki University Graduate School of Biomedical Sciences, 1-7-1 Sakamoto,
Nagasaki 852-8501, Japan*

***Correspondence and reprint requests to: A. Nanashima**

Tel.: +81-95-819-7304, Fax: +81-95-819-7306

E-mail address: a-nanasm@net.nagasaki-u.ac.jp

Key words: Hepatectomy; Liver hanging maneuver; Trisectionectomy; Large hepatocellular carcinoma

Introduction

Large hepatocellular carcinomas often expand in segments 4-8 or segments 2-5 and 8, resulting in severe compression of intra- or extra-hepatic vessels and adjacent organs. Right or left trisectionectomy is necessary for complete removal of such tumors.¹ However, in such tumors, dissection or rotation of the resection-side liver prior to hepatic resection is quite difficult and such procedures may cause tumor dissemination or excessive bleeding. Therefore, the anterior approach should be selected.² To achieve anatomic resection, it is important to ensure adequate exposure of the transection plane or the hepatic vein.³ When a large liver tumor compresses the right hepatic vein or the umbilical portal pedicle, it may be difficult to adequately expose the transection planes for right or left trisectionectomy. The liver hanging maneuver (LHM) proposed by Belghiti et al.⁴ is a useful technique for the anterior approach to reduce the time required for hepatic transection and blood loss in the right or left hemi-hepatectomy. Furthermore, an adequate transection plane might be required using the LHM. Although the application of this technique has been reported recently,⁵ we believe that the LHM can be applied for trisectionectomy of the liver, even in cases of large liver tumors.⁶ We describe here the application of LHM for right and left trisectionectomy in patients with large hepatocellular carcinomas.

Techniques

The patient undergoes a J-shaped incision laparotomy (upper median plus right-sided transverse incision to the 9th intercostal space) in the supine position.⁷ Lifting the right

costal arch by a thoracotomy or median sternotomy is often added to obtain a better operative field.^{7,8} The falciform ligament is cut and the bifurcation of the right, middle and left hepatic veins, and the anterior surface of vena cava are exposed subsequently. Mobilization of the resected liver should be avoided as much as possible to prevent dissemination of cancer cells during operation. The LHM procedure is basically that described by Belghiti et al.⁴ The space between the right and middle hepatic vein (RHV and MHV) is dissected using a right-angled clamp first. From the same space, the space between the anterior surface of the vena cava and the paracaval caudate lobe containing loose connective tissue is dissected for 3 cm using a long right-angled clamp for the renal artery. Subsequently, the space between the vena cava and the infra-hepatic caudate process is dissected and a few short hepatic veins are divided. The loose tissue is dissected for 3 cm using a long, light and curved Kelly clamp. In the next step, a 10-Fr nasogastric tube is inserted between RHV and MHV and this tube can be easily passed through the dissected space (Fig. 1). For right trisectionectomy, the tube is repositioned between the confluence of the middle and left hepatic veins when possible (as (2') in Fig. 2). However, as this procedure can often be difficult in the presence of a large liver tumor compressing these veins, the tube would be rather placed between the right and middle hepatic veins (as (2) in Fig.2) until the confluence of the middle and left hepatic veins is exposed during transection.

At the hepatic hilum, the spaces between Glisson's pedicle and hepatic parenchyma are dissected using a right-angled clamp. They include 1) the space between the right anterior and right posterior Glisson's pedicles for left trisectionectomy, and 2) the space adjacent to the umbilical Glisson's pedicle for right

trisectionectomy. The midline and the right edge of the caudate lobe are cut and the nasogastric tubes are placed in these spaces similar to the tape-repositioning technique reported by Kokudo et al.⁹ (Fig. 2) Then, the LHM using the nasogastric tube is prepared. We prefer to cut the hepatic artery and the portal vein of the resected liver prior to hepatic transection. The hepatic bile duct is usually cut during the transection under intraoperative cholangiography.

