



# Pure laparoscopic donor right hepatectomy: exploring the dark side of the moon

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*Comment on:* Hong SK, Lee KW, Choi Y, *et al.* Initial experience with purely laparoscopic living-donor right hepatectomy. *Br J Surg* 2018;105:751-9.

Received: 30 July 2018; Accepted: 16 August 2018; Published: 17 August 2018.

doi: 10.21037/ls.2018.08.02

View this article at: <http://dx.doi.org/10.21037/ls.2018.08.02>

The group operating at the Department of Surgery—Seoul National University Hospital may be appropriately considered the current excellence in term of expertise and pioneering in the field of laparoscopic donor hepatectomy for living donor liver transplantation (LDLT). They have recently published several articles reporting their experience on what can be considered, according to the Louisville consensus conference held in 2008 (1), the most challenging and controversial procedure in laparoscopic liver surgery: pure laparoscopic donor right hepatectomy (PLDRH). Surely the report of Lee *et al.* (2) represents the most comprehensive analysis of their activity, including 115 donors during the period November 2015–June 2017 and showing excellent results. However, we believe that the study of Hong *et al.* (3) owns the value of providing a critical and detailed investigation on the performance of PLDRH, thus outlining several interesting and useful points of discussion on the topic.

Laparoscopic hepatectomy is defined as a minimally invasive surgical procedure due to the reduction of the surgical wound extent to just the trocars insertion sites in most cases. This technical aspect has been demonstrated to positively impact the surgical outcome by decreasing the postoperative pain, enhancing early resumption of oral feeding, shortening the hospitalization, reducing the risk of incisional hernia or other wound complications and providing a better cosmetic result (3–6). Furthermore, a recent review showed that laparoscopic liver resection may result in fewer overall complications and less blood loss than open liver resection (4). Under this perspective a purely laparoscopic approach would be the ideal standard of

practice for donor surgery in LDLT.

However, donor hepatectomy entails several specific technical demands. Precise transection of the bile duct is crucial to provide respectively an adequately long stump for biliary reconstruction in recipient and an adequate margin from the biliary bifurcation to prevent either biliary leak or stricture in donors (2,3,5,7,8). The parenchymal transection plane along the Cantlie's line must be precisely maintained to minimize congestion or ischemic injury of both liver graft and remnant (5). Overall, donors are healthy individuals who free willingly expose themselves to an invasive procedure, thus every effort should be made to minimize the risk of any intraoperative or postoperative complication.

The knowledge about the safety profile of PLDRH has been currently based mainly on retrospective and relatively small sample size studies with just few comparative studies with open donor hepatectomy (5,9). These limits may potentially hinder an objective and comprehensive evaluation of the performance and outcomes.

Other centers have also performed and reported on PLDRH but with just single case reports or small case series (10–14). This is why the experience of the group led by Professor Suh, based on more than 120 procedures, represents a landmark on the topic.

The main merit of Hong *et al.* (3) to be acknowledged is the attempt to investigate those intraoperative events which do not necessarily evolve into major postoperative complications but represent a potential hazard and are frequently under-estimated and under-reported by the studies.

Indeed, what makes PLDRH a challenging and highly complex procedure are the restrictions in movements and view determined by the fixed port sites. Thus, a purely technical issue (2,3,5,9)

PLDRH is characterized by a caudal view with a relatively vertical axis of movement range through the working ports which both may impair appropriate operative field exposure and angle of dissection, ligation or division. These limits may potentially increase the risks of vascular, biliary and parenchymal complications (3,9)

Hong *et al.* (3) accurately and precisely report the consequences of such technical difficulties, providing a reliable picture of the harms which one may occur in during PLDRH. In 2/26 donors (7.7%) the plane of parenchymal transection was incorrect at the right upper deep portion with exposure of the right hepatic vein. In 2 donors (7.7%) a portal vein injury developed: in one case it occurred during caudate lobe transection and required intracorporeal suturing; in the other case the stapling line at the remnant portal vein resulted oblique rather than vertical, causing mild twisting which luckily did not affect the portal flow and did not require further treatment. One donor (3.8%) had a remnant left bile duct stricture because the suturing on the remaining left Glissonian tissue was too deep. One donor (3.8%) experienced thermal injury of the hepatic artery inadvertently caused by the use of Cavitron ultrasonic surgical aspirator with overlooked differences in the axis of view and working plane. Two donors (7.7%) experienced right liver surface damage, caused by the xiphoid trocar during mobilization. Furthermore, in the postoperative course 2 patients required reoperation respectively for immediate postoperative bleeding at a small venous branch of the inferior vena cava (IVC), probably masked by the pneumoperitoneum of laparoscopy, and a biliary stricture that was treated by resuturing. Overall, no cases of intraoperative transfusion or open conversion were recorded, outlying the high level of laparoscopic expertise.

