Dorsal approach with Glissonian approach in laparoscopic anatomic hepatectomy for right lobe

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Technical advance

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Abstract

Background: Laparoscopic anatomic hepatectomy（LAH）has gradually become the routine surgical procedure. We reported previously that Glissonian approach combined with major hepatic vein first was effective for LAH. Owing to Dorsal approach could expose the major hepatic vein effectively, we merged dorsal approach and Glissonian approach in LAH for right lobe.

Methods: Twenty patients who underwent LAH from January 2017 to November 2018 were retrospectively analyzed. These comprised seven patients who underwent laparoscopic right hemihepatectomy (group LRH), seven patients who underwent laparoscopic right posterior hepatectomy (group LRPH), and six patients who underwent laparoscopic hepatectomy for segment 7 (group LS7). Firstly, the corresponding hepatic pedicles were isolated through Glissonian approach. Next, the liver parenchyma was transected by dorsal approach until the corresponding major hepatic vein was exposed. Then liver parenchyma was transected by a ventral approach. Finally, the root of the major hepatic vein was transected.

Results: The mean age of the patients was 53.8 years and the male: female ratio was 8:12. The median operation time was 306.0 ± 58.2 min and the mean estimated volume of blood loss was 412.5 ± 255.4 mL. The mean duration of postoperative hospital stay was 10.2 days. The mean Pringle maneuver time was 64.8 ± 27.7 min. Five patients received transfusion of 2–4 U of red blood cells. Two patients suffered from transient hepatic dysfunction and one from pleural effusion. No patient underwent conversion to an open procedure. The operative duration, volume of the blood loss, Pringle maneuver time, and postoperative hospital stay duration did not differ significantly among groups LRH, LRPH, and LS7 ($P > 0.05$).

Conclusion: Dorsal approach combined with Glissonian approach for right lobe in LAH is feasible and effective, though, it is essential to include more cases for further study.

Background

Hepatectomy has become a curative procedure for several liver diseases, such as liver neoplasms and hepatolithiasis[1–6]. Since being first successfully performed in 1991[7], laparoscopic hepatectomy has become a routine procedure[8,9]. However, the technical difficulties and the unique vision of laparoscope have restricted performance of laparoscopic anatomic hepatectomy (LAH) remaining in large medical centers[10,11]. Use of an appropriate approach can reduce the operation time and the volume of blood loss, promoting recovery[12,13]. We reported previously the feasibility of LAH using the Glissonian approach combined the major hepatic vein first[14]. However, exposing the whole hepatic vein is still a challenge because of the caudate lobe, particularly in right hepatectomy. Dorsal approach in laparoscopic left hemihepatectomy (LLH) was firstly reported to be efficient in 2014[15], which was free to transect the caudate lobe. Therefore, we combined dorsal approach and Glissonian approach in LAH for right lobe to expose the hepatic veins quickly. This surgical procedure is safe and effective for LAH, including for

laparoscopic right hemihepatectomy (LRH), laparoscopic right posterior hepatectomy (LRPH), and laparoscopic segmentectomy for segment 7 (LS7).

Methods

Patients

From January 2017 to November 2018, 20 patients underwent LAH in Department of Hepato-biliary-pancreatic Center and Transplantation Center, the Affiliated Drum Tower Hospital, School of Medicine, Nanjing University. Among the patients, seven underwent LRH (group LRH), seven received LRPH (group LRPH), and six patients underwent LS7 (group LS7). Seven of the patients had hepatocellular carcinoma (HCC), one had intrahepatic cholangiocarcinoma (ICC), seven had hepatic hemangioma, three had hepatolithiasis (HH), one had hepatic adenoma (HA), and one patient had hepatic angiomyolipoma (HAML). The perioperative indices of all patients are listed in **Table 1**.

The protocol was approved by the Research Ethics Committee of Drum Tower Hospital. Informed consent was obtained in writing from each patient, and the study protocol conformed to the ethical guidelines of the 1975 Declaration of Helsinki, as reflected by prior approval by the Institutional Review Board.

