



# MANAGEMENT OF HILAR CHOLANGIOPANCREATIC TUMORS



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Hepatopancreatobiliary Unit  
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# Review

## Adenocarcinoma of the Hepatic Duct at Its Bifurcation Within the Porta Hepatis\* An Unusual Tumor with Distinctive Clinical and Pathological Features

GERALD KLATSKIN, M.D.

*New Haven, Connecticut*

TABLE I  
PREOPERATIVE SYMPTOMS AND PHYSICAL FINDINGS

Data	Case No.													Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Age (yr.).....	73	29	54	67	63	60	48	45	52	72	54	52	88	...
Sex.....	F	M	F	F	M	F	M	M	M	M	M	M	M	...
Symptoms														
Duration (wk.).....	5	8	4	6	3	6	12	16	4	7	4	4	?	...
Jaundice.....	+	*	+	*	+	+	+	+	+	+	+	+	0	12
Dark urine.....	+	*	+	+	+	+	+	+	+	+	+	+	*	0
Clay-colored stools.....	+	*	+	+	+	*	+	+	+	+	+	+	*	0

## iCCA

### risk factors:

primary sclerosing cholangitis, cirrhosis, *Opisthorchis viverrini* or *Clonorchis sinensis*, obesity, diabetes, chronic hepatitis B and C, hepatolithiasis

Typically presents as incidental hepatic lesion (s)

