Case-Based Lessons in the Management of Complex Hepato-Pancreato-Biliary Surgery

Timothy M. Pawlik
Sharon Weber
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We dedicate this book to our families and to our patients

Foreword

The only source of knowledge is experience

Albert Einstein (1879–1955)

We learn from our experiences. When faced with unusual and difficult situations in which we have limited experience and are out of our comfort zone, we depend on the experiences of others. This is at the core of training in surgery, where residents and fellows learn from experienced surgeons and mentors. What do you do when you are faced with a patient with a difficult or unusual condition and do not have ready access to a colleague with whom to discuss the case, or even seek assistance with the operation? We depend on the literature.

The editors of this book have assembled in one source an international team of experts in hepato-biliary and pancreatic surgery to share their experiences with the management of difficult Hepato-Pancreato-Biliary (HPB) conditions and new therapeutic alternatives. Collectively, the individual authors have well in excess of 300 years' experience with complex HPB patients. The case study approach is the foundation of this book. It allows the reader to learn from experiences in the management of unique patients and the application of innovative techniques. The case method provides the learner with immediate information concerning pattern recognition of the problem at hand, the pre-operative thinking of the surgeons and, importantly, the intraoperative management and technical approach to the patient. Some of the patients presented are incredibly complex and represent one-of-kind situations, others represent difficult management issues or technical challenges, and still others present controversies in treatment. In addition, the content includes excellent discussions of minimally invasive and robotic approaches.

Whether you are a surgeon in training or an experienced hepato-biliary pancreatic surgeon, I think you will find this text an essential complement to your library.

Columbus, OH

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Preface

Hepato-Pancreato-Biliary Surgery is a field filled with unique challenges and requires perspective for rare cases. Such cases commonly demand a set of complex skills. While cases are not routine, the clinical scenarios demand an expertise and insight to offer patients state of the art therapy.

Our goal was to create a case based learning resource based on authorities in the field who share their patients and experience with the reader. Each chapter contains relevant facts and applies expert lessons learned to a particular patient case. Perioperative and intraoperative decisions are discussed in a manner that a colleague would share with a partner, and key points or takeaways are featured in each chapter. The book contains a diverse team of renowned international authorities to guide the reader through challenging HPB topics.

It is our hope that this book will serve as a resource that is often visited by surgeons at all stages of their career. We also hope to stimulate students, residents and fellows regarding the breadth and depth of their knowledge in HPB surgery.

Columbus, OH, USA — Timothy M. Pawlik
Madison, USA — Sharon Weber
Milwaukee, USA — T. Clark Gamblin

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Abbreviations

AA	Anterior approach
AC	Acute cholecystitis
ADC	Apparent diffusion coefficient
AFP	Alpha-fetoprotein
AGA	American Gastroenterological Association
ALK	Alkaline phosphatase
ALPPS	Associating liver partition and portal vein ligation for staged hepatectomy
ALTPS	Associating liver tourniquet and portal ligation for staged hepatectomy
APBJ	Abnormal pancreatico–biliary junction
ARHA	Accessory of the right hepatic arteries
ASA	American Society of Anesthesiologists
AST, ALT	Serum aspartate and alanine aminotransferases
BCLC	Barcelona clinic liver cancer
BD-IPMN	Branch-duct intraductal papillary mucinous neoplasm
BMI	Body mass index
BW	Body weight
CA 19-9	Carbohydrate antigen 19-9
CA	Carbohydrate antigen
CA	Celiac artery/ies
CABG	Coronary artery bypass graft
CALI	Chemotherapy-induced liver injury
CASH	Chemotherapy-associated steatohepatitis
CBD	Common bile duct
CEA	Carcinoembryonic antigen
CHA	Common hepatic artery/ies
COPD	Chronic obstructive pulmonary disease
CP	Chronic pancreatitis
CRLM	Colorectal liver metastases
CT	Computed tomography
CV	Caudate vein
CVP	Central venous pressure