Operative procedures

The preoperative evaluation, postoperative management, port arrangement, and positioning of the 20 patients were as described previously[14]. All patients were placed in a left semi-decubitus position. The main surgeon stood on the patient's left side. The patient was placed in the reverse Trendelenburg position and the central venous pressure was maintained at < 5 cmH_2O. Five trocars were needed for LAH. One 12 mm paraumbilical trocar and carbon dioxide were used to establish the pneumoperitoneum, the pressure of which was maintained at 10–12 mmHg. A 30° flexible laparoscope was introduced through the paraumbilical trocar, and the other four working trocars were placed surrounding the right lobe. A tourniquet for the Pringle maneuver was set using a Nelaton catheter and vessel tape through a 5 mm incision on the left mid-clavicular line. The Pringle maneuver was performed at 15-min intervals to control hemorrhage. The operation began with division of the falciform ligament, which exposed the gap between the middle hepatic vein (MHV) and right hepatic vein (RHV). Next, the gallbladder was resected (in LRH or LRPH). The paracaval portion of the caudate lobe was freed from the IVC by means of the liver hanging maneuver.

Glissonian approach served to isolate and dissect the corresponding hepatic pedicles (right pedicle for LRH, right posterior pedicle for LRPH, or the pedicles for S7), then the demarcation line of the ischemic area appeared on the liver surface. Harmonic shear was used to transect parenchyma between IVC and main hepatic vein (MHV or RHV) firstly through dorsal approach. The corresponding major hepatic vein exposed from the dorsal approach as the intrahepatic landmark. Liver parenchyma between the diaphragmatic demarcation along the MHV or RHV was transected through the ventral approach toward

to the root of the RHV. The branches of the hepatic vein were dissected by Hem-O-lok ligating clip, meanwhile the root of the RHV was dissected by an automatic stapler in LRH or LRPH.

Lastly the specimen was free from the coronary, right triangular ligaments, and right adrenal gland. The key procedures were summarized. (**Fig. 1 for LRH, Fig. 2 for LRPH, Fig. 3 for LS7).** The tumor specimen was removed via a mini-laparotomy.

Statistical Analysis

Data analysis was conducted using SPSS Version 21.0 (SPSS, Inc., Chicago, IL, USA). The operative duration, volume of the blood loss, Pringle maneuver time, and postoperative hospital stay duration (POD) were analyzed. Data are expressed as medians (range) and were compared by one-way analysis of variance or the Kruskal–Wallis test. A value of $P < 0.05$ was considered indicative of statistical significance.

Results

The mean age of the patients was 53.8 years (range 35–66 years), and the male: female ratio was 8:12. The median operation time was 306.0 ± 58.2 min with the estimated volume of the blood loss was 412.5 ± 255.4 mL. The mean Pringle maneuver time was 64.8 ± 27.7 min. The mean POD was 10.2 days (range 5–22 days). Five of the patients underwent transfusion of 2–3 U of red blood cells (RBCs). Two patients suffered from transient hepatic dysfunction and one from pleural effusion. The perioperative indices of the patients are listed in Table 1.

In group LRH (n = 7), the mean operation time was 305.7 ± 52.3 min with the estimated volume of the blood loss was 478.6 ± 241.3 mL. Patients 3 and 6 underwent transfusion of 2–3 U of packed RBCs. The mean Pringle maneuver time was 49.3 ± 16.2 min. Patient 4 suffered from transient hepatic dysfunction. The mean POD was 12.3 days (range 6–22 days).

In group LRPH (n = 7), the mean operation time was 300.7 ± 57.8 min with the estimated volume of the blood loss was 414.3 ± 219.3 mL. The mean Pringle maneuver time was 76.4 ± 27.2 min. Patients 9 and 12 received transfusion of 2–3 U of packed RBCs, and patient 12 suffered from pleural effusion. The mean POD was 10.4 days (range 5–16 days).

In group LS7 (n = 6), the mean operation time was 312.5 ± 74.1 min with the estimated volume of the blood loss was 333.3 ± 326.6 mL. The mean Pringle maneuver time was 69.2 ± 34.3 min. Patient 17 underwent transfusion of 4 U of packed RBCs. No patient suffered from serious postoperative complications. The mean POD was 7.5 days (range 5–13 days).

None of the 20 patients underwent conversion to an open procedure. The operative duration, volume of the blood loss, Pringle maneuver time, and POD did not differ significantly among groups LRH, LRPH, and LS7 ($P > 0.05$) (Fig. 4).

