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LAPAROSCOPIC LIVER RESECTION:
FROM INNOVATION TO STANDARD
PRACTICE

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Laparoscopic Liver Resection for Hepatocellular Carcinoma in Patients with Advanced Cirrhosis

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- **Background:** Laparoscopic liver resection (LLR) for hepatocellular carcinoma (HCC) is well-described for Child's A cirrhotics. It is reported for patients with Child's B and C cirrhosis as well, though not as widely.
- **Objective:** This study aimed to compare safety and outcomes of LLR for HCC for patients with early cirrhosis (Child's A) to patients with more advanced cirrhosis (Child's B and C).

Laparoscopic Liver Resection for HCC in Advanced Cirrhotics



- **Series reporting LLR for HCC in early (Child's A) cirrhosis (≥ 17 patients)**

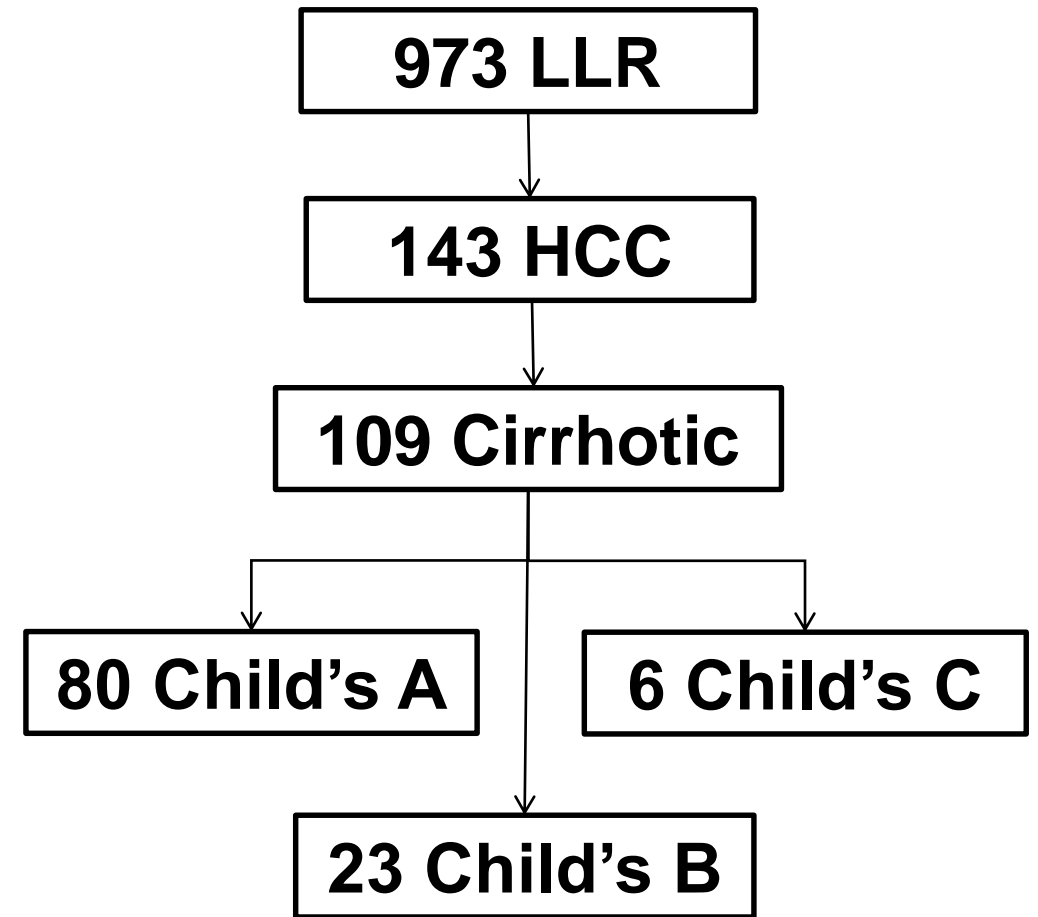
Study	Center	Patients (n)
Soubrane <i>et al.</i> (2014)	Paris, France	275
Shehta <i>et al.</i> (2016) and Brytska <i>et al.</i> (2015)	Seoul, South Korea	125
Dagher <i>et al.</i> (2010)	Clamart, France	111
Cheung <i>et al.</i> (2016)	Hong Kong, China	110
Chen <i>et al.</i> (2008)	Kaohsiung, Taiwan	98
Ettorre <i>et al.</i> (2015)	Rome, Italy	85
Belli <i>et al.</i> (2009)	Naples, Italy	49
Kobayashi <i>et al.</i> (2013)	Osaka, Japan	48
Memeo <i>et al.</i> (2014)	Creteil, France	44
Worhunsky <i>et al.</i> (2016)	Stanford, California	41
Yoon <i>et al.</i> (2017)	Seoul, South Korea	37
Truant <i>et al.</i> (2011)	Lille, France	36
Lee <i>et al.</i> (2011)	Hong Kong, China	33
Herman <i>et al.</i> (2014)	Sao Paulo, Brazil	30
Kaneko <i>et al.</i> (2009)	Tokyo, Japan	30
Hu <i>et al.</i> (2011)	Yangzhou, China	29
Lai <i>et al.</i> (2009)	Hong Kong, China	23
Kanazawa <i>et al.</i> (2013)	Osaka, Japan	20
Cherqui <i>et al.</i> (2006)	Creteil, France	20
Casaccia <i>et al.</i> (2011)	Genoa, Italy	17
Santambrogio <i>et al.</i> (2009)	Milan, Italy	17

