

Medical Expert Training in Advanced Liver Surgery

How to prevent and manage intraoperative complications

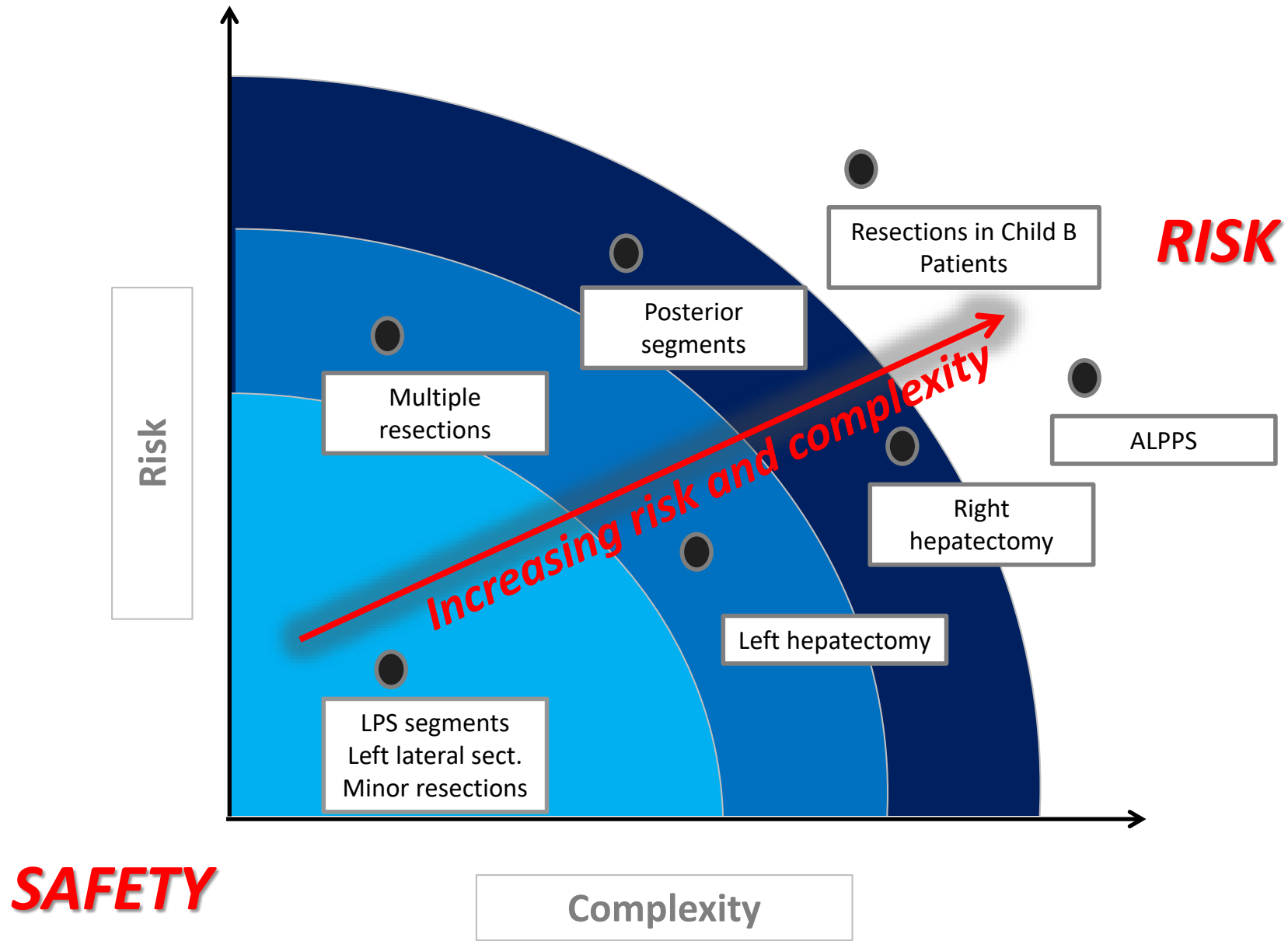
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STRONG COMMITMENT TOWARDS COMPLEX PROCEDURES, TOGETHER WITH THE NEED TO MAINTAIN A GOOD PROFILE OF SAFETY



How to prevent/manage complications, performing a safe MILS?

1

Stepwise learning curve and recruitment of cases according to complexity

2

Preoperative study of liver anatomy and analysis of technical challenges

3

Creation of the ideal setting (Patient position, port sites, mobilization)

4

Instrumentation

5

Anaesthesiological and perioperative management

6

Vascular control

1. Stepwise learning curve and recruitment of cases according to complexity

ORIGINAL ARTICLE

Ann Surg, 2017

The Southampton Consensus Guidelines for Laparoscopic Liver Surgery

From Indication to Implementation

Mohammad Abu Hilal, PhD,* Luca Aldrighetti, PhD,† Ibrahim Dagher, PhD,‡ Bjorn Edwin, PhD,§ Roberto Ivan Troisi, PhD,¶ Ruslan Alikhanov, PhD,|| Somaiah Aroori, PhD,** Giulio Belli, PhD,†† Marc Besselink, PhD,‡‡ Javier Briceno, PhD,§§ Brice Gayet, PhD,¶¶ Mathieu D'Hondt, PhD,|||| Mickael Lesurtel, PhD,*** Krishna Menon, MS,††† Peter Lodge, PhD,†††† Fernando Rotellar, PhD,§§§ Julio Santoyo, PhD,¶¶¶ Olivier Scatton, PhD,||||| Olivier Soubrane, PhD,**** Robert Sutcliffe, MD,††††† Ronald Van Dam, PhD,††††† Steve White, PhD,§§§§ Mark Christopher Halls, MBBS,* Federica Cipriani, MD,† Marcel Van der Poel, MD,‡‡ Ruben Ciria, PhD,§§ Leonid Barkhatov, MD,§ Yrene Gomez-Luque, MD,§§ Sira Ocana-Garcia, MD,§§ Andrew Cook, MBBS,¶¶¶¶ Joseph Buell, MD,||||||| Pierre Alain Clavien, PhD,***** Christos Dervenis, PhD,††††† Giuseppe Fusai, MS,††††† David Geller, MD,§§§§§ Hauke Lang, MD,¶¶¶¶¶ John Primrose, PhD,* Mark Taylor, PhD,||||||| Thomas Van Gulik, PhD,‡‡ Go Wakabayashi, PhD,***** Horacio Asbun, MD,††††††† and Daniel Cherqui, PhD†††††††