Discussion

Anatomic hepatectomy is beneficial for patients with HCC in terms of the recurrence-free survival rate compared with non-anatomic hepatectomy in open surgery, although it may increase the operation time[16 – 20]. Because anatomic hepatectomy is based on the inflow and outflow corresponding to the target lobe or segment, the root of the Glisson pedicle and hepatic vein can serve as extrahepatic landmark, while the major hepatic vein can serve as intrahepatic boundary. Therefore, the pedicle is isolated through Glissonian approach, while the intrahepatic main hepatic vein is located with the guidance under intraoperative ultrasound. It is still a challenge for performers to locate the intrahepatic major hepatic vein under laparoscopy because of the double transection of two dimensions, especially in LAH, having a long learning curve of close to 50 cases[21, 22].

We reported in 2017 that the pedicles are connected to the corresponding main hepatic veins and we could expose the major hepatic vein first[14]. We used this strategy to perform more than 50 patients. During LAH, we found that the caudate lobe hampered exposure of the main hepatic veins. This hindered to expose the middle hepatic vein in right hepatectomy or of the right hepatic vein in right posterior segmentectomy. Koki Maeda et al.[23] previously reported 13 patients underwent LRH with caudodorsal appoach. Soubrane Olivier et al. [24] deemed that it is unnecessary for liver hanging maneuver. However, when a patient suffered from a huge carcinoma, due to little space to reverse the liver and expose the whole IVC, it is difficult to transect the liver through dorsal approach. The liver hanging maneuver is critical in hepatectomy[25]. Under laparoscopic view, it is convenient to perform hanging maneuver than under open view and we use this way in all cases[26]. When Glisson pedicles were isolated, Goldfinger dissector was used to dissect the anterior surface of the IVC. With the assistance of intraoperative ultrasound and extrahepatic landmark, we have enough space to transect the parenchymal between IVC and MHV through hanging maneuver. Although a group of scholars hold that ventral approach using the liver hanging maneuver is better than caudal approach, the number of the patients is too small and it is a retrospective study design[27]. High quality of randomized controlled trials (RCT) are required, and we have registered a Chinese clinical trial in 2018 titled “A randomized controlled trial of Glissonian maneuver combined with dorsal approach and anterior approach: a practical strategy for laparoscopic anatomic hepatectomy” (ChiCTR1800015563). Under laparoscopic view, Glissonian approach could find the main hepatic vein quickly, while dorsal approach could transect the caudate lobe with the liver hanging maneuver effectively. Thus, combined dorsal approach with Glissonian approach could facilitated exposure of the entire main hepatic vein. This modified strategy was testified to be feasible and efficient in LRH, LRPH and LS7 as well.

When performing segmentectomy for S7, dorsal approach cannot apply to the liver with thick inferior right hepatic vein. Okuda et al.[28] reported six patients were performed LS7 through intrahepatic Glissonian approach with dorsal approach by intercostal trocars, which could increase the risk of intercostal artery hemorrhage and need two more trocars. In our center, the main surgeon stood on the

patient’s left side, which could follow an oblique angle and expose the right hepatic vein. By means of intraoperative ultrasound, S7 pedicles could be showed from the dorsal vision.

Although it still took us a long time to perform LAH with dorsal approach and Glissonian approach, the distinct landmark made us no longer ‘get lost’.

Conclusion

Dorsal approach with Glissonian approach in LAH for right lobe is feasible and effective. However, the operation time was approximately 300 min, similar to that of the traditional approach. The sample size was small and it is essential to include more cases for further study.

Abbreviations/acronyms

LAH = laparoscopic anatomic hepatectomy

LLH = laparoscopic left hemihepatectomy

LRH = laparoscopic right hemihepatectomy

LRPH = laparoscopic right posterior hepatectomy

LS7 = laparoscopic hepatectomy for segment 7

IVC = inferior vena cava

MHV = middle hepatic vein

RHV = right hepatic vein

RBC = red blood cell

HCC = hepatocellular carcinoma

RAP = right anterior pedicle

RPP = right posterior pedicle

PP = paranasal portion

CP = caudate process

S7P = Glissonian pedicles of segment 7

S5HV = segment 5 hepatic vein

S6HV = segment 6 hepatic vein

S7HV = segment 7 hepatic vein

S8HV = segment 8 hepatic vein

POD = postoperative hospital stay duration

Declarations

Ethics approval and consent to participate

This study was approved by Ethic Committee of Nanjing Drum Tower Hospital, and this Ethic Committee comply with the Declaration of Helsinki (Approval No. 2018–085-01). Informed consent was obtained from all individual participants included in the study and we received written informed consent from all eligible patients.

