The issue of conversion

Luca Aldrighetti

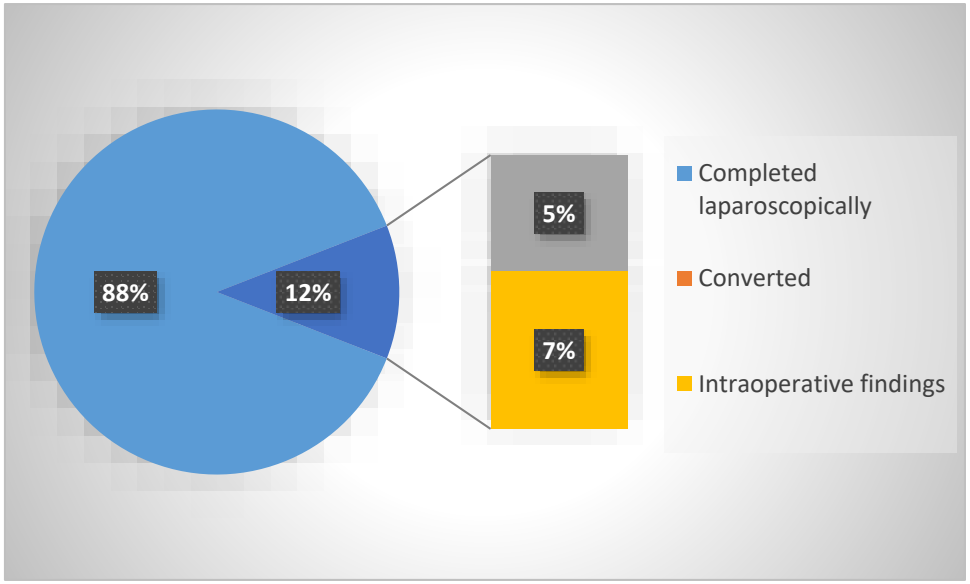
Hepatobiliary Surgery Division, Head
IRCCS San Raffaele Hospital, Milano
Italy

1032 Laparoscopic hepatic resections

(September 2005 – April 2019)

34.7% of the entire Institutional Series

Variable	
Procedure, n (%)	
Right hepatectomy	126 (12,2)
Left hepatectomy	107 (10,4)
ALPPS	9 (0,9)
Left lateral sectionectomy	150 (14,5)
Bisegmentectomy	108 (10,5)
Segmentectomy	217 (21,0)
Wedge resection	315 (30,5)
Lesions side, left/right n(%)	560/476 (54.3/ 45.7)
No. resections/patients n (%)	
Single	756 (73.3)
Multiple	280 (26.7)
Associated procedures, n (%)	
LPS colorectal resection	67 (6.5)
Conversion rate n (%)	116 (11.2)



49 intraoperative adverse events (***42.2% of conversions***)

67 intraoperative findings (***57.8% of conversions***)

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49 intraoperative adverse events

(***42.2% of conversions***)

- ✓ 41 bleeding (35.3%)
- ✓ 4 concerns regarding biliostasis (3.5%)
- ✓ 4 anaesthesiological problems (3.5%)

67 intraoperative findings

(***57.8% of conversions***)

- ✓ 58 oncological concerns (50%)
- ✓ 16 adhesions (13.8%)
- ✓ 3 need for vascular/biliary resections (2.6%)

Ann Surg, 2016

ORIGINAL ARTICLE

Comparative Short-term Benefits of Laparoscopic Liver Resection: 9000 Cases and Climbing

Ruben Cirita, MD, PhD,† *Daniel Cherqui, MD,*‡ *David A. Geller, MD,*§
Javier Briceno, MD, PhD,‖ *and Go Wakabayashi, MD, PhD, FACS*¶