- Series reporting LLR for HCC in advanced (Child's B and/or C) cirrhosis (≥ 7 patients)

Study	Center	Patients (n)
Chen <i>et al.</i> (2008)	Kaohsiung, Taiwan	18
Shehta <i>et al.</i> (2016) and Brytska <i>et al.</i> (2015)	Seoul, South Korea	16
Dagher <i>et al.</i> (2010)	Clamart, France	9
Kaneko <i>et al.</i> (2009)	Tokyo, Japan	9
Kanazawa <i>et al.</i> (2013)	Osaka, Japan	8
Kobayashi <i>et al.</i> (2013)	Osaka, Japan	8
Worhunsky <i>et al.</i> (2016)	Stanford, California	7

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- **Method:** Retrospective review of a prospectively maintained database at a single, high-volume hepatobiliary center in the United States over a 15-year period (May 2002 - July 2016)
- **Median duration of follow-up:** 22 months (range 0 - 163 months)



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- **Patient Characteristics**

	Child's A n = 80	Child's B/C n = 29	p-value
Median Age (years)	65 (38 - 84)	61 (49 - 77)	0.224
Male Gender	81%	76%	0.54
Median BMI	28 (16 - 54)	30 (20 - 46)	0.37
Preoperative Median Platelets (x10⁹)	132 (33 - 621)	97 (35 - 275)	0.003
Preoperative Median TBili (μmol/L)	0.7 (0.3 - 1.9)	1.2 (0.5 - 3.9)	<0.001
Preoperative Median PT (sec)	13.6 (9.6 - 24.5)	16.0 (9.8 - 30.9)	<0.001
Preoperative Median Albumin (g/dL)	3.8 (2.7 - 4.9)	3.2 (2.3 - 4.6)	<0.001
Preoperative Ascites	8.8%	48%	<0.001
Preoperative Encephalopathy	6.1%	31%	0.002
ASA Class (%)	I	0	0.09
	II	10%	
	III	83%	
	IV	7.5%	

- Tumor Characteristics**

		Child's A n = 80	Child's B/C n = 29	p-value
Number of Lesions	1	68%	59%	0.55
	2-3	27%	38%	
	≥4	5.0%	3.4%	
Longest Diameter of Largest Tumor (median, cm)		3.1 ± 2.1	2.5 ± 1.5	0.21
Location of Tumor	Left lateral	32%	24%	0.26
	Left medial	3.8%	14%	
	Right anterior	15%	24%	
	Right posterior	21%	17%	
	Multiple	29%	21%	

- Perioperative Variables

		Child's A n = 80	Child's B/C n = 29	p-value
Case Type	Segmentectomy/Wedge	71%	83%	0.33
	Sectionectomy	21%	17%	
	Lobectomy	7.5%	0	
Median Operative Time (minutes)		151 (30 - 488)	99 (43 - 354)	0.03
Hand-Assisted		24%	0	0.004
Converted to Open Procedure		7.3%	6.9%	1.00
Median EBL (cc)		50 (5 – 2100)	50 (10 – 36,650)	0.41
Required PRBC Transfusion		5.0%	17%	0.054