Consent for publication

Written informed consent for publication was obtained from all of the patients. Copies of consent forms containing personal or clinical details or any identifying images published in this study are available on request.

Availability of data and materials

All data generated or analyzed during this study are included in this published article and its supplementary information files. The datasets generated and analyzed during the current study are available from the corresponding author by email yudecai@nju.edu.cn on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Study conception and design: YDC, SXT, SBC

Acquisition of data: WSH, ZWJ, LQY, YY

Analysis and interpretation of data: WSH, ZWJ

Drafting of manuscript: WSH, YDC, SXT

Critical revision: YDC, SXT

All authors have read and approved the manuscript.

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Tables

Table 1 Patient Characteristics

Number	Age range (y)/ Sex#	Diagnosis	Operation time (min)	Pringle maneuver time (min)	Blood loss (ml)	POD (d)	Postoperative complications
Group LRH							
1	50-59/1	HCC	210	60	600	6	none
2	40-49/2	HL	270	30	200	7	none
3*	30-39/2	HL	345	45	600	18	none
4	50-59/2	HL	360	40	300	22	transient hepatic dysfunction
5	30-39/2	HM	320	45	200	8	none
6*	60-69/1	HM	340	80	800	9	none
7	60-69/1	ICC	295	45	650	16	transient hepatic dysfunction
Group LRPH							
8	40-49/1	HA	315	105	300	15	none
9*	50-59/1	HCC	335	75	700	9	none
10	50-59/2	HCC	260	45	100	9	none
11	50-59/1	HCC	350	75	500	12	none
12*	50-59/1	HCC	375	120	200	16	pleural effusion
13	50-59/2	HM	220	60	500	5	none
14	50-59/2	HM	250	55	600	7	none
Group LS7							
15	60-69/2	HAML	235	40	200	9	none
16	60-69/1	HCC	260	60	200	6	none
17*	60-69/2	HCC	430	130	1000	13	none
18	40-49/2	HM	260	35	200	5	none
19	60-69/2	HM	350	75	200	5	none
20	30-39/2	HM	340	75	200	7	none

POD, postoperative hospital stay duration; M, Male; F, Female; HCC: hepatocellular carcinoma; ICC, intrahepatic cholangiocarcinoma; HL: hepatolithiasis; HM, hepatic hemangioma; HA, hepatic adenoma; HAML, hepatic angiomyolipoma; LRH, laparoscopic right hemihepatectomy; LRPH, laparoscopic right posterior hepatectomy; LS7, laparoscopic segment 7 hepatectomy; *, Case 3, 6, 9, 12, 17 transfused 2-3 U packed red blood cells;#, amending sex from "M" and "F" to "1" and "2", without addressing which sex corresponds to which number.

Supplementary Material

Supplemental Video 1:

Dorsal approach with Glissonian approach in laparoscopic right hemihepatectomy (LRH)

Supplemental Video 2:

Dorsal approach with Glissonian approach in laparoscopic right posterior hepatectomy (LRPH)

Supplemental Video 3:

Dorsal approach with Glissonian approach in laparoscopic hepatectomy for segment 7 (LS7)