radioembolization or radiation can be considered for liver-predominant disease

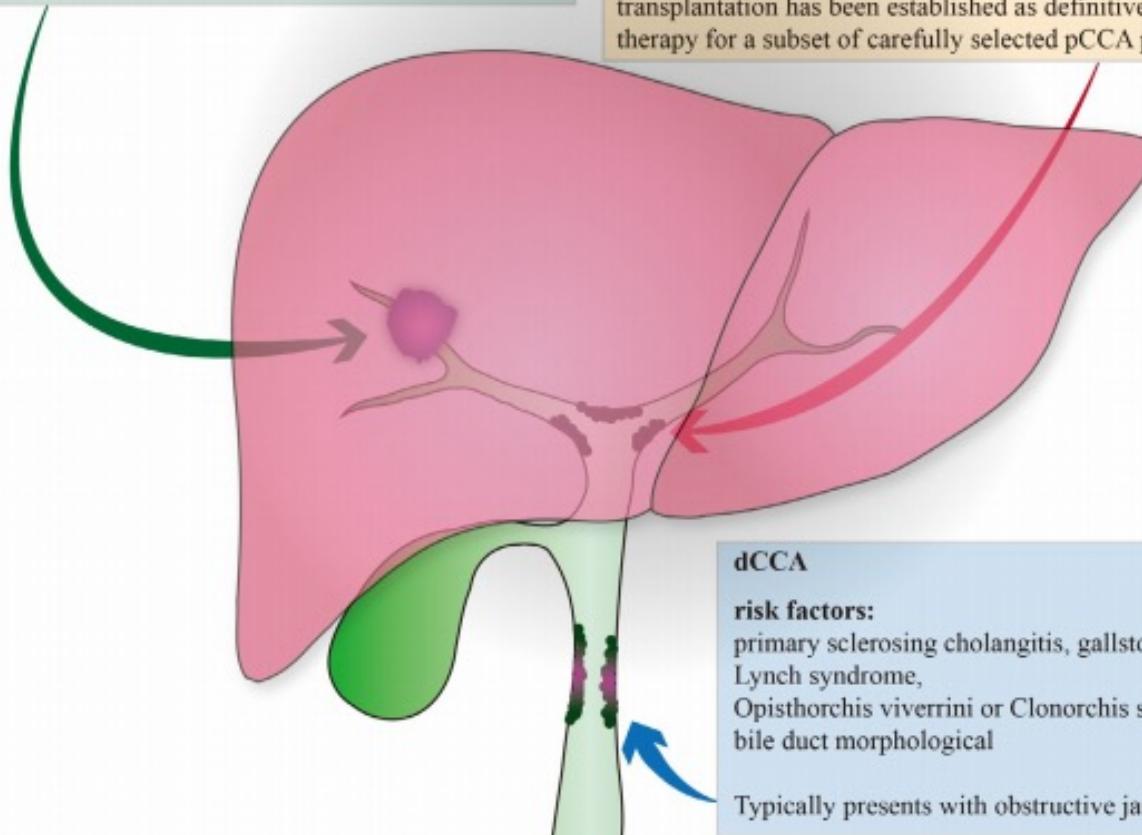
## pCCA

### risk factors:

primary sclerosing cholangitis, gallstones, Lynch syndrome, *Opisthorchis viverrini* or *Clonorchis sinensis*

Typically presents as well/moderately differentiated mucin producing cylindrical cells and a periductal infiltrating growth pattern

Neoadjuvant chemoradiation followed by liver transplantation has been established as definitive therapy for a subset of carefully selected pCCA patients