Surely the accumulation of technical experience and the implementation of new technologies have both contributed to significantly reduce the risk of such adverse surgical events. In the study of Lee *et al.* (2) the comparison of the outcomes of initial (November 2015–October 2016) *vs.* more recent (November 2016–June 2017) periods of surgical activity showed that greater experience was associated with a statistically significant shortening of the operation time and time for liver graft removal (but similar warm ischemic time), reduced blood loss, and shortened hospitalization. Moreover, all the cases of postoperative

complications greater than grade III on the Clavien-Dindo scale and the cases of rehospitalization occurred just in the initial period. The introduction of the 3-dimensional and flexible laparoscope and the real-time indocyanine green (ICG) near-infrared fluorescence technique for both demarcation of the Cantlie's plane and identification of the optimal bile division site have been recognized as fundamental determinants of the outcomes improvement as well (2,3,9). Nevertheless, the incidence of double portal vein orifices and multiple bile duct openings, identifying a division level too close to the graft with resulting more complex reconstruction during graft implantation, did not significantly decrease. Furthermore, when compared to conventional open right hepatectomy (9), PLDRH was associated with longer operation time, longer warm ischemia time, higher estimated blood loss, higher postoperative aspartate aminotransferase (AST)/alanine aminotransferase (ALT) peak level and higher incidence of multiple bile duct openings of the graft. In 2 cases hepatic artery thrombosis in recipients were related to problems at graft side of the vessel, resulting in a higher rate of hepatic artery thrombosis compared to their previous reports (14). Nonetheless the incidence of donors and recipients' postoperative complications were similar.

Thus, it can be concluded that the feasibility and safety of PLDRH at the Department of Surgery of Seoul National University Hospital have undoubtedly been proved but the real questions still to be answered are: which is the final aim of the clinical research on PLDRH? Can it be developed to become an accessible and widespread surgical technique for a future standard of practice?

Laparoscopy itself owns several advantages even from the technical point of view. The magnified view provided by the laparoscope may increase the preciseness of dissection identifying smaller vascular or biliary structures and more accurate surgical planes (5,6,15). Furthermore, the laparoscope viewing can be empowered by real-time ICG near-infrared fluorescence technique for perfusion area or biliary tract demarcation, as already mentioned (5,15,16).

Thanks to the report of Hong *et al.* (3) with real-intro-practice examples of complicated intraoperative events and the comparative study of Suh *et al.* (9), the most complex and risky phases of PLDRH may be identified. These appeared not to be the right liver mobilization and isolation from the IVC but actually the right hepatic triad division and the parenchymal transection.

The rationale that has parallelly sustained the employment of laparoscopic-assisted or hybrid donor

hepatectomy (HDH) is to apply an integrated procedure which compensate the limits and maintain the advantages of both laparoscopy and open approach (17,18).

In HDH the mobilization of the right liver with progressive exposure of the IVC until the right adrenal gland is visualized, is performed under laparoscopic guidance. Therefore, the liver can be retracted medially into a small upper midline incision of usually around 12 cm (17). Hepatic hilar dissection and parenchymal transection, the most hindered phases in laparoscopy, can be performed under direct open view, without any movement restriction, and in combination with Ultrasound Doppler and 3-dimensional cholangiogram surveillance. Moreover, the open approach still guarantees the possibility for a prompt and efficacious reaction in case of incidental events such major bleeding. Obviously real-time ICG near-infrared fluorescence technique can still be used. The need for subcostal incision with muscle layer interruption is therefore avoided with low impact on the patient's capacity to physically recover after surgery (17). Two recent meta-analysis comparing HDH to conventional open procedure (19,20) showed that HDH was associated with significantly shorter operative time, reduced blood loss, lower postoperative pain, shorter hospital stay and lower overall morbidity.

In conclusion, we believe that PLDRH is a fascinating and highly elegant surgical procedure which mirrors the high level of expertise in both LDLT and laparoscopic liver surgery of the centers where it is performed. However, we feel that pragmatism should drive the clinical practice into the development of new procedures which aim to improve globally the quality of the health care reaching the widest grade of diffusion with the highest level of safety. This, relying less on the availability of the latest new technologies and the highest surgical proficiency. Under this perspective HDH currently appears to meet more such needs. Enthusiastically promoting the feasibility of PLDRH as part of the routine clinical practice may expose both patients and surgeons to overlook serious intraoperative hidden hazards. Therefore, practical selection criteria such absence of biliary or portal anomalies still appear a relevant clinical recommendation. Hopefully new developments in the surgical technique will someday establish PLDRH as the new gold standard of practice.

## Acknowledgments

*Funding:* None.

## Footnote

*Provenance and Peer Review:* This article was commissioned by the editorial office, *Laparoscopic Surgery*. The article did not undergo external peer review.

*Conflicts of Interest:* The authors have completed the ICMJE uniform disclosure form (available at <http://dx.doi.org/10.21037/ls.2018.08.02>). The authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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doi: 10.21037/ls.2018.08.02

**Cite this article as:** Pravisani R, Takatsuki M, Baccarani U, Eguchi S. Pure laparoscopic donor right hepatectomy: exploring the dark side of the moon. *Laparosc Surg* 2018;2:37.