Figures

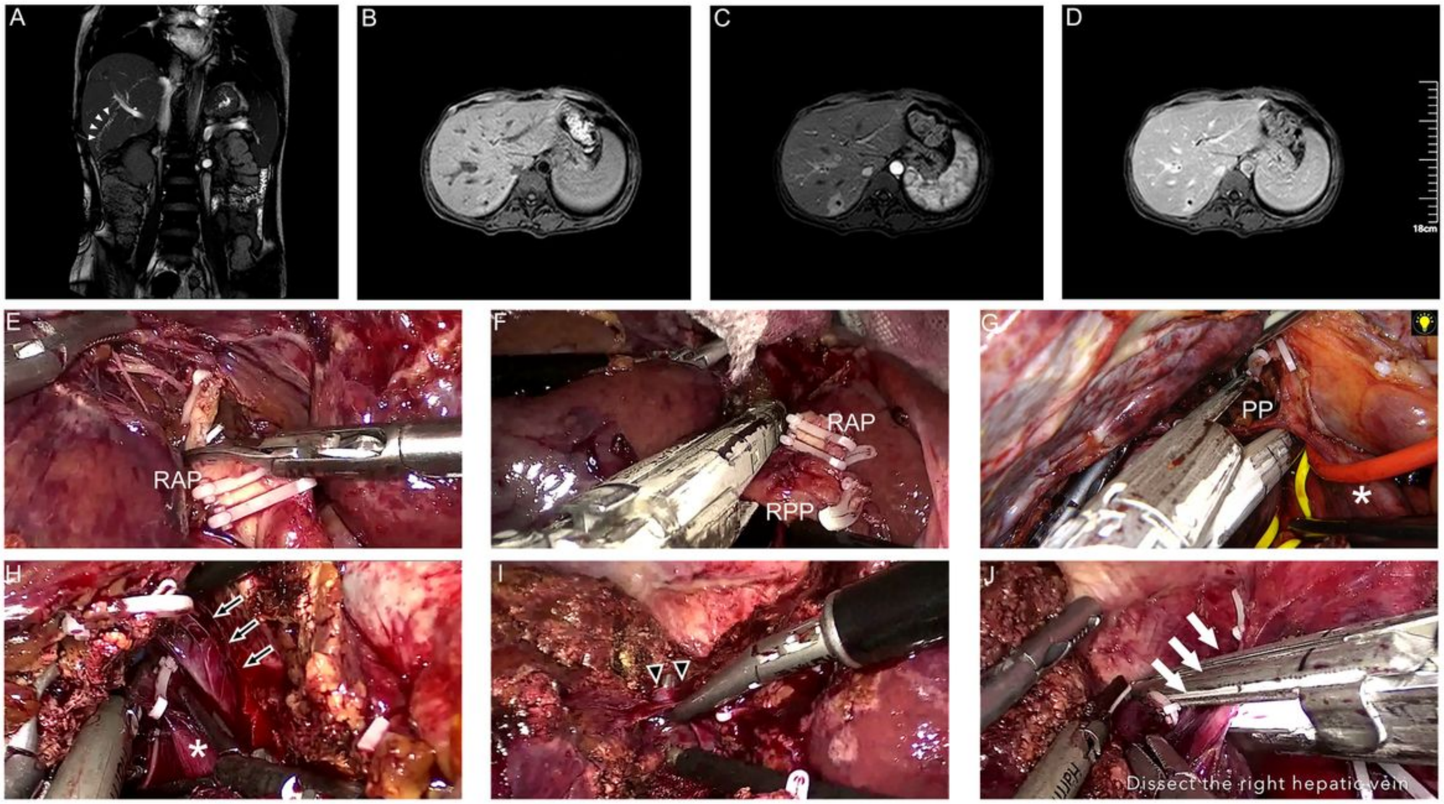

Figure 1

Dorsal approach with Glissonian approach in laparoscopic right hemihepatectomy (LRH) Preoperative MRI showed hepatolithiasis (A-D) and intraoperative key view during procedure (E-J):E, to isolate RAP; F, to isolate RPP; G, to transect PP of the caudate lobe between MHV and IVC; H, to expose MHV and transect liver parenchymal along MHV through dorsal approach; I, to isolate S5HV through ventral approach; J, to dissect RHV. White arrowheads, hepatolithiasis; white asterisk, IVC; black arrows with white edge, MHV; black arrowheads with white edge, S5HV; white arrows, RHV.