Training

- ✓ Laparoscopic liver resections should only be performed by surgeons with advanced laparoscopic skills and a wide experience of open liver surgery. Surgeons intending to start a laparoscopic liver practice should first pursue specific training through fellowships, courses, or proctoring programs. **Strong**
- ✓ Surgeons should develop their laparoscopic liver practice in a stepwise fashion. Proficiency should initially be gained by performing minor resections of lesions in the left lateral and anterior segments. Major resections should not be attempted before completing this first part of the learning curve. **Strong**

1. Stepwise learning curve and recruitment of cases according to complexity

Updates in Surgery

<https://doi.org/10.1007/s13304-019-00658-9>

2019

ORIGINAL ARTICLE

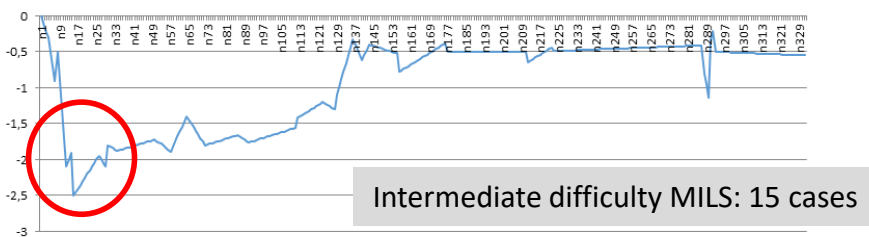
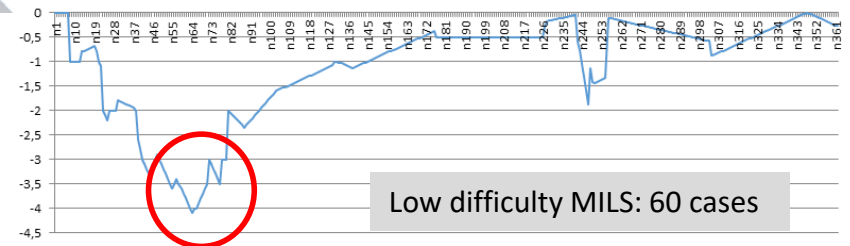


A stepwise learning curve to define the standard for technical improvement in laparoscopic liver resections: complexity-based analysis in 1032 procedures

Aldrighetti Luca¹ · Federica Cipriani¹ · Guido Fiorentini¹ · Marco Catena¹ · Michele Paganelli¹ · Francesca Ratti¹



CUSUM analysis of learning curve



A **standard educational model—stepwise and progressive**—is mandatory to allow surgeons to define the technical and technological backgrounds to deal with a specific degree of difficulty, providing a help in the definition of indications to laparoscopic approach in each phase of training.

1. Stepwise learning curve and recruitment of cases according to complexity

Difficulty scores

J Hepatobiliary Pancreat Sci (2014) 21:745–753
DOI: 10.1002/jhbp.166

J HBP Sci, 2014

TOPIC

A novel difficulty scoring system for laparoscopic liver resection

Daisuke Ban · Minoru Tanabe · Hiromitsu Ito ·
Yuichiro Otsuka · Hiroyuki Nitta · Yuta Abe ·
Yasushi Hasegawa · Toshio Katagiri · Chisato Takagi ·
Osamu Itano · Hironori Kaneko · Go Wakabayashi

ORIGINAL ARTICLE

Ann Surg, 2017

Difficulty of Laparoscopic Liver Resection




Proposal for a New Classification

Yoshikuni Kawaguchi, MD, PhD,*† David Fuks, MD, PhD,*
Norihiro Kokudo, MD, PhD,† and Brice Gayet, MD, PhD*

Original article

Br J Surg, 2017

Development and validation of a difficulty score to predict intraoperative complications during laparoscopic liver resection

M. C. Halls¹ , G. Berardi³, F. Cipriani^{1,5}, L. Barkhatov⁶, P. Lainas⁷, S. Harris², M. D'Hondt⁴,
F. Rotellar⁸, I. Dagher⁷, L. Aldrighetti⁵ , R. I. Troisi³ , B. Edwin⁶ and M. Abu Hilal¹

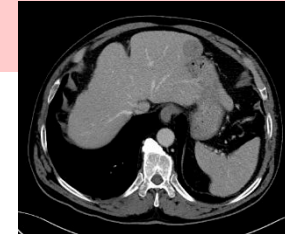
¹Department of Hepato-Biliary and Pancreatic Surgery, University Hospital Southampton, and ²Department of Public Health Sciences and Medical Statistics, Faculty of Medicine, University of Southampton, Southampton, UK, ³Department of General and Hepatobiliary Surgery, Liver Transplantation, Ghent University Hospital Medical School, Ghent, and ⁴Department of Digestive and Hepatopancreatobiliary Surgery, Groeninge Hospital, Kortrijk, Belgium, ⁵Department of Hepatobiliary Surgery, San Raffaele Hospital, Milan, Italy, ⁶Intervention Centre and Department of Hepatopancreatobiliary Surgery, Oslo University Hospital, and Institute of Clinical Medicine, University of Oslo, Oslo, Norway, ⁷Department of Hepatobiliary Surgery, Antoine-Béclère Hospital, Paris, France, and ⁸Department of General Surgery, University of Navarra Hospital, Pamplona, Spain
Correspondence to: Professor M. Abu Hilal, Department of Hepato-Biliary and Pancreatic Surgery, University Hospital Southampton NHS Foundation Trust, Tremona Road, Southampton SO16 2YD, UK (e-mail: abuhilal9@gmail.com)