Author (Country)	Year	No. LLR	No. OLR	Etiology	Conversion
Memeo[23] (Creteil, France)	2014	45	45	HCC	0
Chan[24] (Hong Kong, China)	2014	17	34	Malign	5.8%
Kim[25] (Seoul, South Korea)	2014	29	29	HCC	23.3%
Dokmak[26] (Clichy, France)	2014	31	31	Benign	12.9% (to HA)
Inoue[27] (Osaka, Japan)	2013	23	24	CRLM	4.3%
Abu Hilal[28] (Southampton, UK)	2013	46	19	Malign + benign	1 (2%)
Kanazawa[29] (Osaka, Japan)	2013	28	28	HCC	5/23 hybrid (21.73%)
Cheung[30] (Hong Kong, China)	2013	32	64	HCC	6 HA (18.8%)
Slim[31] (Milan, Italy)	2012	46	46	Malign + benign	3 (6.5%)
Truant[32] (Lille, France)	2011	36	53	HCC	7 (19.4%)
Lee[33] (Hong Kong, China)	2011	33	50	HCC	6 (18.2%)
Aldrighetti[34] (Milan, Italy)	2010	16	16	HCC	1 (6.25%)
Robles[35] (Murcia, Spain)	2009	18	18	Malign + benign	0
Endo[36] (Oita, Japan)	2009	10	11	HCC	Laparoscopy-assisted
Ito[37] (New York, USA)	2009	65	65	Malign + benign	13 (20%)
Vanounou[38] (Montreal, Canada)	2009	44	29	Malign +; benign	–
Carswell[39] (London, UK)	2009	10	10	Malign + benign	1 (10%)
Tsinberg[40] (Cleveland, USA)	2009	31	43	Malign + Benign	0
Abu Hilal[41] (Southampton, UK)	2008	24	20	Malign + benign	0
Belli[45] (Naples, Italy)	2007	23	23	HCC	1 (4.3%)
Soubrane[46] (Paris, France)	2006	16	14	LDLT	1 (6.25%)
Tang[47] (Hong Kong, China)	2005	10	7	Benign	1 (10%)
Kaneko[10] (Tokyo, Japan)	2005	30	28	HCC	3.3%
Morino[48] (Turin, Italy)	2003	30	30	Malign + benign	0
Laurent[49] (Creteli, France	2003	13	14	HCC	2 (15%)
Lesartel[50] Creteil-France)	2003	18	20	Malign + benign	2 (11%)
Farges[51] (Clichy, France)	2002	21	21	Benign	0
Mala[52] (Oslo, Norway)	2002	13	14	CRLM	0
Shimada[53] (Fukuoka, Japan)	2001	17	38	HCC	0

LLR indicates laparoscopic liver resections; OLR, open liver resections.

Conversion rate in minor resections:
0 - 21.7%

Surgery, 2018

Contents lists available at ScienceDirect
Surgery
journal homepage: www.elsevier.com/locate/surg

Clinical Review

Laparoscopic versus open major hepatectomy: a systematic review and meta-analysis of individual patient data ☆