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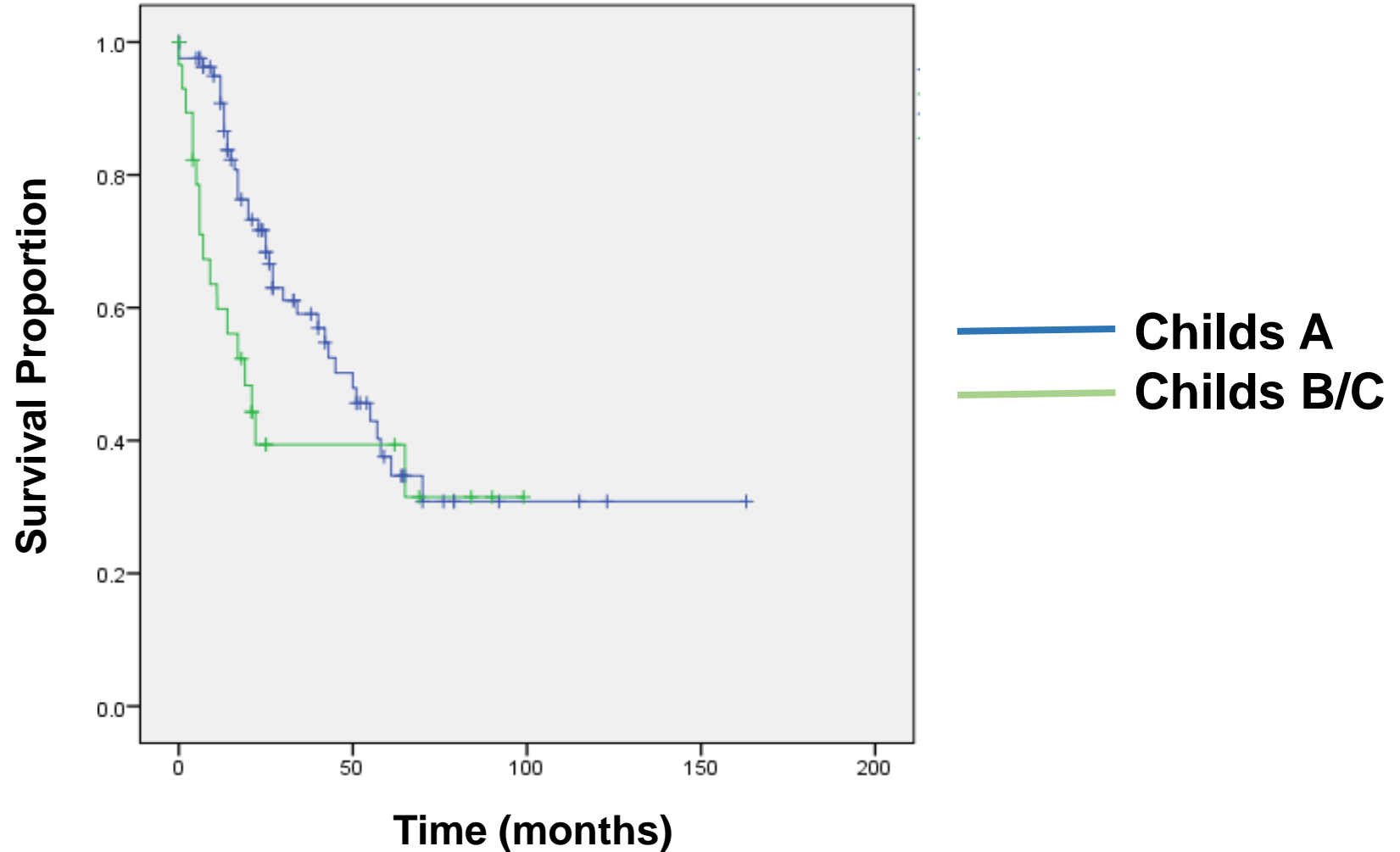
- **Outcomes**