1. Stepwise learning curve and recruitment of cases according to complexity

Original article

Br J Surg, 2017

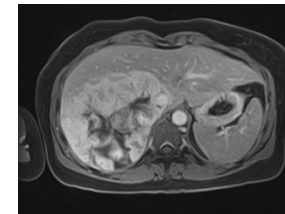
Score 2
Low



Score 5
Moderate



Score 9
High



Development and validation of a difficulty score to predict intraoperative complications during laparoscopic liver resection

M. C. Halls¹, G. Berardi³, F. Cipriani^{1,5}, L. Barkhatov⁶, P. Lainas⁷, S. Harris², M. D'Hondt⁴, F. Rotellar⁸, I. Dagher⁷, L. Aldrighetti⁵, R. I. Troisi³, B. Edwin⁶ and M. Abu Hilal¹

¹Department of Hepato-Biliary and Pancreatic Surgery, University Hospital Southampton, and ²Department of Public Health Sciences and Medical Statistics, Faculty of Medicine, University of Southampton, Southampton, UK, ³Department of General and Hepatobiliary Surgery, Liver Transplantation, Ghent University Hospital Medical School, Ghent, and ⁴Department of Digestive and Hepatopancreatobiliary Surgery, Groeninge Hospital, Kortrijk, Belgium, ⁵Department of Hepatobiliary Surgery, San Raffaele Hospital, Milan, Italy, ⁶Intervention Centre and Department of Hepatopancreatobiliary Surgery, Oslo University Hospital, and Institute of Clinical Medicine, University of Oslo, Oslo, Norway, ⁷Department of Hepatobiliary Surgery, Antoine-Béclère Hospital, Paris, France, and ⁸Department of General Surgery, University of Navarra Hospital, Pamplona, Spain
Correspondence to: Professor M. Abu Hilal, Department of Hepato-Biliary and Pancreatic Surgery, University Hospital Southampton NHS Foundation Trust, Tremona Road, Southampton SO16 2YD, UK (e-mail: abuhilal9@gmail.com)

Table 4 Reference values with the reference base value for each predictor, the regression coefficient and points attributed to each factor

Risk factor (I)	Risk factor category	Reference value	Regression coefficient (B _i)	Regression units (B _i (W _{ij} - W _{REF}))	Points assigned (B _i (W _{ij} - W _{REF})/B)
Neoadjuvant chemotherapy	No	0 (W _{REF})	0.294	0	0
	Yes	1 (W _i)		0.294*	1
Previous open liver resection	No	0 (W _{REF})	1.401	0	0
	Yes	1 (W _i)		1.401	5
Lesion type	Benign	0 (W _{REF})	0.659	0	0
	Malignant	1 (W _i)		0.659	2
Lesion size (cm)	< 3	1.5 (W _{REF})	0.186	0	0
	3-5	4 (W _i)		0.465	2
	> 5	6.5 (W _i)		0.930	3
Classification of resection	Minor	1 (W _{REF})	0.583	0	0
	Technically major	2 (W _i)		0.583	2
	Anatomically major	3 (W _i)		1.166	4

Factors

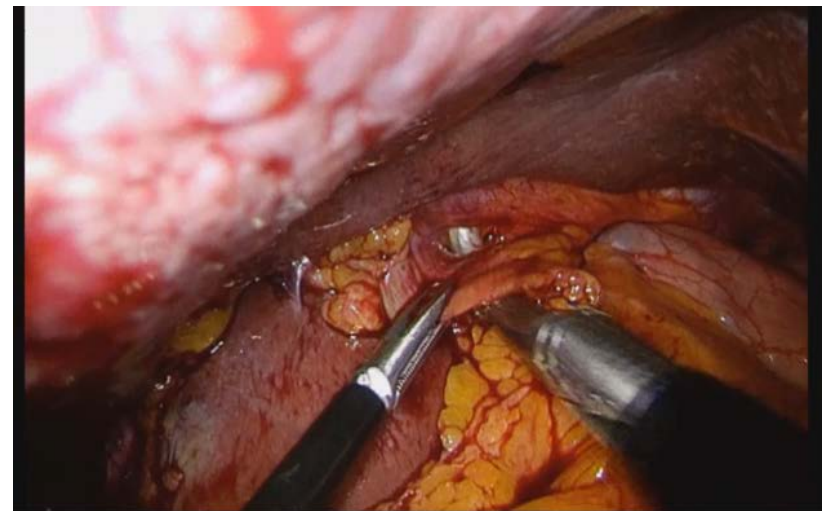
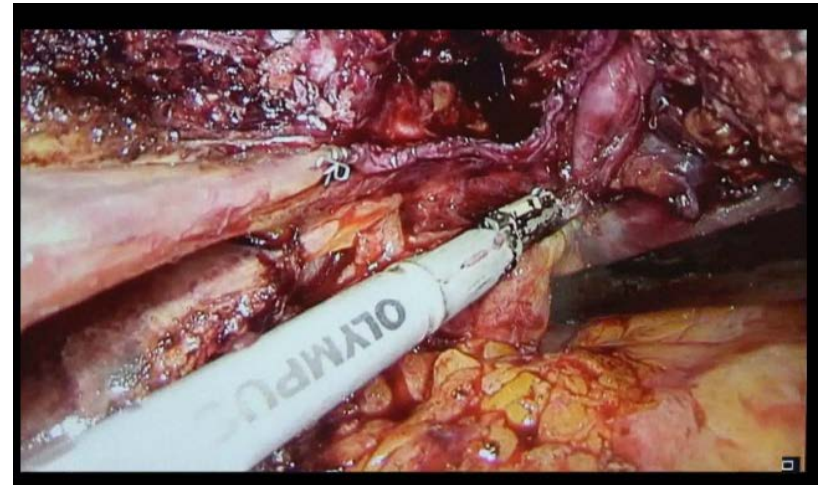
Points