DCD	Donation after cardiac death
DFS	Disease-free survival
DGE	Delayed gastric emptying
DSS	Disease-specific survival
DVT	Deep vein thrombosis
DW-MRI	Diffusion-weighted MRI
EC	Emphasematous cholecystitis
ED	Emergency department
EGD	Esophagogastroduodenoscopy
ERAS	Enhanced recovery after surgery
ERC	Endoscopic retrograde cholangiography
ERCP	Endoscopic retrograde cholangiopancreatography
EUS	Endoscopic ultrasound
EUS-FNA	Endoscopic ultrasound and fine needle aspiration
FAMMMS	Familial atypical multiple mole melanoma syndrome
FDA	Food and Drug Administration
FFP	Fresh frozen plasma
FISH	Fluorescence in situ hybridization
FLR	Future liver remnant
FNA	Fine-needle aspiration
GC	Gangrenous cholecystitis
GDA	Gastroduodenal artery
Gem/Cis	Gemcitabine and cisplatin
GGT	Gamma glutamyl transferase
HALS	Hand-assisted laparoscopic surgery
HBV	Hepatitis B virus
HC	Hilar cholangiocarcinoma
HCC	Hepatocellular carcinoma
HPB	Hepato-pancreato-biliary
HTK	Histidine-tryptophan-ketoglutarate
IBC	Intrahepatic biliary cystadenoma
IBCC	Intrahepatic biliary cystadenocarcinoma
ICG	Indocyanine green
ICG	International Association of Pancreatology Consensus Guidelines
IDUS	Intraductal ultrasound
IJ	Internal jugular
INR	International normalized ratio
IOUS	Intraoperative ultrasonography
IRHV	Inferior right hepatic vein
ISGPF	International Study Group on Pancreatic Fistula
ISGPS	International Study Group of Pancreatic Surgery
IVC	Inferior vena cava
LCRT	Long-course radiation therapy
LDP	Laparoscopic distal pancreatectomy
LFTs	Liver function test(s)

LHM	Liver hanging manoeuver
LHV	Left hepatic vein
LLR	Laparoscopic liver resection
MARS	Molecular Adsorbents Recirculating System
MDC	Multidisciplinary conference
MDCT	Multidetector computed tomography
MD-IPMN	Main-duct intraductal papillary neoplasm
MHV	Middle hepatic vein
MIS	Minimally invasive surgery/surgical (approaches)
MRCP	Magnetic resonance cholangiopancreatography
MRHV	Middle right hepatic vein
MRI	Magnetic resonance imaging
NCCN	National Comprehensive Cancer Network
NED	No evidence of disease
NET	Neuroendocrine tumors
OLR	Open liver resection
OS	Overall survival
PD	Pancreaticoduodenectomy
PDA	Pancreatic ductal adenocarcinoma
PF	Pancreatic fistula
PNET(s)	Pancreatic neuroendocrine tumor(s)
POD	Postoperative day
PPT	Partial parenchymal transection
PSA	Pseudoaneurysm
PSC	Primary sclerosing cholangitis
PTBD	Percutaneous transhepatic biliary drainage
PTC	Percutaneous transhepatic cholangiography
PTFE	Polytetrafluoroethylene
PTPE	Percutaneous transhepatic portal vein embolization
PVE	Portal vein embolization
PVL	Portal vein ligation
PVO	Portal vein occlusion
RALPP	Radio-frequency-assisted liver partition with portal vein ligation
RAMPS	Radical antegrade modular pancreatosplenectomy
RCC	Renal cell carcinoma
RFA	Radiofrequency ablation
RHV	Right hepatic vein
RPV	Right portal vein
RRHA	Replacement of the right hepatic arteries
SA	Splenic artery
SAPE	Sentinel acute pancreatitis event
SBNET	Small bowel neuroendocrine tumors
SBRT	Stereotactic body radiotherapy
SHV	Short hepatic vein
SIRS	Systemic inflammatory response syndrome