Applying LHM, the hepatic transection is performed using a combination of the crush clamping method¹⁰ and use of the ultrasonic dissector during intermittent occlusion of the hepatic inflow (15 minutes occlusion and 5 minutes de-clamping) using Pringle's maneuver.¹¹ The tubes are always pulled up during transection and the direction of transection is always targeted toward the hanging tube. Transection toward the anterior aspect of the vena cava can be easily performed using the hanging tube.

Case reports

Liver hanging maneuver for right trisectionectomy

A 72-year-old male negative for hepatitis B and C viral infections was diagnosed with a large hepatocellular carcinoma measuring 25 cm in diameter in segments 4-8 on computed tomography (CT) scan (Fig. 3). The tumor compressed the right diaphragm and vena cava and a right trisectionectomy was planned. Although the liver could not be mobilized, we were able to identify a tumor-free space between the vena cava and infra-hepatic caudate process from the opposite side. A 10-Fr nasogastric tube was passed along the retrohepatic vessel-free space and suspension of the liver was achieved by placing the tube between the liver and left portal pedicle.⁹ As shown in Fig. 4, an

adequate transection plane could be obtained along the umbilical pedicle using the LHM. This was achieved by lifting the nasogastric tube during transection, which resulted in rotation of the resected liver including the tumor toward the right hand side, and rotation of the remnant liver (i.e., segments 2 and 3) to the other side. The right Glisson's pedicle and pedicles in the lower segment 4 were divided. The hanging tube was first placed between the confluence of the right and middle hepatic veins (as (2) in Fig. 2) during parenchymal transection as described above. Following exposure of the confluence of the middle and left hepatic veins, the hanging tube was positioned between these two veins (as (2') in Fig. 2 and Fig. 4). The hanging tube was always pulled up during transection and the direction of transection was always targeted toward the tube on the vena cava. The hepatic parenchyma was easily transected within 20 minutes using LHM and the confluent of the middle hepatic vein was cut during transection. The operating time was 9 hours 12 minutes and blood loss was 1,250 mL and the patient required no red blood cell transfusion.

Liver hanging maneuver for left trisectionectomy

A 68-year-old male with chronic hepatitis B was diagnosed by CT scan to have a large hepatocellular carcinoma measuring 20 cm in diameter, involving segments 4, 5 and 8, and compressing the right hepatic vein. Segments 2 and 3 were markedly atrophic (Fig. 5). A left trisectionectomy was planned. We applied LHM using a 10-Fr nasogastric tube. We dissected the space between Glisson's pedicle and hepatic parenchyma and placed a tube underneath the liver in the space between the right anterior and posterior Glisson's pedicles. As shown in Fig. 6, we were able to obtain an adequate transection

plane along the right hepatic vein, using LHM because the resected liver including the tumor rotated towards the left hand side, while the remnant liver (i.e., segments 6 and 7) rotated laterally upon lifting the tube during transection. The left Glisson's pedicle and the right paramedian pedicles were then divided. The hepatic parenchyma was easily transected during a period of 38 minutes using the LHM and the compressed right hepatic vein was entirely exposed without injury. The operating time was 9 hours 48 minutes and blood loss was 2,290 mL. The cut plane along the right hepatic vein was hung up by the tube.

Discussion

History and development of liver hanging maneuver

The LHM proposed by Belghiti et al.^{4, 12} has been used widely in liver resection^{6, 13, 14} and living donor liver transplantation^{9, 15} worldwide. Mobilization or rotation of the resected liver with liver tumor is not necessary, which is better for avoiding tumor dissemination during operation. In patients with a large tumor or a tumor involving adjacent organs, liver transection can be performed prior to combined resection of the invasive parts. Furthermore, this technique has been applied in not only right hemihepatectomy but also left hepatectomy¹³ and isolated caudate lobectomy.¹⁶ LHM can be applied in various hepatic resection techniques. To our knowledge, there are no reports that provide detailed description of the procedures that describe the LHM technique for trisectionectomy in a large hepatocellular carcinoma compressing intra-hepatic vessels. Kim et al. presented three cases of right trisectionectomy among

187 anatomical liver resections, however, details of the tumor profile or the procedure of LHM for trisectionectomy was not described in that report.⁵