Total points scored	Post-calibration risk	Risk group
0	0.5	Low
1	3.0	Low
2	6.1	Low
3	9.9	Moderate
4	14.5	Moderate
5	20.0	Moderate
6	26.2	High
7	33.1	High
8	40.3	High
9	47.6	High
10	54.7	Extremely high
11	61.3	Extremely high
12	69.8	Extremely high
13	72.4	Extremely high
14	76.7	Extremely high
15	80.2	Extremely high

2. Preoperative study of liver anatomy and analysis of technical challenges

Preoperative anatomical study of the case

- Vessel anatomy
 - ✓ Artery
 - ✓ Portal vein
 - ✓ Hepatic veins
- Main glissonian pedicles
- Hepatic vein branches
- Location of the MHV and Cantile line
- Shape of the segment 1
- Compression by the lesion of portobiliary/hepatic pedicles



2. Preoperative study of liver anatomy and analysis of technical challenges

How to choose the optimal candidate to laparoscopic right hepatectomy

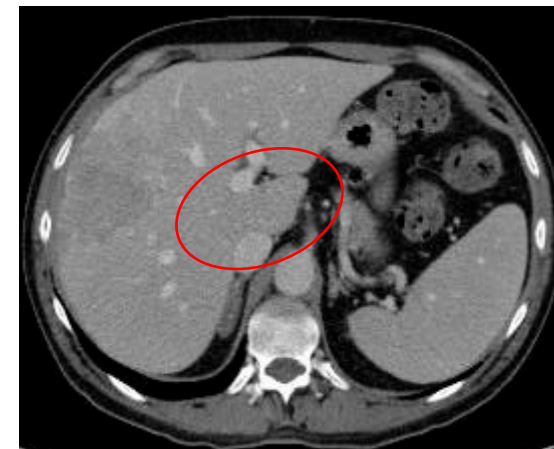
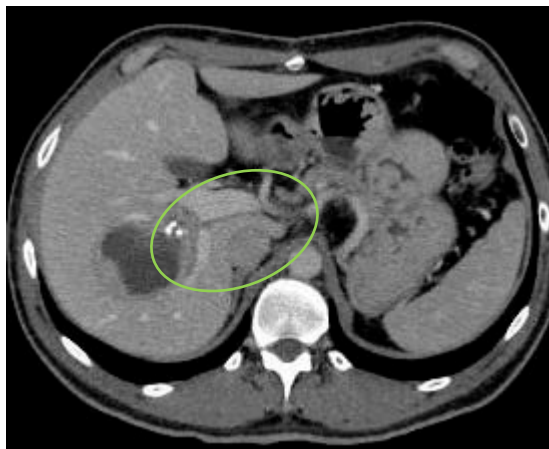
Ideal

Challenging

Length of portal vein



Thickness of segment 1



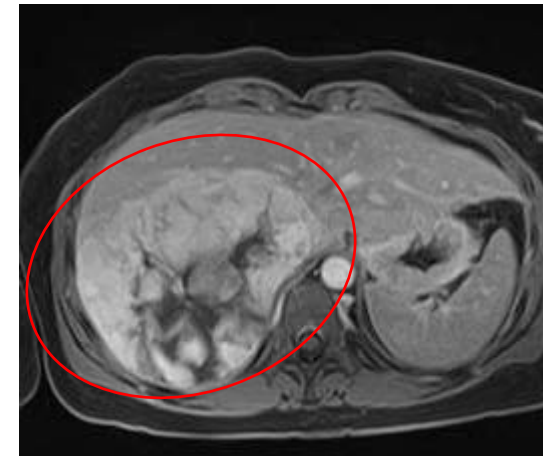
2. Preoperative study of liver anatomy and analysis of technical challenges

How to choose the optimal candidate to laparoscopic right hepatectomy

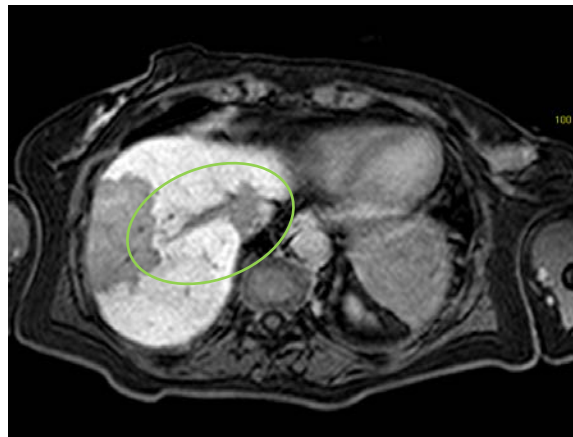
Ideal

Challenging

Lesion dimension



Relationship of the lesion with hepatocaval confluence

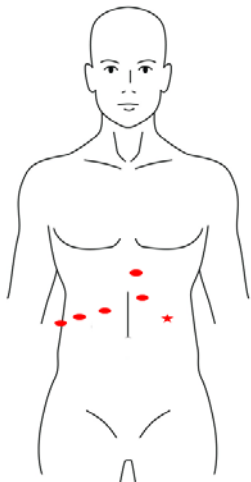


3. Creation of the ideal setting

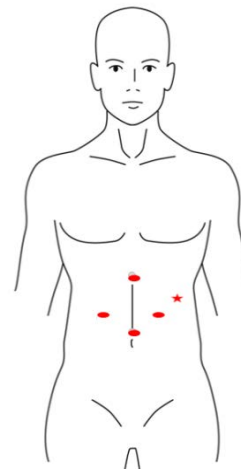
Standard patient position



Trocar position according to planned procedure



- ✓ procedures for lesions in right lobe and Sg4
- ✓ major resections



- ✓ left lateral sectionectomy
- ✓ procedures for lesions in left lobe

3. Creation of the ideal setting

Liver mobilization

Ann Surg Oncol
https://doi.org/10.1245/s10434-019-07165-6 2019

Annals of
SURGICAL ONCOLOGY
OFFICIAL JOURNAL OF THE SOCIETY OF SURGICAL ONCOLOGY



ORIGINAL ARTICLE – HEPATOBILIARY TUMORS

Theory of Relativity for Posterosuperior Segments of the Liver

G. Fiorentini, MD, F. Ratti, MD, F. Cipriani, MD, L. Cinelli, MD, M. Catena, MD, PhD, M. Paganelli, MD, and L. Aldrighetti, MD, PhD