		Child's A n = 80	Child's B/C n = 29	p-value
R0 Resection Margin		76%	83%	0.74
Postoperative Change	Total Bilirubin (mol/L)	0.70	1.59	0.07
	Prothrombin Time (sec)	-1.3	-0.06	0.40
Median length of stay (days)		3.0 (1 - 26)	2.0 (1 - 19)	0.15
ICU admission		5.0%	14%	0.20
Complication	None	85%	76%	0.64
	Minor (Clavien-Dindo <3)	10%	17%	
	Serious (Clavien-Dindo ≥3)	5.0%	6.9%	

- Mortality and Survival**

		Child's A n = 80	Child's B/C n = 29	p-value
Mortality	30 Days	2.5%	3.5%	OR 0.72 (95% CI 0.06 - 8.2)
	90 Days	2.5%	10%	OR 0.22 (95% CI 0.03 - 1.4)
Overall Median Survival (months)		50 (95%CI 36 - 64)	19 (95%CI 7.8 - 30)	0.08

- Overall Survival



- **Operative Observations**

- Child's B/C patients were only selected when the surgeon felt surgery could be accomplished in a purely laparoscopic manner.
- Handports were used for major resections in select Child's A patients per surgeon preference.
- Recannulized umbilical veins and collaterals were identified preoperatively on cross-sectional imaging and avoided at all costs.
- If ascites was present all trocar sites, including 5mm ports, were closed and a surgical drain was left in place.

- **Study Limitations:**
 - Single institution study
 - Small sample size
- **Conclusion:** These results indicate that laparoscopic liver resections can be safely performed in select Child's B/C patients with outcomes that are comparable to Child's A patients.
- **Future:** Further studies should be directed at determining which Child's B/C patients are good candidates for laparoscopic liver resection.

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- **Causes for Conversion**

Case	Child's Classification	Procedure	Reason for Conversion
1	A	Partial right hepatectomy	Bleeding during parenchymal dissection secondary due to portal hypertension
2	A	Wedge resection of segment 7 tumor	Technical difficulty accessing tumor due to location
3	A	Left lateral sectionectomy	Asystole with insufflation of abdomen
4	A	Left lateral sectionectomy	Injury to left PV and bile duct due to staples not holding – technical difficulty
5	A	Right hepatectomy	Technical difficulty during parenchymal transection due to very large right lobe
6	B	Wedge resection segment 6 tumor	Bleeding secondary to coagulopathy
7	C	Left lateral sectionectomy	Bleeding secondary to adhesions and portal hypertension

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- **Minor (Clavien-Dindo <3) Complications (within 30 days)**

Case	Child's Classification	Procedure	Minor Complication (Clavien-Dindo <3)
1	A	Segment 3 resection (handport)	Ileus
2	A	Left hepatectomy (handport)	Troponin leak
3	A	Left lateral sectionectomy (handport)	Atrial fibrillation
4	A	Segment 6 resection	New persistent oxygen requirement
5	B	Segment 4 resection	Portal vein thrombus
6	B	Segment 4A resection	Atrial fibrillation
7	B	Segment 8 resection	Delirium
8	C	Segment 8 resection	Pulmonary edema
9	C	Laparoscopic converted to open left lateral sectionectomy	Portal vein thrombus, delirium

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- **Serious (Clavien-Dindo ≥ 3) Complications (within 30 days)**

Case	Child's Classification	Procedure	Serious Complication (Clavien-Dindo ≥ 3)
1	A	Partial right hepatectomy (handport)	Respiratory failure requiring reintubation, tracheostomy
2	A	Segment 3 wedge resection	Pleural effusion requiring drainage
3	A	Laparoscopic left lateral sectionectomy	Death within 30 days – sepsis secondary to foot abscess requiring readmission and debridement, respiratory arrest while in rehab
4	A	Laparoscopic segment 8 wedge resection	Death within 30 days – readmitted with severe hyponatremia and seizures, intubated, then made CMO
5	B	Laparoscopic converted to open wedge resection	Intraoperative death due to massive bleeding, intracardiac thrombus, right-sided heart failure
6	C	Left lateral sectionectomy	Respiratory failure requiring reintubation

- Causes of Death Between Postoperative Day 31 and 90

Case	Child's Classification	Procedure	Cause of Death
1	B	Laparoscopic segment 4 wedge resection and RFA	Aortic valve endocarditis and abscess (history of IVDA) with sepsis and respiratory failure
2	C	Laparoscopic segment 8 wedge resection	Patient passed away in hospice , exact cause of death unknown