SMA	Superior mesenteric artery
SMPV	Superior mesenteric-portal vein
SMV	Superior mesenteric vein
SMV-PV-SVV	Superior mesenteric vein–portal vein–splenic vein confluence
SV	Splenic vein
SVT	Splenic vein thrombosis
TACE	Transarterial chemoembolization
TG	Tokyo Guidelines
TIGAR-O	Toxic/metabolic, idiopathic, genetic, autoimmune, recurrent pancreatitis, obstructive
TLV	Total liver volume
TNM	Tumor node metastasis
TPIAT	Total pancreatectomy with islet autotransplantation
TPN	Total parenteral nutrition
TSH	Two-stage hepatectomy
TVE	Total vascular exclusion
US	Ultrasound
UW	University of Wisconsin [solution]
VARD	Video-assisted retroperitoneal debridement
WOPN	Walled-off pancreatic necrosis

Part I
Liver

Resection of Large Hepatocellular Carcinoma: Hanging Technique

1

Bin-hao Zhang, Bi-xiang Zhang and Xiao-ping Chen

Introduction

About 70% of the tumors in patients diagnosed with hepatocellular carcinoma (HCC) are categorized as either large (5–10 cm in diameter) or huge (larger than 10 cm in diameter). A prevalent belief in the medical community is that large and huge tumors cannot be removed.

We hypothesized that while the resection of large liver tumors had proved difficult in clinical practice, the procedure was safe in theory. In anatomic resections of equal size, which involve removing liver tissue along functional lines, less tumor-free tissue was resected for larger tumors and more tumor-free tissue was resected for smaller tumors. In the 1980s, intraoperative blood loss from liver resection was reported to be around 2,000 ml and the mortality rate caused by intraoperative massive hemorrhage was about 10%. The liver-hanging maneuver (LHM) is one of the improved techniques to reduce bleeding and mortality. Improved techniques reduced intraoperative blood loss during liver resection for large and huge tumors to around 250 ml and caused the mortality rate to drop below 0.7%.

Conventionally, for right hepatectomy, full mobilization of the right hemi-liver is necessary before liver parenchymal transaction [1, 2]. This approach is not always feasible in patients with huge tumor or diaphragmatic tumor invasion. For large tumors, even when full liver mobilization is technically possible, several increased risks are observed, including tumor rupture from excessive pull, tumor cell dissemination from excessive manipulation, and massive bleeding from tear of short hepatic veins from the inferior vena cava (IVC). More surgeons now use an

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anterior approach (AA) for these patients, with parenchymal transection starting from the anterior surface of the liver toward the IVC [1, 2]. This anterior approach has a problem of controlling bleeding from the deeper liver parenchymal tissue because of poor exposure.

To overcome this problem, LHM was proposed by surgeons, allowing surgeons to hang the liver during right hepatectomies without primary liver mobilization.

Belghiti et al. [3] proposed a LHM using a tape to pass through the retrohepatic space between the anterior surface of the IVC and the liver parenchyma. The most important step for this maneuver is the dissection of the anterior plane of the IVC, which is a blind procedure deep in the retrohepatic space. Several short hepatic veins drain directly from the liver into the IVC. These veins vary in size, number, and position. The retrohepatic IVC often becomes compressed or bent in cirrhosis, which increases the risk of injury to the IVC and its branches during the blind dissection. A success rate of 80–92% for blind retrohepatic dissection and a massive bleeding rate caused by injured short hepatic veins of 4–6% have been reported [4–6], which explains why some surgeons are still reluctant to use this technique.

The liver double-hanging maneuver was proposed to develop a retrohepatic tunnel on the right side of the IVC [7]. The tunnel goes through a true avascular space that contains loose connective tissues only. This improved double-hanging maneuver is more safe and easy.

LHM has been reported to have numerous advantages, especially in terms of shortened operative time and reduced blood loss. Moreover, the LHM avoids liver rotation with lower risk for tumor dissemination and higher possibilities of oncologic benefits, helps to reduce remnant liver manipulation with potential improvement in postoperative liver function, and allows better exposure and hemostasis of the deeper section plane with safer IVC protection. Additionally, the tension on the elastic tape would help to obtain a linearly cut surface and would avoid the zigzag manner, thereby contributing to protection of the IVC from surgical injury. Furthermore, the hepatectomies in cases of huge tumors with diaphragm adhesions would be facilitated.