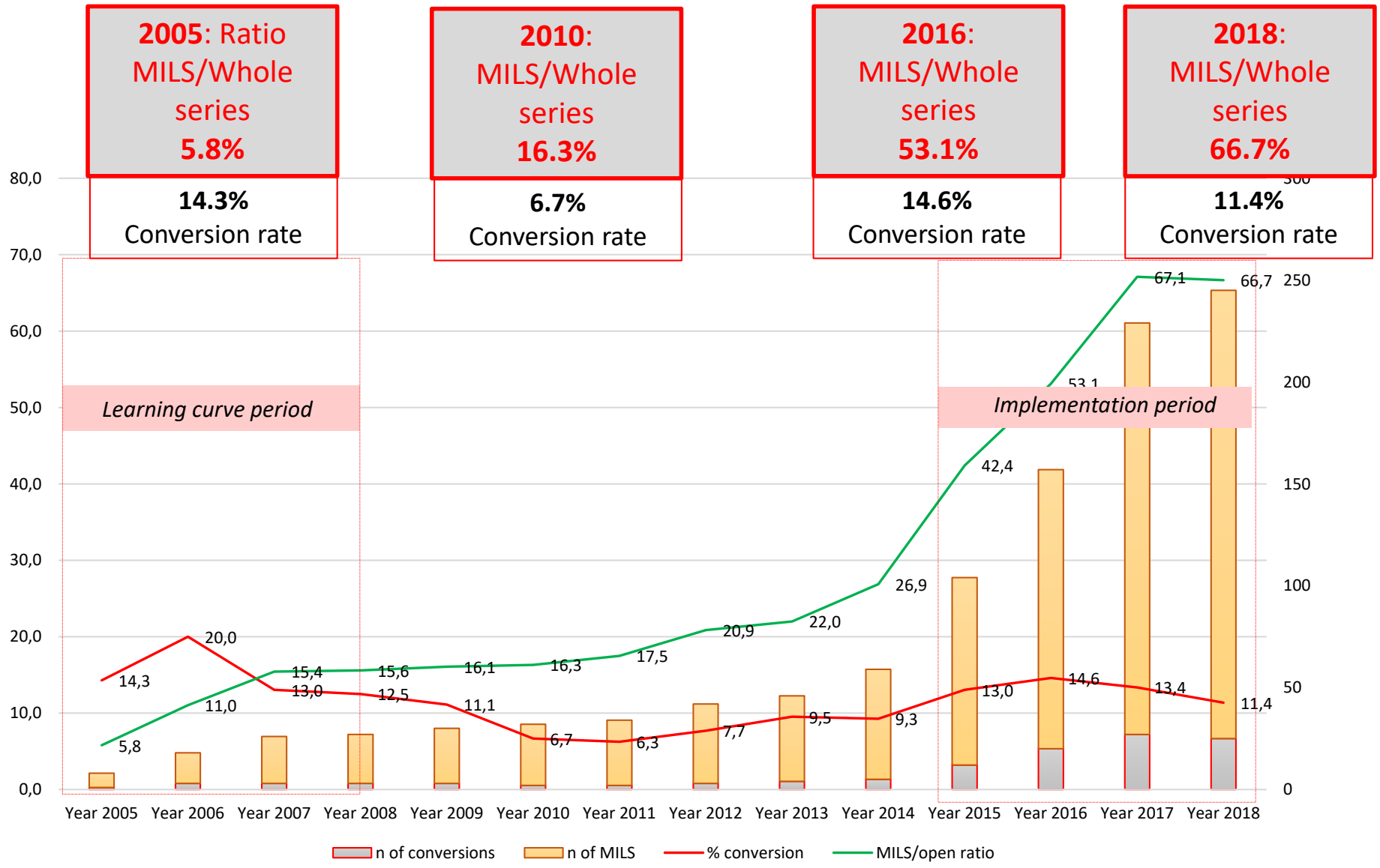
Meidai Kasai[a,b,1], Federica Cipriani[a,1], Brice Gayet[c], Luca Aldrighetti[d], Francesca Ratti[d], Juan M. Sarmiento[e], Olivier Scatton[f,g], Ki-Hun Kim[h], Ibrahim Dagher[i,j], Baki Topal[k], John Primrose[a], Takeo Nomi[c], David Fuks[c], Mohammad Abu Hilal[a,*]

Table 1
Patient characteristics from the included studies.

Author	Year	Country	Study design	No. of patients		Conversion (%)
				LMH	OMH	
Abu Hilal et al[14]	2013	UK	RM	38 (45%)	46 (55%)	7 (19)
Dagher et al[15]	2009	France	RM	22 (30%)	50 (70%)	2 (9)
Komatsu et al[16]	2015	France	RM	38 (50%)	38 (50%)	13 (26)
Medbery et al[17]	2014	US	RM	48 (46%)	57 (54%)	5 (10.4)
Nomi et al[18]	2015	France	R	183 (86)	28 (14%)	21 (11.5)
Ratti et al[19]	2015	Italy	RM	49 (25%)	147 (75%)	13 (26)
Topal et al[20]	2012	Belgium	RM	20 (50%)	20 (50%)	5 (25)
Yoon et al[21]	2016	Korea	RM	37 (24%)	115 (76%)	NR