Hepatobiliary Surgery Division, IRCCS San Raffaele Hospital, Milan, Italy



FIG. 2 Up-to-down rotational motion of the liver

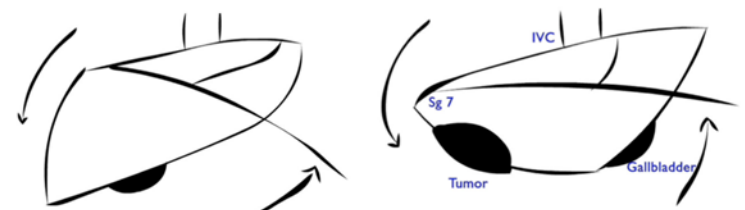


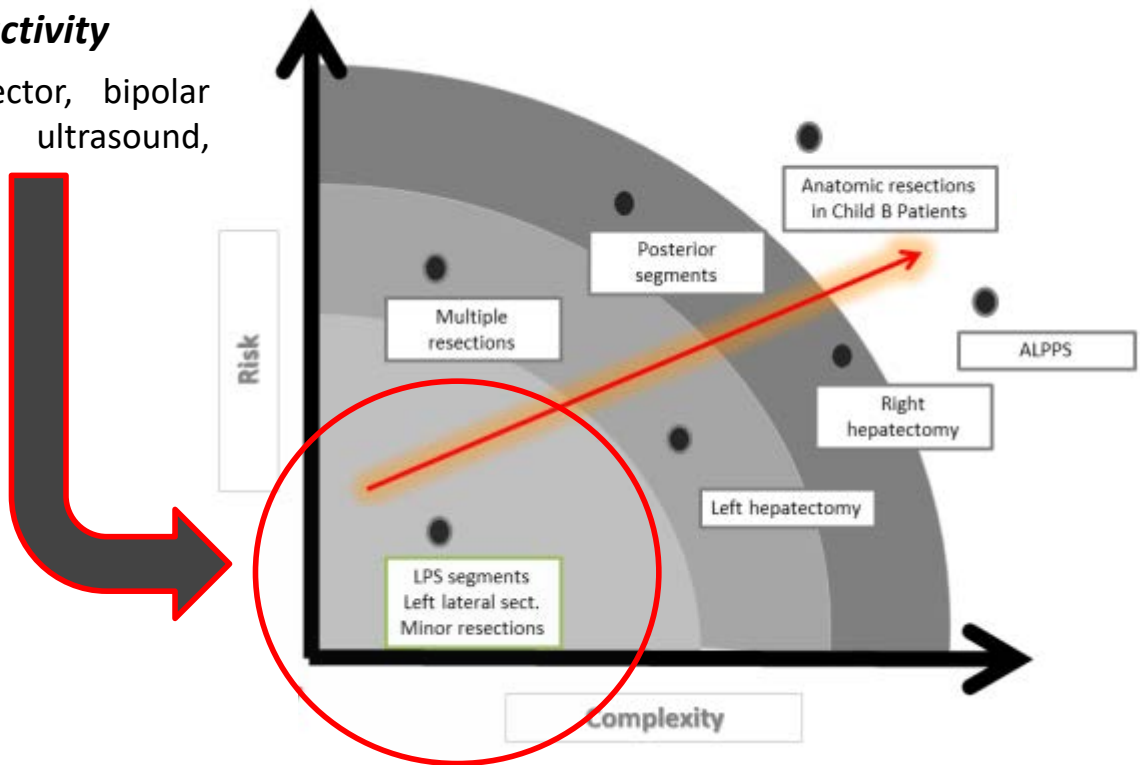
FIG. 3 Counterclockwise mobilization and rotation