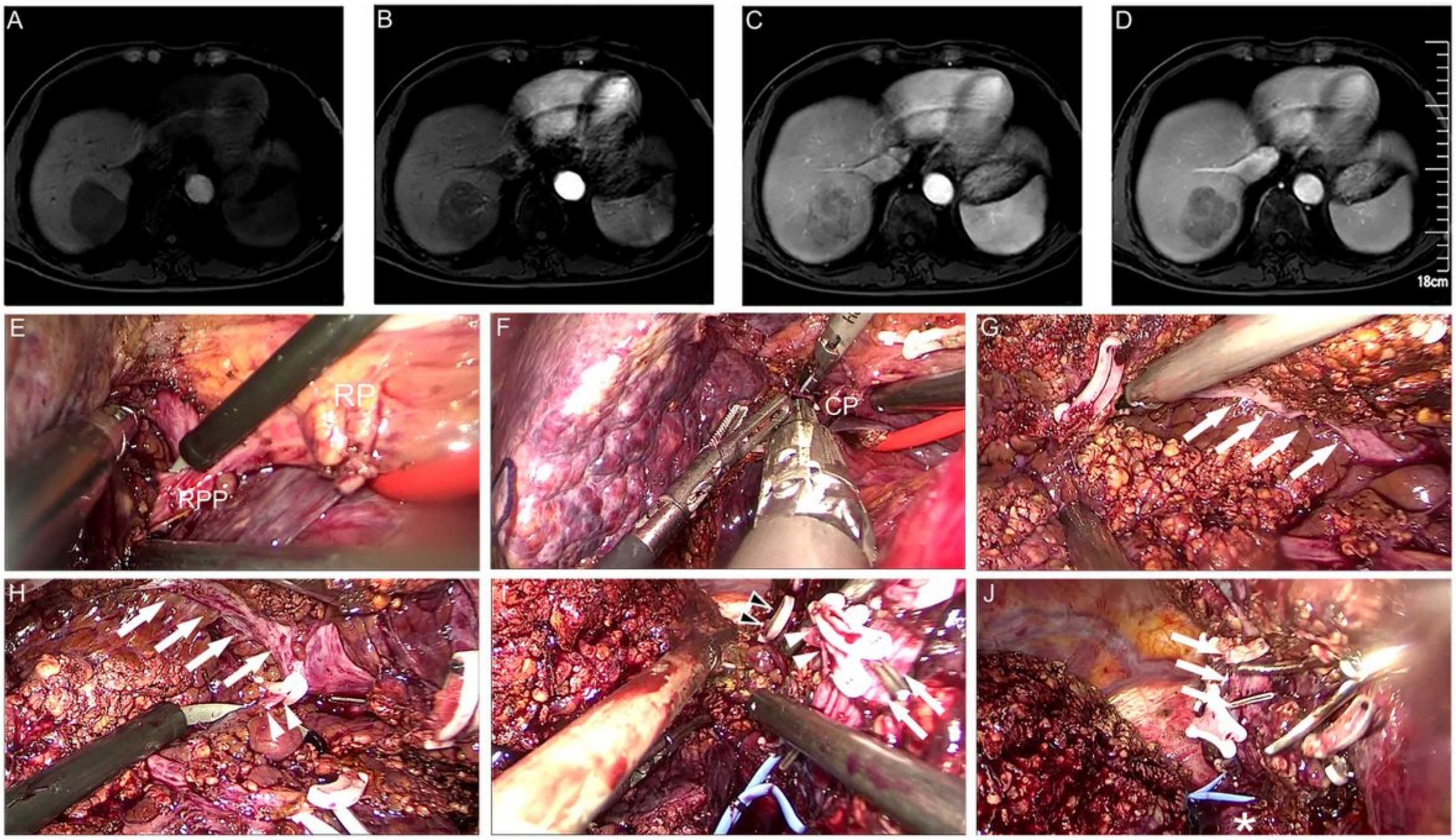

Figure 2

Dorsal approach with Glissonian approach in laparoscopic right posterior hepatectomy (LRPH) Preoperative MRI showed HCC (A-D) and intraoperative key view during procedure (E-J) :E, to isolate RPP; F, to transect liver parenchymal of CP ; G, to transect liver parenchymal between RHV and IVC through dorsal approach; H, to isolate S6HV; I, to isolate S7HV; J, the right posterior of liver was transected, and RHV was clearly shown. White arrows, RHV; White arrowheads, S6HV; black arrowheads with white edge, S7HV; white asterisk, IVC.

