ORIGINAL ARTICLE

The many faces of ALPPS: surgical indications and techniques among surgeons collaborating in the international registry

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Abstract

Background: ALPPS was developed to induce accelerated future liver remnant (FLR) hypertrophy in order to increase hepatic tumour resectability and reduce the risk of post-operative liver failure. While early studies demonstrated concerning complication rates, others reported favourable results. This inconsistency may be due to variability in surgical indications and technique.

Methods: A web-based survey was sent to surgeons participating in the International ALPPS Registry in September of 2014. Questions addressed surgeon demographics and training, surgical indications and technique, and clinical management approaches.

Results: Fifty six out of 85 surgeons from 78 centers responded (66%) and half (n = 30) had training in liver transplantation. Forty seven (84%) did not reserve ALPPS solely for colorectal liver metastases (CRLM) and 30 (54%) would perform ALPPS for an FLR over 30%. Neoadjuvant chemotherapy for CRLM was recommended by 37 (66%) respondents. Surgical approaches varied considerably, with 30% not preserving outflow to the middle hepatic vein and 39% believing it necessary to skeletonize the hepatoduodenal ligament. Twenty five (45%) surgeons have observed segment 4 necrosis.

Conclusion: There is considerable variability in how ALPPS is performed internationally. This heterogeneity in practice patterns may explain the current incongruity in published outcomes, and highlights the need for standardization.

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Introduction

Controversial since its first description in 2012, the ALPPS procedure has demonstrated impressive accelerated liver hypertrophy and expansion of resectability for high liver tumour load, as well as unacceptably high morbidity and mortality.[1–13] Inconsistent results plague the procedure: some centers report high mortality rates[5,8] while others report no mortality.[3,4,7,13] The source of this inconsistency is uncertain. Our group hypothesized that variation with respect to indications for surgery, pre-operative decision making, perioperative care, and surgical technique may explain some of these inconsistencies in published outcomes. This information might be a first step in achieving an acceptable multicenter morbidity and mortality through international standardization of patient selection, indications and surgical technique.

ALPPS has been plagued by skepticism since the original landmark study was published in 2012. This study reported an unacceptably high 90-day mortality of 12%,[1] and subsequent reports also confirmed this high risk.[2,5,6,8,14] Individual centers have reported mortality rates up to 22% and 29%.[5,8] ALPPS has also been associated with a high rate of severe complications (Clavien-Dindo classification over IIIB), with some series reporting up to 28%.[6] The first analysis of the international registry reported that the rate of post-operative liver failure by 50-50 criteria is 9% after either the first or second stage of ALPPS.[6] This has led to calls for caution from experienced liver centers[15,16] and controversial discussions at recent hepatobiliary meetings.

Not all ALPPS outcomes have been so problematic. In fact, several studies have demonstrated impressive hypertrophy with a

60–90% increase in volume between stages 1 and 2, with almost all patients going on to complete the second stage with an R0 resection.[1–13] Furthermore, some centers have reported no mortalities and low morbidity in their series.[3,4,7,13]

Two explanations for this variability in reported ALPPS outcomes among centers have been suggested. The first explanation is variability in surgical indications, which was suggested by an analysis of the international registry report to play a major role in determining outcomes.[6] For instance, the use of ALPPS for primary liver tumours was associated with high morbidity and mortality, especially in elderly patients; similarly, a prolonged stage 1 with operating time over 5 h, combined with blood transfusions, yielded inferior outcomes.[6] The second explanation for variable ALPPS outcomes is the abundance of technical variations on the original ALPPS technique. Developed in an attempt to improve outcomes, these include the non-touch anterior approach,[17–19] the "hybrid ALPPS" which combines parenchymal transection with portal vein embolization,[20] the use of a liver tourniquet rather than an in-situ split of liver parenchyma,[10] radio-frequency assisted liver partition (RALPP),[21] laparoscopic ALPPS,[22–24] as well as a myriad of modifications regarding which segments of the liver are resected and preserved.[25–27]

While ALPPS outcomes have garnered much controversy, variability in surgical indications and technical procedures have received insufficient attention. Before rejecting ALPPS as unsafe, these explanations require systematic study. Towards this end, a voluntary survey was conducted of surgeons collaborating in the international ALPPS registry to explore their approaches to surgical indications and surgical technique.

Methods

The survey instrument was created by consensus amongst experts in the ALPPS procedure. An initial draft was pilot tested with additional experts and modified based on feedback. The study protocol and survey questions were approved by the Scientific Committee of the International ALPPS Registry. The final survey instrument contained 47 questions designed to evaluate current practice patterns among surgeons performing the ALPPS procedure internationally. It was divided into five thematic sections consisting of questions addressing: demographics and training of respondents, indications for ALPPS, surgical technique of stage 1, clinical management during the interval between stages 1 and 2, and surgical technique of stage 2.

Specific questions pertained to patient factors, tumour characteristics, indications for ALPPS, and the use of systemic chemotherapy. Further questions sought out surgeons' opinions regarding the use of intraoperative ultrasound, parenchymal transection, approach to the hepatoduodenal ligament, and approach to ligation of the right portal vein during stage 1, as well as the right hepatic artery and bile duct in stage 2. Additional questions were posed regarding perioperative care such as postoperative nutrition, use of deep vein thrombosis (DVT) prophylaxis, diagnosis and treatment of post-hepatectomy liver failure, as well as specific complications.

E-mail invitations for participation in the survey as well as a link to the web-based survey (QuestionPro, 2014) were sent to all attending HPB surgeons from centers that are members of the ALPPS registry (Appendix 1 and 2). The International ALPPS Registry was initiated in 2012 and included over 500 patients from 78 centers in 48 countries in March 2015. The invitation e-mail stipulated that participation in the survey was voluntary and anonymous with no financial incentive, and consent was inferred with participation. Using a modified Dillman approach,[28] after the initial email invitation in September of 2014, potential participants received three additional weekly reminders with a defined end date for participation in the survey in October of 2014. Opening the e-mail and viewing the survey was considered as receiving the invitation for purposes of response rate calculation. Each participant was assigned a unique coded identification number by the web-based software to determine survey completion without linkage to identifying data, and all survey responses remained de-identified for analysis.

Data are presented primarily as frequencies with associated percentages. Categorical responses were compared using chi-square or Fischer's exact tests where appropriate. All data were analyzed using SPSS Version 20 (Chicago, Ill), with a p-value of <0.05 considered significant.

Results

Demographics, training, clinical practice, and experience of participants

Eighty-five attending surgeons with an independent practice from 78 international centers were individually addressed by e-mail. Fifty-six attending surgeons completed the survey (response rate 66%). The majority of the respondents (n = 36, 64%) were from Europe with fewer surgeons from North America (n = 4, 7%), South America (n = 5, 9%), and Asia (n = 9, 16%). Approximately half of the respondents (n = 30, 54%) had training in liver transplantation. The majority of surgeons surveyed (n = 34, 61%) did not perform liver transplantation in their current practice. The majority of respondents (n = 50, 89%) had performed 12 or less ALPPS procedures, and 24 surgeons (43%) reported performing ALPPS for 1 year or less at the time of survey completion.

Indications for ALPPS

Age and performance status

Most respondents (n = 41, 73%) consider patient age in their pre-operative decision making and patient selection, but only 2 out of 56 surgeons (4%) stated that they had a firm age cut-off, beyond which they would not consider performing ALPPS. For most (n = 46, 82%) respondents, patients considered for ALPPS have to be at minimum ambulatory. No respondents reported