4. Instrumentation

Basic instruments

Beginning of MILS activity

Ultrasonic dissector, bipolar forceps, lap ultrasound, energy device

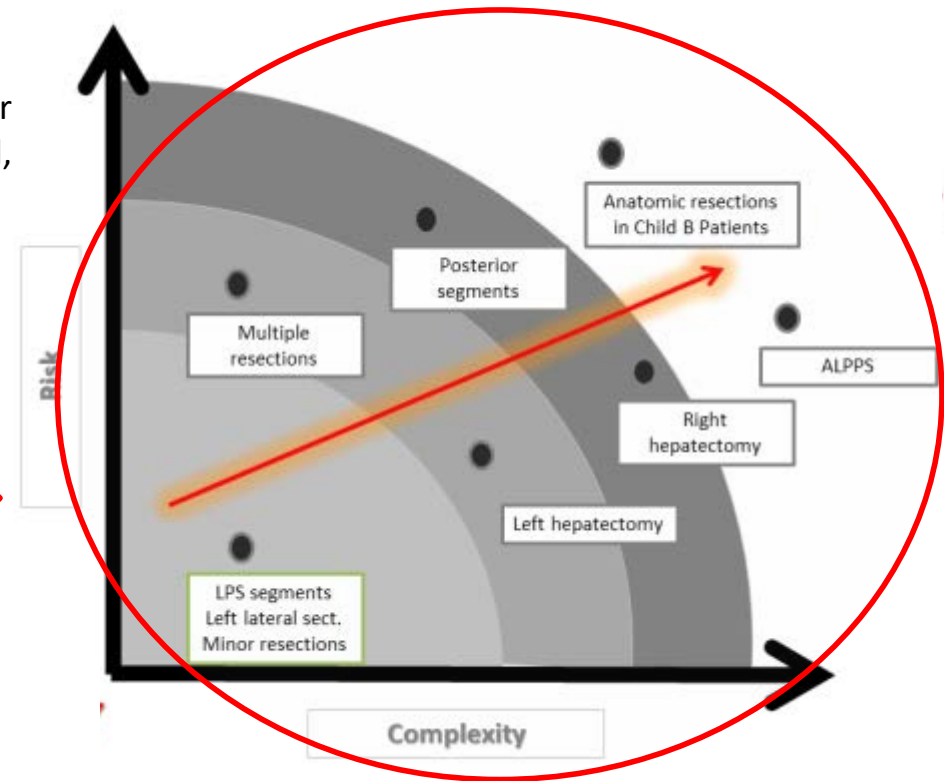


4. Instrumentation

**Basic
instruments**

Beginning of MILS activity

Ultrasonic dissector, bipolar forceps, lap ultrasound, energy device



**Advanced
instruments**

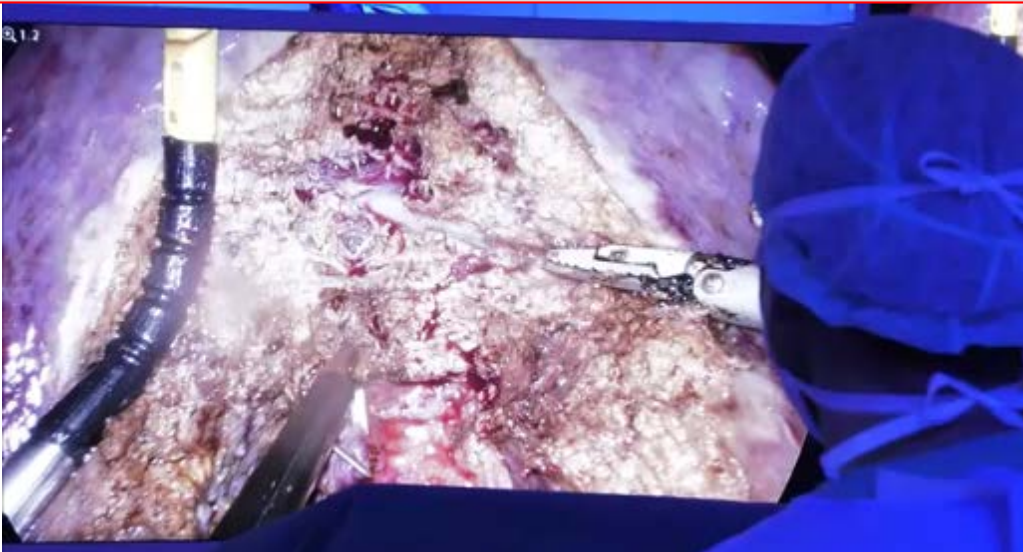
Advanced program of minimally invasive liver resections

Laparoscopic liver surgery operating room (advanced vision systems, integrated imaging systems, pre-defined sets of instruments for different type of resections)

4. Instrumentation



MILS Operating Room



Basic rules

1. Choose **your** technique and become **confident** with that
2. The availability of instruments should be **proportional** to the **complexity** of the case
3. Use the **right** instrument for the **right** step in the **right** way!

5. Anaesthesiological and perioperative management



Contents lists available at ScienceDirect

2018

Surgery

journal homepage: www.elsevier.com/locate/surg



Liver

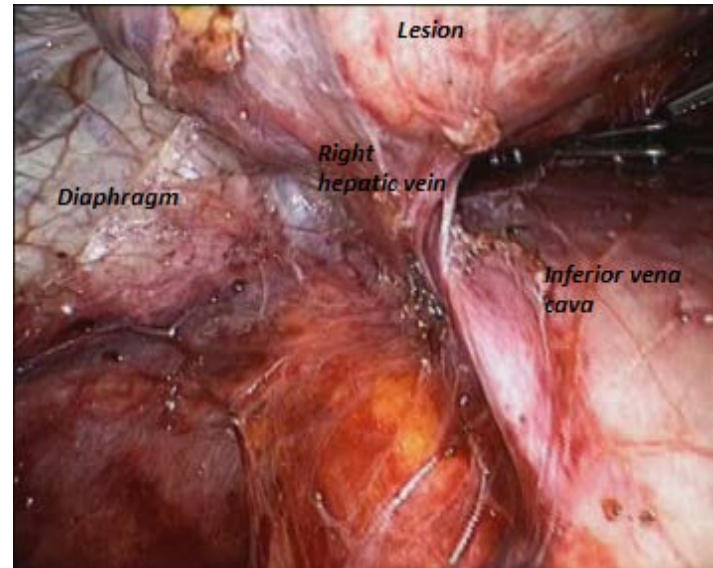
The clinical and biological impacts of the implementation of fast-track perioperative programs in complex liver resections: A propensity score-based analysis between the open and laparoscopic approaches



Francesca Ratti, MD^{a,*}, Federica Cipriani, MD^a, Raffaella Reineke, MD^b,
Laura Comotti, MD^b, Michele Paganelli, MD^a, Marco Catena, MD, PhD^a, Luigi Beretta, MD^b,
Luca Aldrighetti, MD, PhD^a