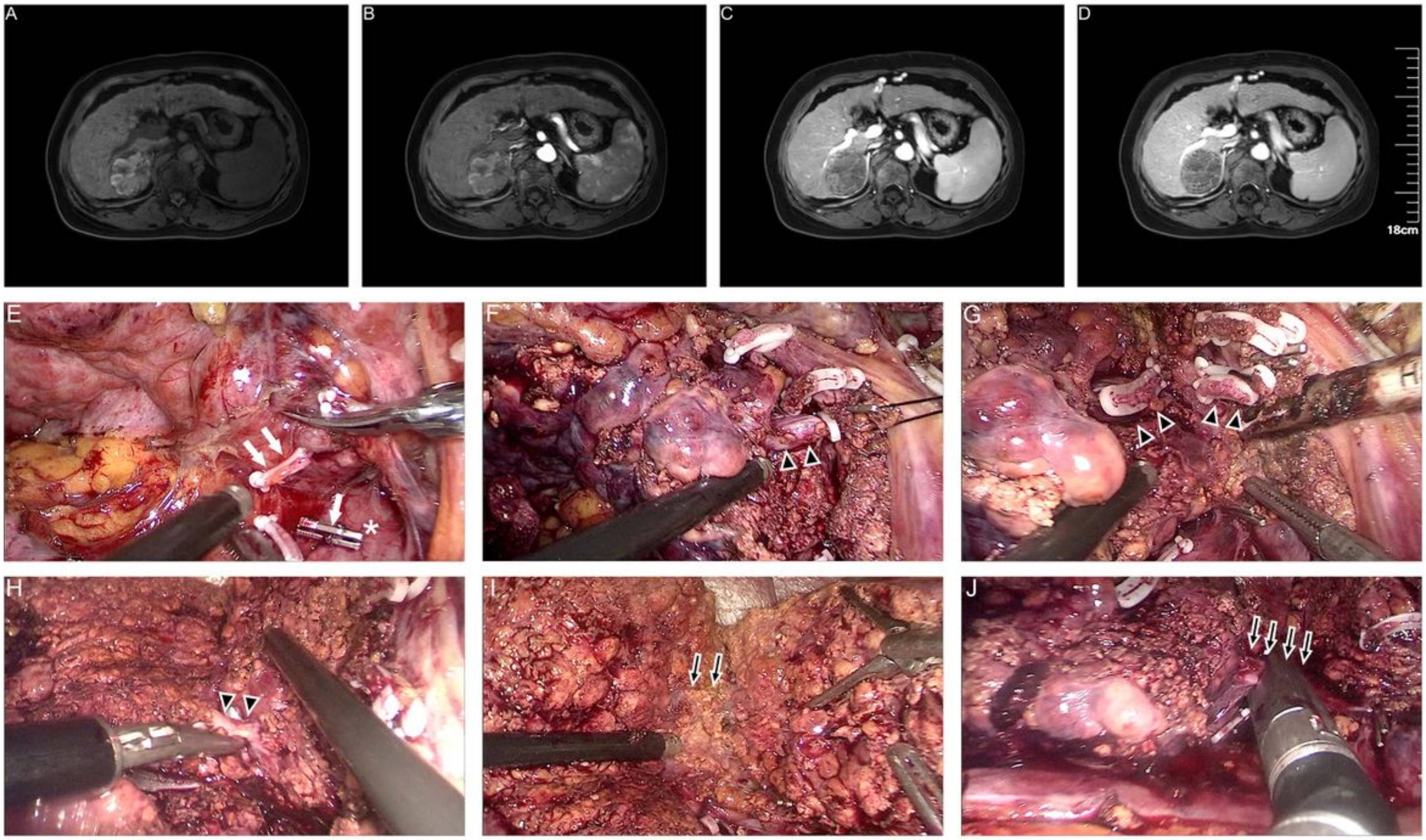

Figure 3

Dorsal approach with Glissonian approach in laparoscopic hepatectomy for segment 7 (LS7) Preoperative MRI showed HCC (A-D) and intraoperative key view during procedure (E-J): E, to isolate the short hepatic vein; F, to isolate S7P; G, to transect liver parenchymal through dorsal approach; H, to isolate S7P through ventral approach; I, to isolate S7HV; J, the S7HV and S7 was transected. White arrows, the short hepatic vein; white asterisk, IVC; black arrowheads with white edge, S7P; black arrows with white edge, S7HV.