Conversion rate in minor resections:
2 - 26%

Liver resection activity – Hepatobiliary Surgery Division
Rate of conversion and MILS/open ratio



Updates Surg (2017) 69:271–283
DOI 10.1007/s13304-017-0489-x

ORIGINAL ARTICLE

Diffusion, outcomes and implementation of minimally invasive liver surgery: a snapshot from the I Go MILS (Italian Group of Minimally Invasive Liver Surgery) Registry

Luca Aldrighetti[1] · Francesca Ratti[1] · Umberto Cillo[2] · Alessandro Ferrero[3] · Giuseppe Maria Ettorre[4] · Alfredo Guglielmi[5] · Felice Giuliante[6] · Fulvio Calise[7] · On behalf of the Italian Group of Minimally Invasive Liver Surgery (I GO MILS)

Procedures

Table 3 Procedures performed in 1476 cases included in the Registry

Type or resection	%	*n*
Wedge	49.3	728
Anatomic segmentectomy	20.2	298
Bisegmentectomy	3.4	50
Left lateral sectionectomy	13.3	196
Right posterior sectionectomy	1.6	24
Right anterior sectionectomy	0.2	3
Cystopericystectomy	1.6	23
ALPPS-1 stage	0.4	6
Left hepatectomy	4.8	71
Right hepatectomy	4.3	64
Central hepatectomy	0.3	5
Right trisectionectomy	0.3	4
ALPPS-2 stage	0.2	3
Left trisectionectomy	0.1	1

Conversion rate: 9.4% (132/1399)

Oncological concerns	76 (57.6%)
Bleeding	35 (26.5%)
Adhesions	26 (19.7%)
Biliostasis	6 (4.5%)
Anaesthesiological problems	3 (2.3%)

I Go MILS
Italian Group of Minimally Invasive Liver Surgery

JOURNAL OF LAPAROENDOSCOPIC & ADVANCED SURGICAL TECHNIQUES
Volume 28, Number 7, 2018

DOI: 10.1089/lap.2018.0071

Full Reports

Effect of Previous Abdominal Surgery on Laparoscopic Liver Resection: Analysis of Feasibility and Risk Factors for Conversion

Federica Cipriani, MD, Francesca Ratti, MD, Guido Fiorentini, MD, Marco Catena, MD, PhD, Michele Paganelli, MD, and Luca Aldrighetti, MD, PhD

TABLE 2. COMPARISON OF CONVERSION RATES AND REASONS FOR CONVERSION BETWEEN THE CONTROL GROUP (NPS) AND THE TWO STUDY GROUPS (PS AND UPS)

	NPS group (control group) n = *349*	*PS group (study group)* n = *349*	P	*UPS subgroup (study subgroup)* n = *161*	P
Conversion, *n* (%)	18 (5.1)	48 (13.7)	.021	37 (23)	.015
Reason for conversion, *n* (%)					
Bleeding	5 (1.4)	12 (3.4)	.004	9 (5.6)	.031
Oncologic inadequacy	7 (2.0)	9 (2.5)	.892	5 (3.1)	.945
Difficult adhesiolysis	0 (0)	20 (5.7)	.004	19 (11.8)	.002
Damage to organs	1 (0.3)	1 (0.3)	.540	1 (0.6)	.647
Anesthesiological issue	2 (0.6)	3 (0.8)	.092	1 (0.6)	.495
Inaccurate biliostasis	3 (0.8)	3 (0.8)	.093	2 (1.2)	.343

NPS group, patients with no history of abdominal surgery; PS group, patients known for previous abdominal surgery; UPS group, patients known for previous upper abdominal surgery.

Previous abdominal surgery, major resections and position in postero-superior segments resulted significantly associated with the risk of conversion at multivariate analysis

Hot topics in conversion

Outcome

How to prevent conversion?

How to manage conversion?

Experience and conversion

Hot topics in conversion

Outcome

How to prevent conversion?

How to manage conversion?