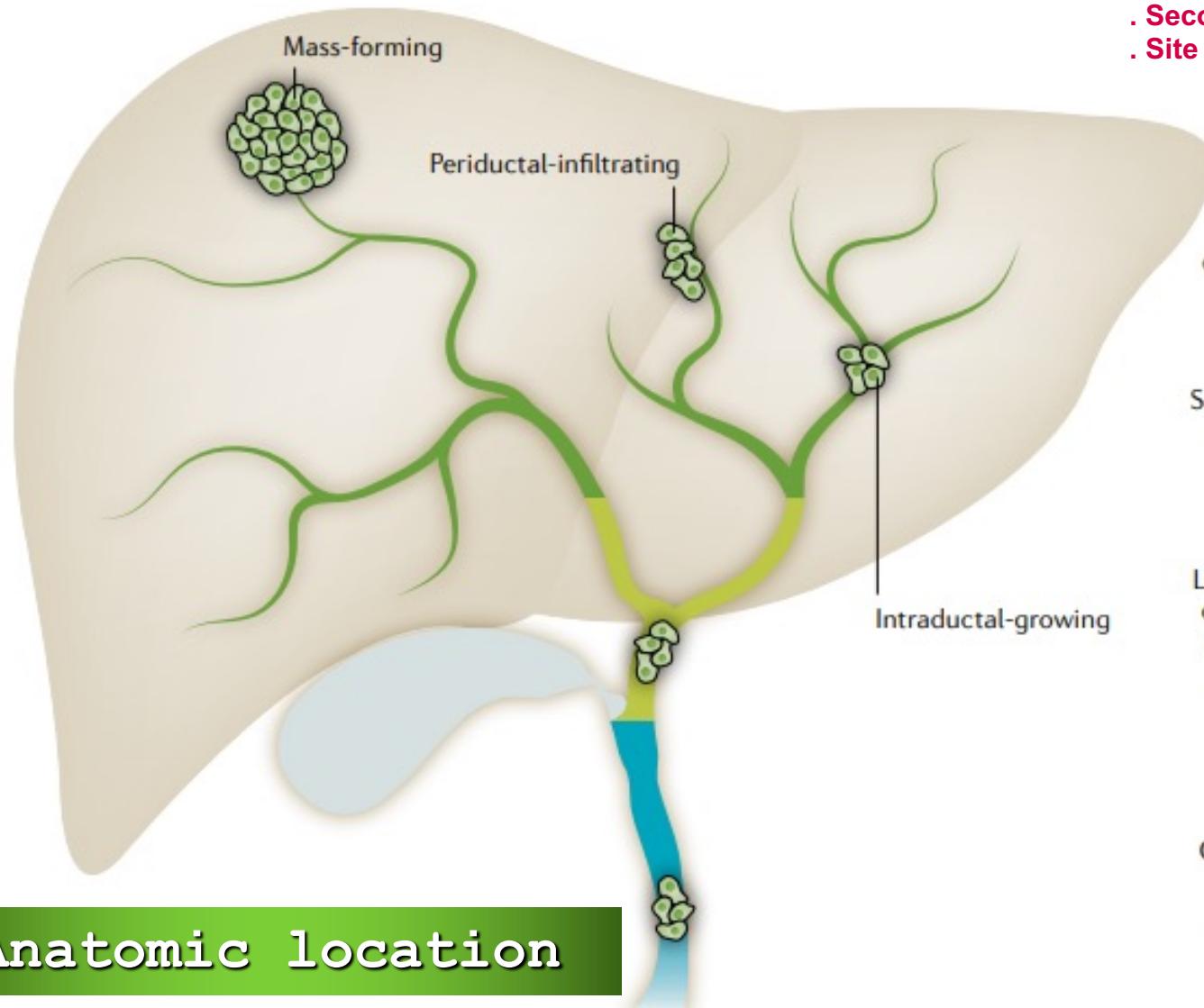
## dCCA

### risk factors:

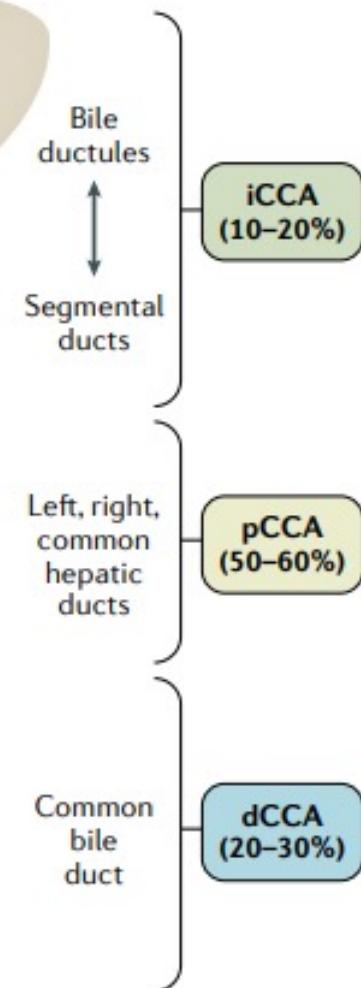
primary sclerosing cholangitis, gallstones, Lynch syndrome, *Opisthorchis viverrini* or *Clonorchis sinensis*, bile duct morphological

Typically presents with obstructive jaundice.