Advantages of liver hanging maneuver for large liver tumors

Since the transected area is hung up by LHM, the transection time or parenchymal bleeding may be lower compared with the non-hanging procedure. The advantage of LHM is confirmation of the appropriate cut line during transection. By placing the hanging tape or tube, the transected line can be always targeted toward this tape. As the tape is placed adjacent to the hepatic vein, appropriate transection can be accomplished with LHM when the first cut-line is appropriately obtained. Our experience indicates that the LHM and its application should be a useful operative technique in anatomic hepatic resections especially for trainees. When a liver tumor severely compresses or invades the vena cava, placement of a tube in the space between the liver and vena cava is impossible. However, in some cases, the compressed space can be relieved by lifting the liver, which allows placement of a soft nasogastric tube for LHM. A large tumor could also compress the transection plane or the main vessels in the preserved-side liver. Taking advantage of the weight of the tumor, the resected-side liver is gradually rotated by the LHM and an adequate transection plane can be opened out. Since the tube in the space between the liver and vena cava is always fixed, the surgeon can easily transect toward the tube without hesitation.

Conclusion

LHM can be applied for not only hemihepatectomy but also various anatomic resections. Our experience indicates that LHM can be applied also for right and left trisectionectomy and can be considered a key operative technique in liver resection for large hepatocellular carcinomas

References

1. Rui JA, Zhou L, Wang SB, et al. Hepatic trisegmentectomy for 29 patients with huge liver neoplasms. *Hepatobiliary Pancreat Dis Int*, 2002;**1**(2):187-90.
2. Liu CL, Fan ST, Cheung ST, Lo CM, Ng IO, Wong J. Anterior approach versus conventional approach right hepatic resection for large hepatocellular carcinoma: a prospective randomized controlled study. *Ann Surg* 2006;**244**(2):194-203.
3. Hasegawa K, Kokudo N, Imamura H, et al. Prognostic impact of anatomic resection for hepatocellular carcinoma. *Ann Surg* 2005;**242**(2): 252-9.
4. Belghiti J, Guevara OA, Noun R, Saldinger PF, Kianmanesh R. Liver hanging maneuver: a safe approach to right hepatectomy without liver mobilization. *J Am Coll Surg* 2001;**193**(1):109-11.
5. Kim SH, Park SJ, Lee S, et al. Various liver resections using hanging maneuver by three Glisson's pedicles and three hepatic veins. *Ann Surg* 2007;**245**(2): 201-5.
6. Gaujoux S, Douard R, Ettorre GM, Delmas V, Chevallier JM, Cugnenc PH. Liver hanging maneuver: an anatomic and clinical review. *Am J Surg* 2007;**193**(4): 488-92.
7. Sato H, Sugawara Y, Yamasaki S, et al. Thoracoabdominal approaches versus inverted T incision for posterior segmentectomy in hepatocellular carcinoma. *Hepatogastroenterology* 2000;**47**(32): 504-6.
8. Nagano Y, Togo S, Tanaka K, et al. The role of median sternotomy in resections for large hepatocellular carcinomas. *Surgery* 2005;**137**(1):104-8.

9. Kokudo N, Sugawara Y, Imamura H, Sano K, Makuuchi M. Sling suspension of the liver in donor operation: a gradual tape-repositioning technique. *Transplantation* 2003;**76**(5): 803-7.
10. Lesurtel M, Selzner M, Petrowsky H, McCormack L, Clavien PA. How should transection of the liver be performed? A prospective randomized study in 100 consecutive patients: comparing four different transection strategies. *Ann Surg* 2005;**242**(6): 814-22.
11. Man K, Fan ST, Ng IO, Lo CM, Liu CL, Wong J. Prospective evaluation of Pringle maneuver in hepatectomy for liver tumors by a randomized study. *Ann Surg* 1997;**226**(6): 704-11.
12. Ogata S, Belghiti J, Varma D, et al. Two hundred liver hanging maneuvers for major hepatectomy: a single-center experience. *Ann Surg* 2007;**245**(1): 31-5.
13. Suh KS, Lee HJ, Kim SH, Kim SB, Lee KU. Hanging maneuver in left hepatectomy. *Hepatogastroenterology* 2004;**51**(59): 1464-6.
14. Kokudo N, Imamura H, Sano K, et al. Ultrasonically assisted retrohepatic dissection for a liver hanging maneuver. *Ann Surg* 2005;**242**(5): 651-4.
15. Ettorre GM, Vennarecci G, Santoro R, et al. Modified liver hanging maneuver during orthotopic liver transplantation with inferior vena cava preservation. *Transplantation* 2003;**75**(2): 247-9.
16. Kim SH, Park SJ, Lee S, Lee WJ, Park JW, Kim CM. Isolated caudate lobectomy using the hanging maneuver. *Surgery* 2006;**139**(6): 847-50.