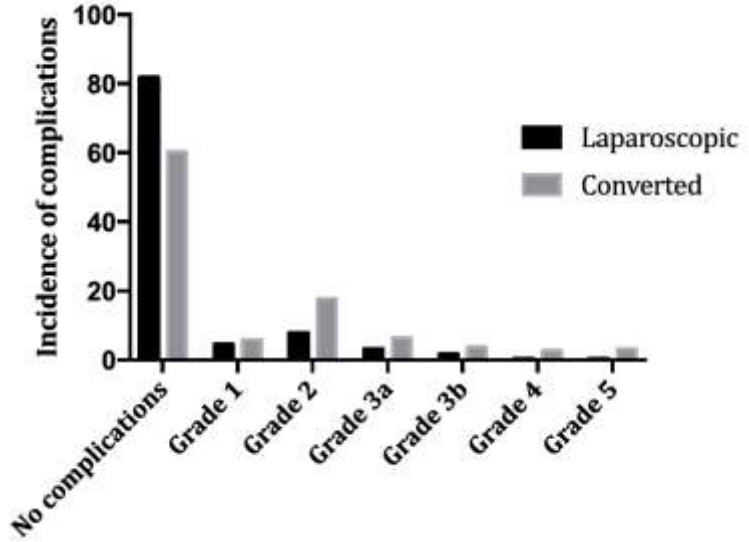
Experience and conversion

Conversion for Unfavorable Intraoperative Events Results in Significantly Worst Outcomes During Laparoscopic Liver Resection

Ann Surg, 2018

Lessons Learned From a Multicenter Review of 2861 Cases

Mark C. Halls, MBBS, Federica Cipriani, MD,† Giammauro Berardi, MD,‡ Leonid Barkhatov, MD,§ Panagiotis Lainas, MD,¶ Mohammed Alzoubi, MBBS,* Mathieu D'Hondt, MD,|| Fernando Rotellar, PhD,# Ibrahim Dagher, PhD,¶ Luca Aldrighetti, PhD,† Roberto I. Troisi, PhD,‡ Bjorn Edwin, PhD,§ and Mohammed Abu Hilal, MD, PhD**



Complication rate

Resection Extent	Laparoscopic	Converted	*P* Value
Estimated blood loss (mL)			
Wedge/atypical segmentectomy	150	350	<0.001
Anatomical segmentectomy	250	400	<0.001
Bisegmentectomy/sectionectomy	200	600	<0.001
Trisegmentectomy/hemi-hepatectomy	350	650	<0.001
Extended hepatectomy	750	800	0.712
Intra-operative time (min)			
Wedge/atypical segmentectomy	145	213	<0.001
Anatomical segmentectomy	200	265	0.006
Bisegmentectomy/sectionectomy	180	290	<0.001
Trisegmentectomy/hemi-hepatectomy	298	310	0.001
Extended hepatectomy	376	335	0.171

- ✓ Completed laparoscopically: 17.1%
- ✓ Converted: 39.1%

P<0.001

Conversion for Unfavorable Intraoperative Events Results in Significantly Worst Outcomes During Laparoscopic Liver Resection

Ann Surg, 2018

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222 conversions analyzed

TABLE 1. Causes of Conversion

Classification	Cause of Conversion	Absolute Frequency (%)	Total
Unfavorable intra-operative findings	Adhesions	42 (18.9%)	123
	Oncological concern prior to resection	32 (14.4%)	
	Poor access	24 (10.8%)	
	Poor liver quality (e.g., cirrhosis/steatosis)	3 (1.4%)	
	Other (e.g., aberrant Hilar anatomy, inability to locate lesion, biliary obstruction)	22 (9.9%)	
Unfavorable intra-operative events	Bleeding	81 (36.5%)	99
	Oncological concern during/after resection	12 (5.4%)	
	Damage to surrounding structures	3 (1.4%)	
	Cardiovascular instability on induction	3 (1.4%)	

90 days mortality 1.9%

90 days mortality 10%

44.6% of conversions

Patients who had an elective conversion for an unfavorable intraoperative finding had better outcomes than patients who had an emergency conversion secondary to an unfavorable intraoperative event.