# CHOLANGIOPAPILLOMA

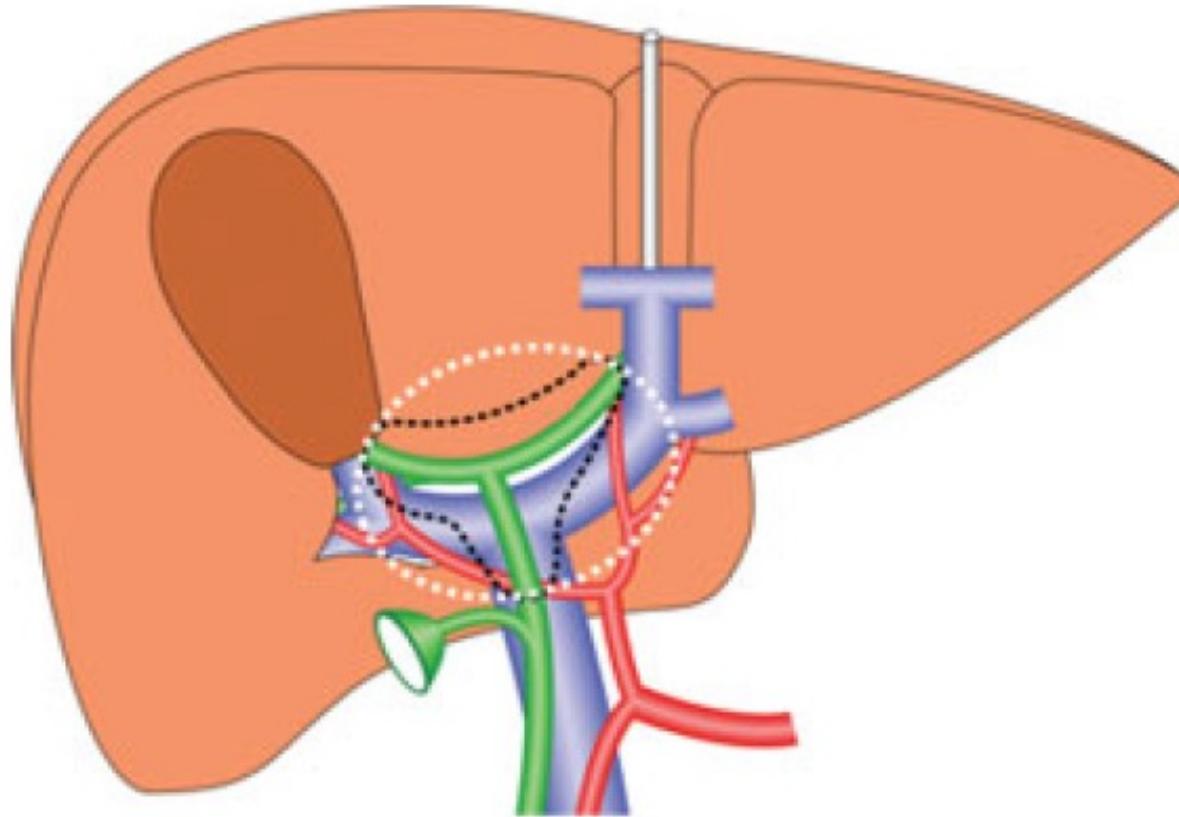


- . Second order biliary ducts
- . Site of cystic duct origin



## Anatomic location

# PERIHILAR CHOLANGIOCARCINOMA



- When the centre of the liver mass is located between the right side of the umbilical portion of the left portal vein and the left side of the right posterior portal (white dotted line).

# CLASSIFICATION

Bismuth and Corlette (1975)