^a Hepatobiliary Surgery Division, IRCCS San Raffaele Hospital, Milano, Italy

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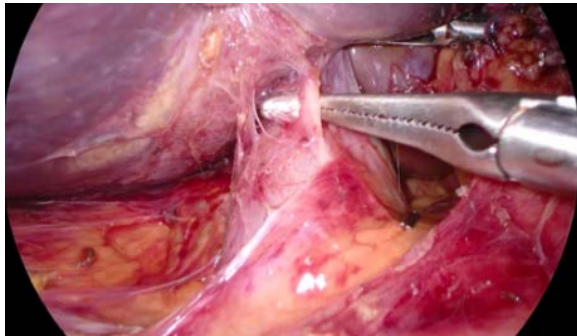
The role of the anaesthesiologist is crucial to reduce intraoperative accidents

Low cardiac preload and controlled ventilation allow better control of bleeding from hepatic veins

5. Anaesthesiological and perioperative management

Low cardiac preload and controlled ventilation

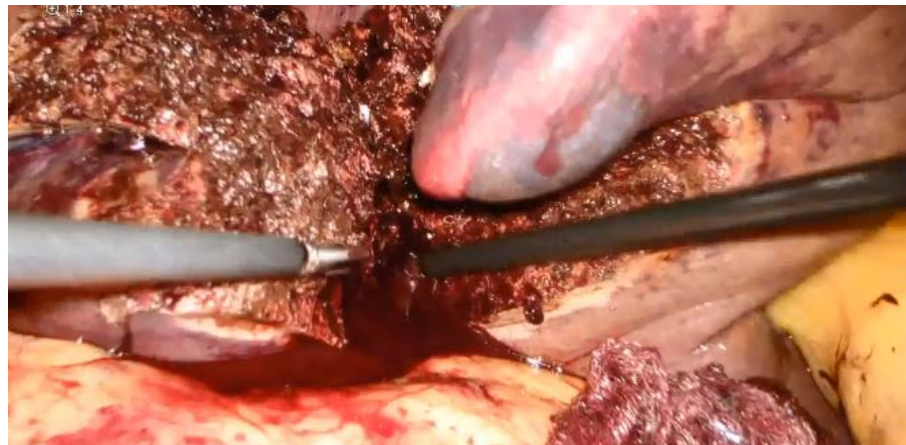
Virtual space becomes real



Kissing vena cava



When cardiac preload is not low and/or airway pressure is high..



5. Anaesthesiological and perioperative management

ORIGINAL ARTICLE

Intraoperative monitoring of stroke volume variation versus central venous pressure in laparoscopic liver surgery: a randomized prospective comparative trial

HPB, 2016

Francesca Ratti¹, Federica Cipriani¹, Raffaella Reineke², Marco Catena¹, Michele Paganelli¹, Laura Comotti², Luigi Beretta² & Luca Aldrighetti¹

¹Division of Hepatobiliary Surgery, and ²Department of Anaesthesiology and Intensive Care, IRCCS San Raffaele Hospital, Milano, Italy

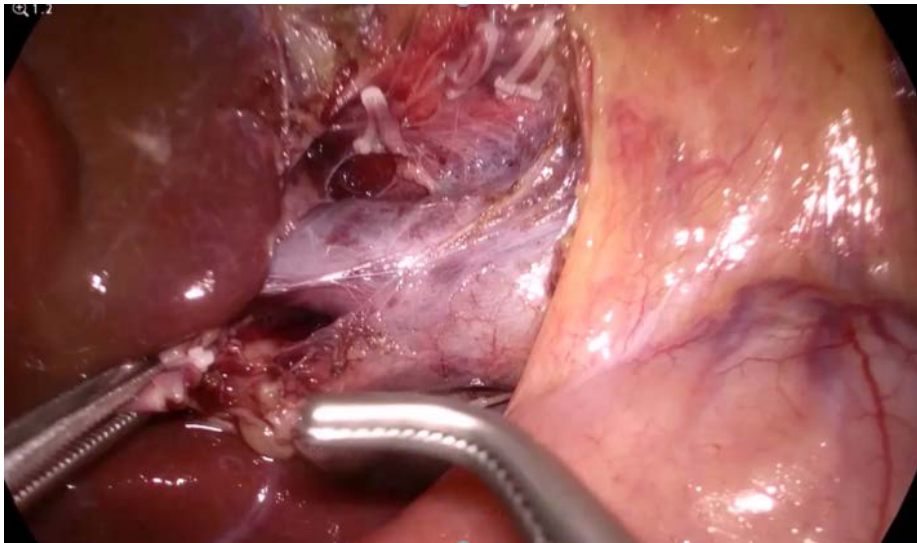
	SVV group (n = 45)	CVP group (n = 45)	p
Conversion, n (%)	3 (6.7)	8 (17.8)	0.02
Reason for conversion, n (%)			
Haemorrhage	0 (0)	4 (8.9)	0.05
Oncologic inadequacy	1 (2.2)	2 (4.4)	ns
Anaesthesiological problems	0 (0)	1 (2.2)	ns
Damage to the liver	1 (2.2)	0 (0)	ns
Inadequate biliostasis	1 (2.2)	0 (0)	ns

		SVV group (n = 45)	CVP group (n = 45)	p
Pringle manoeuvre, n (%)				ns
	Not performed	19 (42.2)	24 (53.3)	
	Performed	26 (57.8)	21 (46.7)	
Length of surgery (min)	Mean ± SD	220 ± 50	210 ± 60	ns
Blood Loss (mL)	Mean ± SD	150 ± 100	300 ± 250	0.04
Associated procedures, n (%)				ns
	None	39 (86.7)	41 (91.1)	
	Colecistectomy	6 (13.3)	4 (8.9)	
Surgical margin, n (%)				ns
	R0	44 (97.8)	45 (100)	
	R1	1 (2.2)	0 (0)	
Surgical margin (mm)	Mean ± SD	8 ± 4	9 ± 6	ns
Intraoperative blood transfusions, n (%)				ns
	No	43 (95.6)	43 (95.6)	
	Yes	2 (4.4)	2 (4.4)	
Total blood transfusions, n (%)				ns
	No	43 (95.6)	41 (91.1)	
	Yes	2 (4.4)	4 (8.9)	
Morbidity, n (%)				ns
Grade of complications, n (%)				
Minor	I grade	1 (2.2)	1 (2.2)	ns
	II grade	2 (4.4)	3 (6.7)	ns
Major	IIIa grade	1 (2.2)	1 (2.2)	ns
Mortality, n (%)				ns
	0 (0)	0 (0)	0 (0)	
Functional recovery (days)	Median (range)	3 (1–6)	3 (1–7)	ns
Length of stay (days)	Median (range)	4 (2–10)	5 (3–13)	ns