Hot topics in conversion

Outcome

How to prevent conversion?

How to manage conversion?

Experience and conversion

Ann Surg, 2018

ORIGINAL ARTICLE

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‡‡‡‡‡‡*

ORIGINAL ARTICLE

Ann Surg, 2018

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‡‡‡‡‡‡*

What are the haemostatic techniques during laparoscopic liver resections?

R22.1: Inflow control, intravascular volume management, and secure division of vascular elements should be regarded to as the pillars of bleeding control during laparoscopic liver resections.	4	Strong (upgraded from conditional)
R22.2: Pringle maneuver is the most effective technique of inflow control, provided it is used intermittently. Hemi-hepatic inflow control should be considered as an alternative to Pringle maneuver when technically convenient.	2−	Strong (upgraded from conditional)
R22.3: A low CVP and a CO_2 pneumoperitoneum between 12 and 14 mm Hg during the transection phase allows reduced blood loss without a subsequent risk of gas embolism.	3	Strong (upgraded from conditional)
R22.4: Cardiac preload monitoring through stroke volume variation is a valid alternative to the traditional CVP measurement as guide to fluid management during laparoscopic liver resections.	1−	Strong

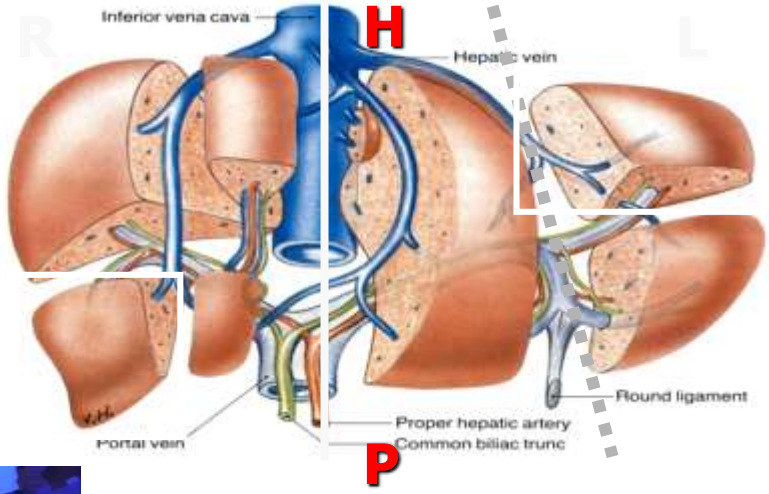
HPB, 2016

ORIGINAL ARTICLE

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

Francesca Ratti[1], Federica Cipriani[1], Raffaella Reineke[2], Marco Catena[1], Michele Paganelli[1], Laura Comotti[2], Luigi Beretta[2] & Luca Aldrighetti[1]

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



The American Journal of Surgery 195 (2008) 270–272

How I do it

Ultrasonic-mediated laparoscopic liver transection

Luca Aldrighetti, M.D., Ph.D.*, Carlo Pulitanò, M.D., Marcella Arru, M.D., Marco Catena, M.D., Ph.D., Eleonora Guzzetti, M.D., Massimiliano Casati, M.D., Gianfranco Ferla, M.D.

ORIGINAL ARTICLE

Ann Surg, 2018

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‡‡‡‡‡‡*

When and how should conversions to open surgery be considered?

R23.1: Early conversion should be considered to protect the patient from complications related to late/emergency conversions.	2–	Strong (upgraded from conditional)
R23.2: Conversion to open should be considered if the surgeon is failing to progress due to technical difficulties, if patient's condition is compromised, or if blood loss is higher than expected. In cases of uncertainty of the oncological margin, conversion should be performed if adequate margins are expected with an open approach.	3	Strong (upgraded from conditional)
R23.3: Major bleeding that requires conversion should be temporarily tamponaded and controlled before opening to avoid the risk of haemorrhagic shock and air embolism.	4	Strong (upgraded from conditional)

Hot topics in conversion

Outcome

How to prevent conversion?