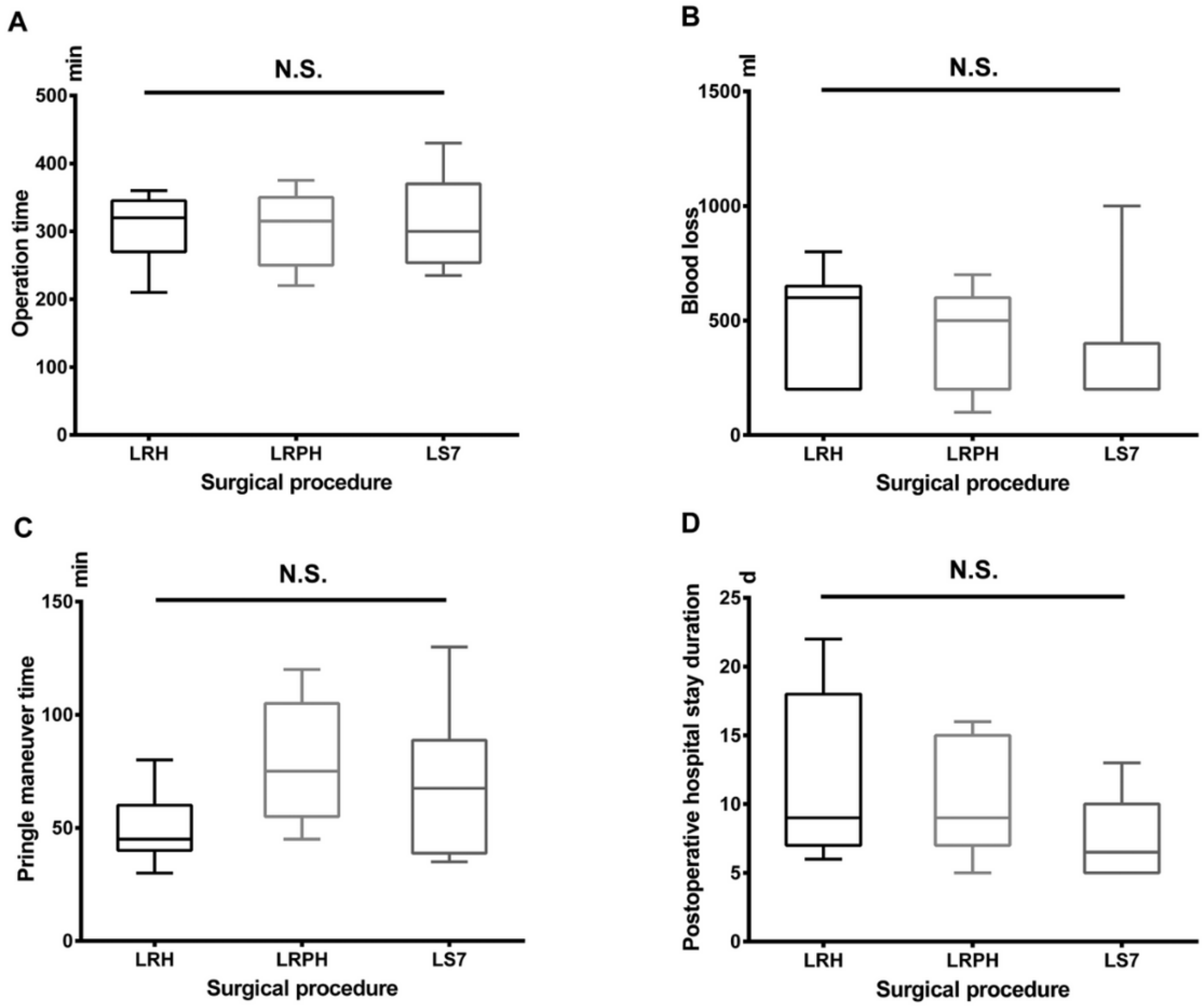

Figure 4

Comparison about operation time (A), blood loss (B), pringle maneuver time (C) and postoperative hospital stay duration (D) among Group LRH, LRPH and LS7 There was no significance about operation time (A), blood loss (B), pringle maneuver time (C) and postoperative hospital stay duration(D) among Group LRH, LRPH and LS7.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Supplementalvideo3LS7.mp4
- Supplementalvideo2LRPH.mp4
- Supplementalvideo1LRH.mp4