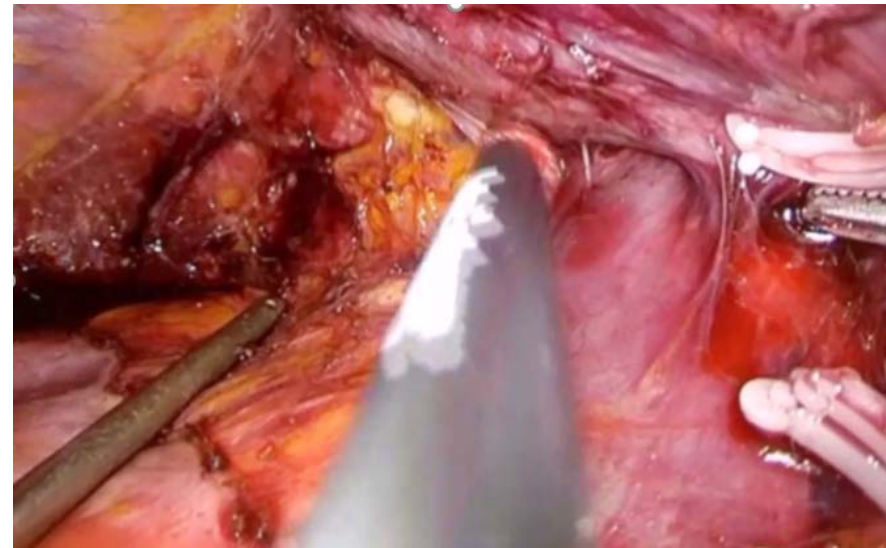
6. Vascular control

Main pedicles

Primary control of pedicles when feasible and safe



Portal vein



Hepatic vein

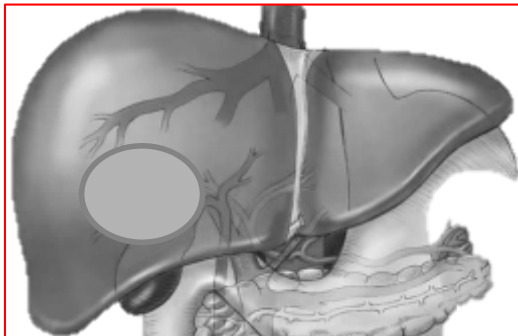
6. Vascular control

VIDEO

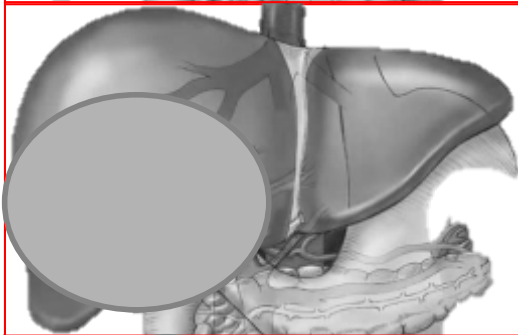
Surg Endosc, 2016

Approach to hepatocaval confluence during laparoscopic right hepatectomy: three variations on a theme

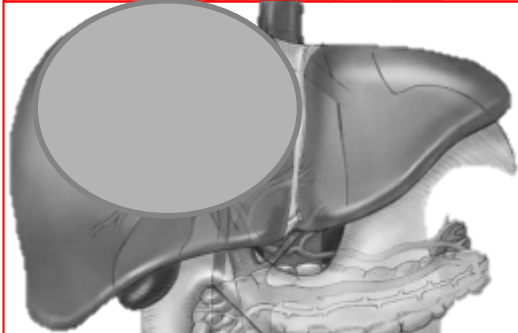
Francesca Ratti¹ · Federica Cipriani¹ · Marco Catena¹ · Michele Paganelli¹ · Luca Aldrighetti¹



*Primary approach
to hepatocaval
confluence*



*Anterior approach
with hanging
maneuver*



*Anterior approach
without hanging
maneuver*

6. Vascular control

How to deal with persistently ineffective haemostasis / biliostasis ?

- ✓ **Abdominal Drain:** the opportunity to leave unsatisfactory haemostasis / biliostasis to self amend should be **avoided** or **carefully evaluated**
- ✓ **Conversion:** should be performed if the accomplishment of adequate haemostasis / biliostasis is **expected with open surgery**

When suture and when conversion?

- **Laparoscopic suture** can be an option:
 - when you see the bleeding site and the bleeding site is not located in a deep/narrow space
 - when you can temporarily stop the bleeding (you're slower in lap than in open)
 - if the ergonomics (bleeding site-instrument) allows it
 - if you're sure you do not damage any structure in the remnant liver
 - if hemodynamic status still has a compliance

Remember that open suture is very effective!!

Conclusions

The feasibility of procedures with a profile of high technical complexity has been demonstrated

The balance between risk and safety in this setting is crucial

Flagship issues to perform liver resections safely

- Learning curve should be stepwise, as well as recruitment to MILS of patients with a progressively increasing profile of difficulty
- The study of preoperative anatomy allows to reduce intraoperative accidents and to perform a good selection of candidates
- The creation of an ideal intraoperative setting is fundamental (patient and trocars position, technique of liver mobilization)
- A MILS operating room should be implemented to perform complex procedures
- The role of the anaesthesiologist is crucial to control bleeding from hepatic veins
- Patients and disease characteristics play a role in the definition of the approach to main vascular structures