How to manage conversion?

Experience and conversion

How to manage conversion?

Conversion for Intraoperative findings:

- Do not rush
- Prepare required instrumentation
- Change patient's position

How to manage conversion?

Conversion for Intraoperative findings:

- Do not rush
- Prepare required instrumentation
- Change patient's position

Conversion for Intraoperative adverse events:

- Analyse the type of bleeding
  - Arterial/portal: no need to grasp, just close the hilum
  - Hepatic vein: close the hilum, grasp, increase the pneumo
- Check the list of the instruments for quick conversion (Scalpel, forceps, vascular clamps)
- Do not stop to insufflate while converting
- Open the abdomen at least enough to put an hand (better if the whole incision)
- If grasper is in place (active bleeding ongoing) put the retractor. If grasping is unsatisfactory manual compression and then retractors
- If grasper in place: 1° operator keeps the camera and the grasper, assistents open the abdomen

Hot topics in conversion

Outcome

How to prevent conversion?

How to manage conversion?

Experience and conversion

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 Luca[1] · Federica Cipriani[1] · Guido Fiorentini[1] · Marco Catena[1] · Michele Paganelli[1] · Francesca Ratti[1]

- 1032 laparoscopic liver resections performed by a single surgeon (2005-2019) were stratified by difficulty scores.
- Low-Difficulty (LD, n=362); Intermediate-Difficulty (ID, n=332) and High-Difficulty (HD, n=338).
- The learning curve effect was analyzed using the Cumulative Sum (CUSUM) method taking into consideration the expected risk of conversion.

	Total (n=1032)		Low difficulty (n=362)		Intermediate difficulty (n=332)		High difficulty (n=338)		
	n	%	n	%	n	%	n	%	p
Pringle Manuevre, n (%)	946	91,7	295	81,5	317	95,5	334	98,8	<0.05
Length of surgery (min), mean ±SD	175 ± 64		149 ± 64		187 ± 71		235 ± 91		NS
Blood Loss (mL), mean ±SD	210 ± 115		150 ± 150		200 ± 50		350 ± 200		<0.05
Associated procedures, n (%)	302	29,3	25	6,9	106	31,9	171	50,6	<0.05
Surgical margin, n (%)									NS
R0	997	96,6	357	98,6	320	96,4	320	94,7	
R1	35	3,4	5	1,4	12	3,6	18	5,3	
Surgical margin (mm), mean ±SD	8 ± 4		10 ± 2		8 ± 5		5 ± 5		NS
Intraoperative blood transfusions, n (%)	114	11,0	14	3,9	33	9,9	67	19,8	<0.05
Postoperative blood transfusions, n (%)	160	15,5	31	8,6	51	15,4	78	23,1	<0.05
Conversion, n(%)	120	11,6	24	6,6	38	11,4	58	17,2	<0.01
Morbidity, n(%)	184	17,8	31	8,6	59	17,8	94	27,8	<0.05
Grade of complications, n (%)		0,0							
Minor	120	11,6	22	6,1	34	10,2	64	18,9	<0.05
Major	64	6,2	9	2,5	25	7,5	30	8,9	NS
Mortality, n(%)	4	0,4	1	0,3	1	0,3	2	0,6	NS
Length of stay (days), mean ±SD	4 ± 1		3 ± 1		4 ± 1		5 ± 1		NS

Intra- and postoperative outcome of procedures according to difficulty of laparoscopic liver resection