Belghiti-Hanging Maneuver

The liver is exposed through an abdominal incision using either a bilateral subcostal or a J-shaped incision. After performing intraoperative ultrasonography, confirming the absence of tumor contact toward the IVC, a cholecystectomy is performed and the portal pedicle encircled. The upper surface of the liver is exposed up to the anterior surface of the suprahepatic IVC. The space between the right and middle hepatic veins is dissected on 2 cm downward. Without any mobilization of the right liver, the hilum's tape is pulled upward and to the left to allow exposure of the anterior surface of the infrahepatic portion of the IVC. If present, a vein of the caudate process is ligated and divided, and a right inferior hepatic vein is dissected but not ligated.

The most important step of this maneuver is the dissection of the anterior plane of the IVC. The dissection starts with a long vascular clamp posterior to the caudate lobe on the left side of the right inferior hepatic vein, if present, proceeding cranially with great care along the middle plane of the IVC toward the space between the right and middle hepatic veins previously dissected. After 4–6 cm of blind dissection the clamp appears between the right and middle hepatic veins (Fig. 1.1). A tape is seized with the clamp and passed around the hepatic parenchyma. This allows the elevation of the liver away from the anterior surface of the IVC. Before the parenchymal transection, the right pedicle was divided, devascularizing the right liver. The parenchymal transection is conducted from the anterior surface down to the posterior plane in front of the IVC. During parenchymal division, upward traction on the tape-hanging maneuver leads to follow the direct plane and facilitates the exposure and hemostasis of the deeper parenchymal plane in front of the IVC (Fig. 1.1). After completing the exposure of the anterior surface of the IVC, the right side of the IVC is dissected with division and ligation of the inferior hepatic veins and the IVC ligament. Then the trunk of the right hepatic vein is either stapled with a vascular stapler or divided between vascular clamps and oversewn. The coronary and right triangular ligaments are then transected and the specimen removed.

The Belghiti's LHM prerequisite is the existence of a longitudinal avascular plane between the IVC and the liver (Fig. 1.2), which was first anatomically suggested by Couinaud in 1981 [8, 9]. However, 7–15% of this channel passage is not truly avascular but only vascularized by lower density of veins [10].

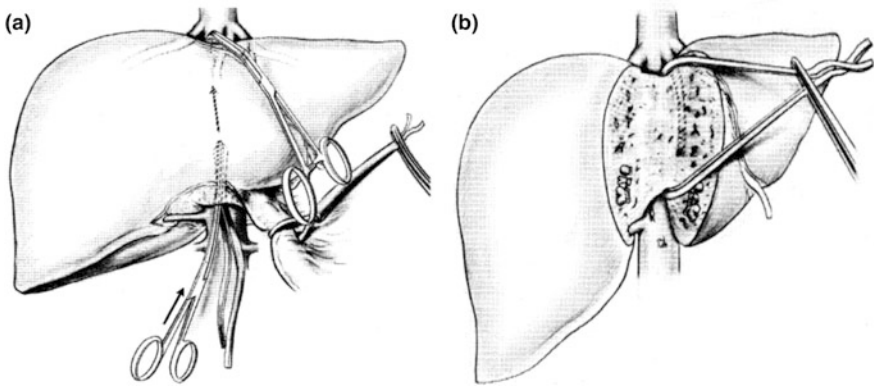

Fig. 1.1 Belghiti's liver-hanging maneuver. **a** The most important dissection time is the blind passage of a long vascular clamp inserted along the midline of the anterior surface of the vena cava and on the left side of the inferior right hepatic vein, if present, **b** proceeding cranially up to the space between the right and the middle hepatic vein trunks. Reprinted from J Am Coll Surg 193; Belghiti J, Guevera OA, Noun R, Saldinger PF, Kianmanesh R. Liver-hanging maneuver: a safe approach to right hepatectomy without liver mobiliztion. p.109–111; copyright © 2001; with permission from Elsevier