Figure legends

Figure 1. Insertion of a small nasogastric tube behind the liver.

Figure 2. Repositioning of each tube in the space between the hepatic parenchyma and Glisson's pedicle. (1) Between right anterior and posterior pedicles in case of left trisectionectomy. (2) or (2') On the left side of the umbilical pedicle in case of right trisectionectomy. Tube was replaced from (2) to (2') during transection. Arrow shows the tip of hanging tube. RHV: right hepatic vein, MHV: middle hepatic vein, LHV: left hepatic vein, GP: Glisson's pedicle, UP: umbilical pedicle

Figure 3. CT finding of a large hepatocellular carcinoma occupying the right liver and compressing the vena cava and the umbilical portal pedicle.

Figure 4. Right trisectionectomy. A nasogastric tube was inserted underneath the liver. The slim black arrow shows the direction of hepatic transection and the thick open arrow shows the direction of lifting. The curved thick arrow shows the direction of rotation of the resected and remnant liver. T: tumor, LHM: liver hanging maneuver, LHV: left hepatic vein, MHV: middle hepatic vein, UP: umbilical pedicle.

Figure 5. CT finding of a large hepatocellular carcinoma occupying central liver compressing the right hepatic vein.

Figure 6. Left trisectionectomy. The slim black arrow shows the direction of hepatic transection and the thick open arrow shows the direction of lifting. The curved thick arrow shows the direction of rotation of the resected and remnant liver. T: tumor, LHM: liver hanging maneuver, RHV: right hepatic vein.

Figure 1.

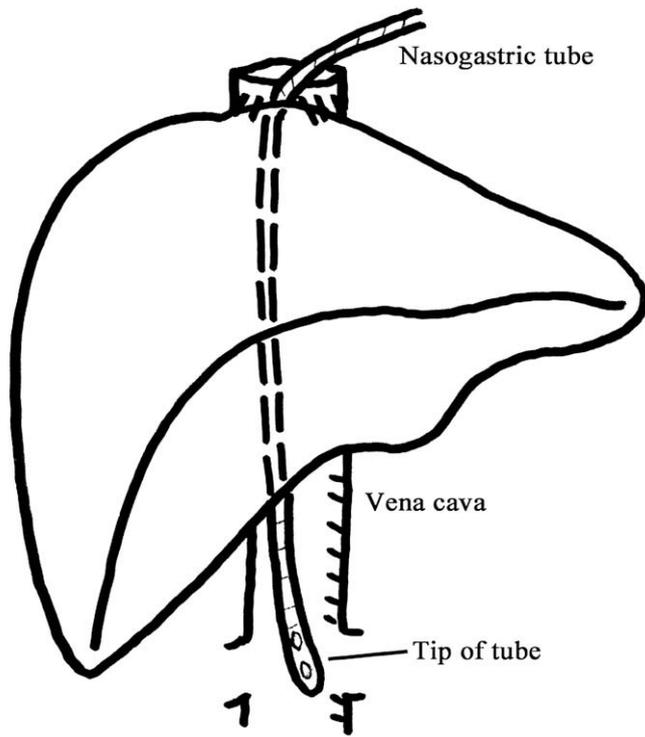


Figure 2.