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

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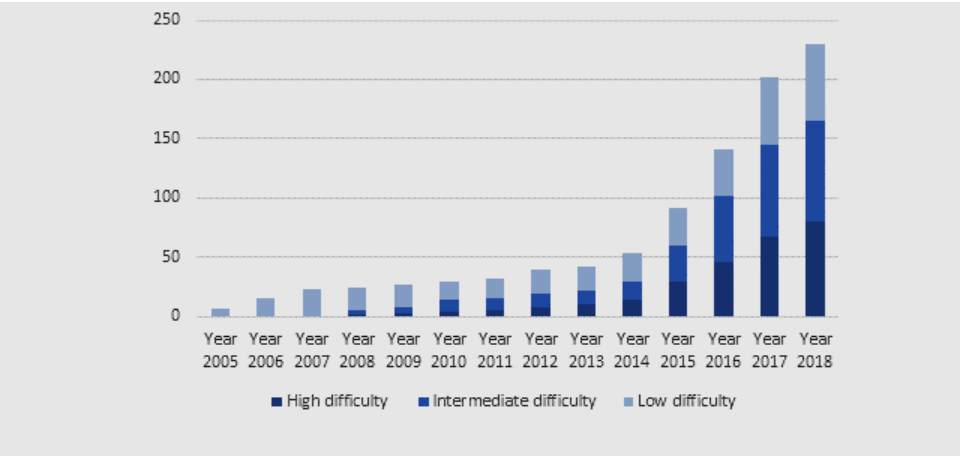
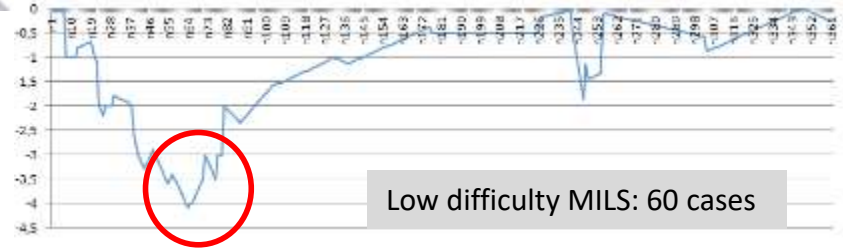
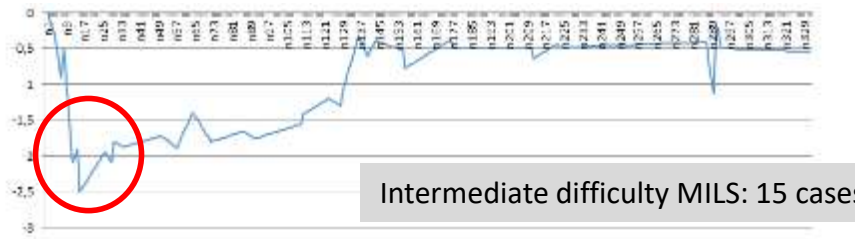


A standard educational model—stepwise and progressive—is mandatory to allow surgeons to deine the technical and technological backgrounds to deal with a specific degree of diiculty, providing a help in the definition of indications to laparoscopic approach in each phase of training.

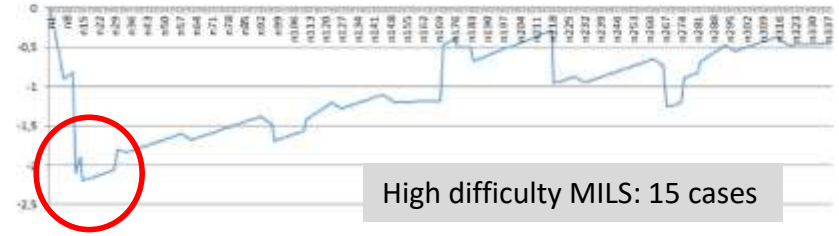
CUSUM analysis of learning curve



Low difficulty MILS: 60 cases



Intermediate difficulty MILS: 15 cases



High difficulty MILS: 15 cases

Conclusions

- Laparoscopic liver surgery has to deal with an intrinsic risk of conversion
- Causes of conversion are related to intraoperative findings (oncologic issues, adhesions) and to intraoperative accidents (bleeding, anaesthesiological problems)
- Late conversion secondary to intraoperative accidents negatively affects postoperative outcome
- The most frequent intraoperative accident is bleeding
- Measures to control bleeding are based on inflow (surgeon) and outflow (anaesthesiologist) control
- A good management of conversion is fundamental to maintain a good profile of safety
- Since the risk of conversion is affected by technical complexity, a stepwise approach to MILS is strongly recommended