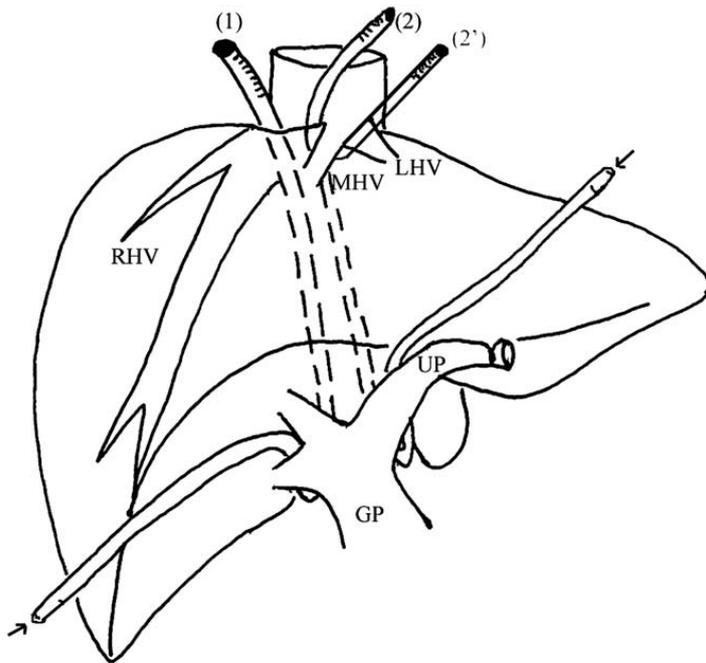


Figure 3.



Figure 4.

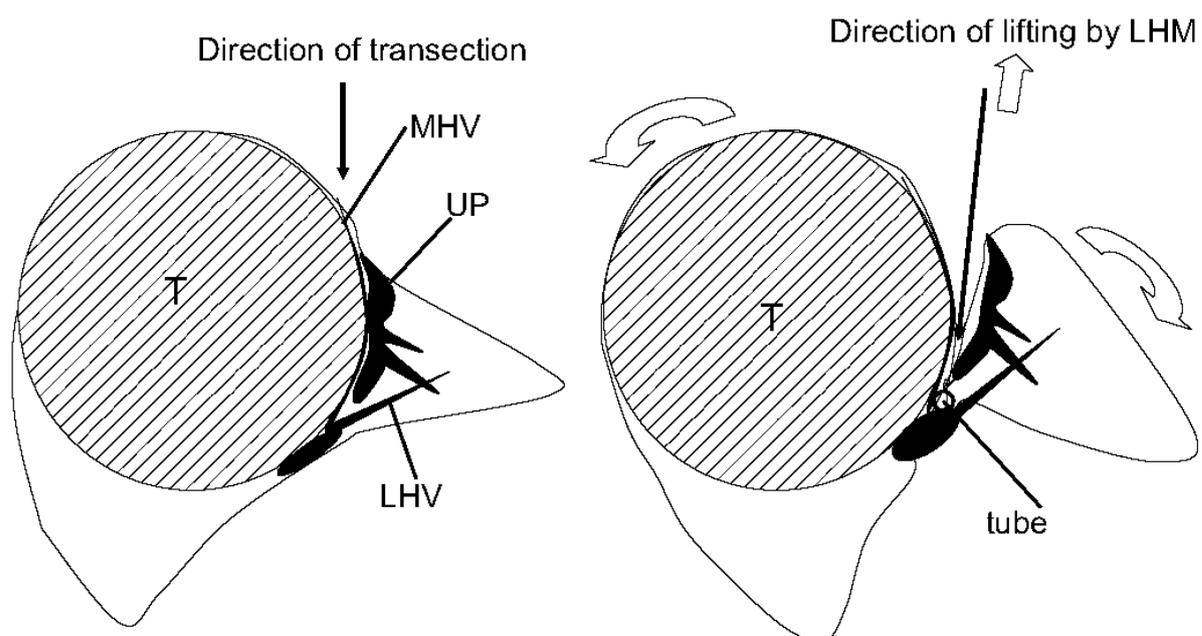


Figure 5.



Figure 6.