Type I



Type II



Type III a



Type III b



Type IV





## ALTERNATIVE DIAGNOSES

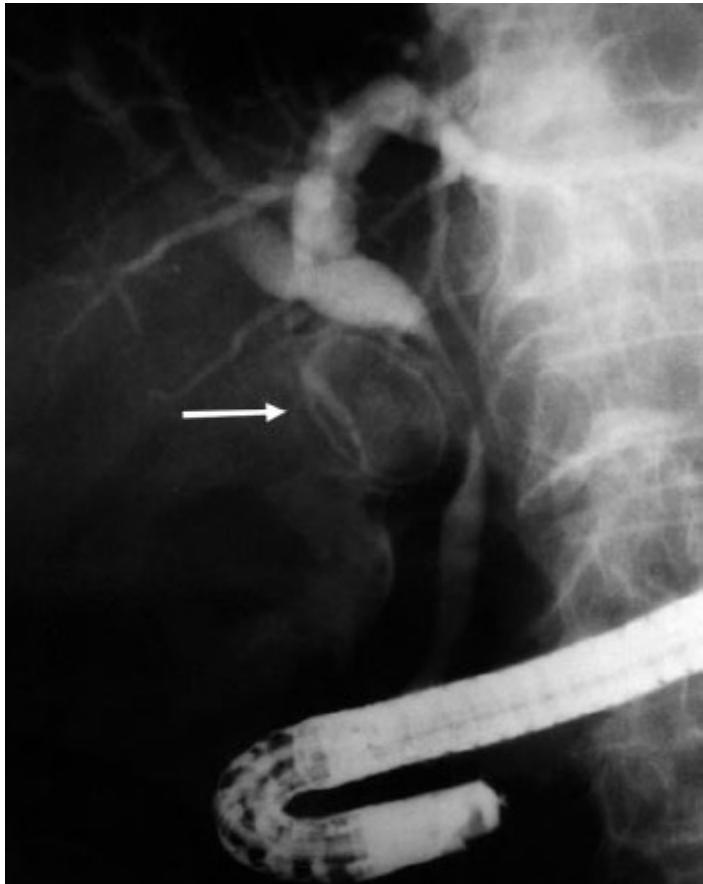
- Gallbladder carcinoma



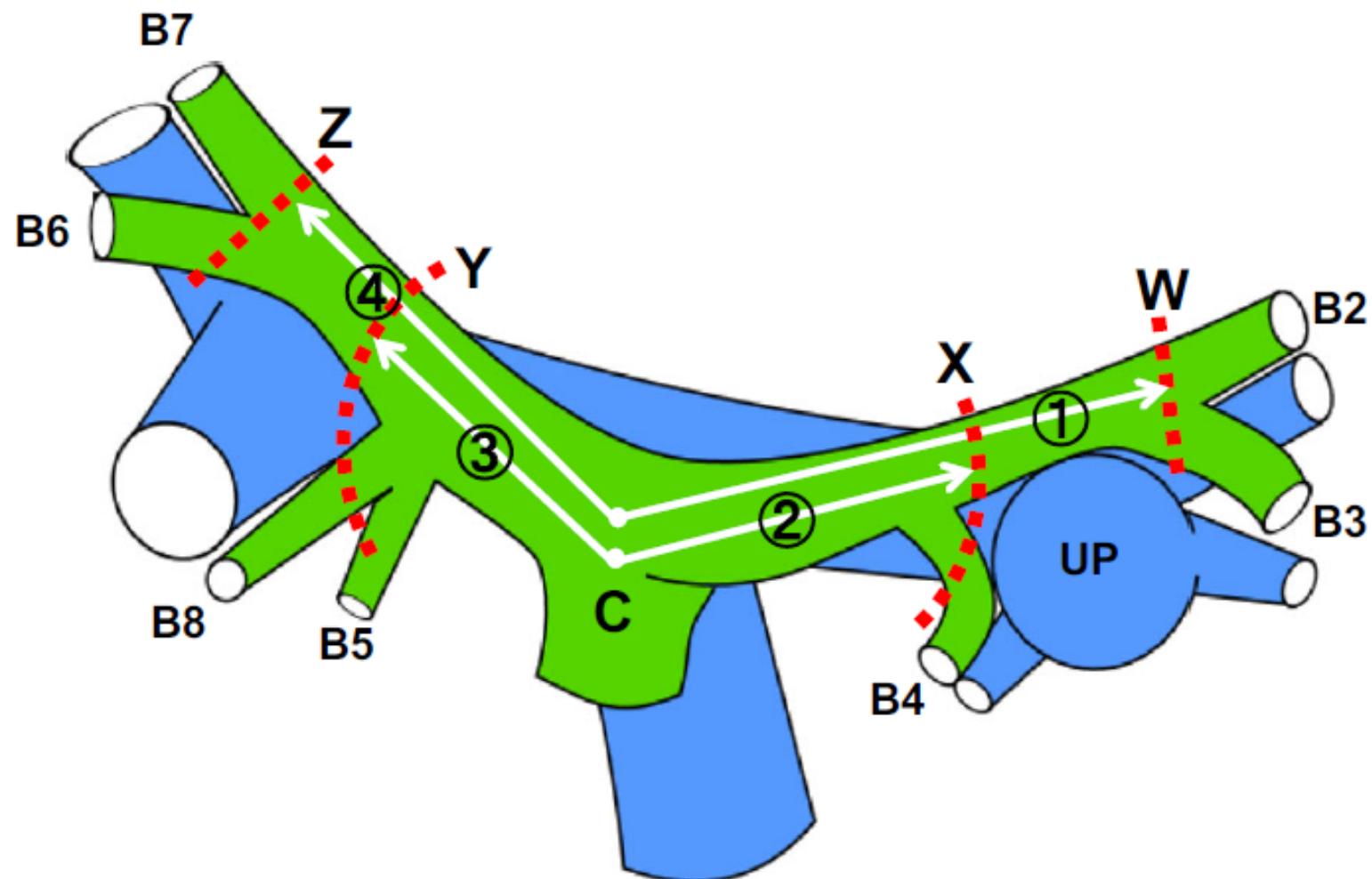
- Distended gallbladder (GC)
- Shrunken gallbladder (CC)

## ALTERNATIVE DIAGNOSES

### □ Mirizzi syndrome

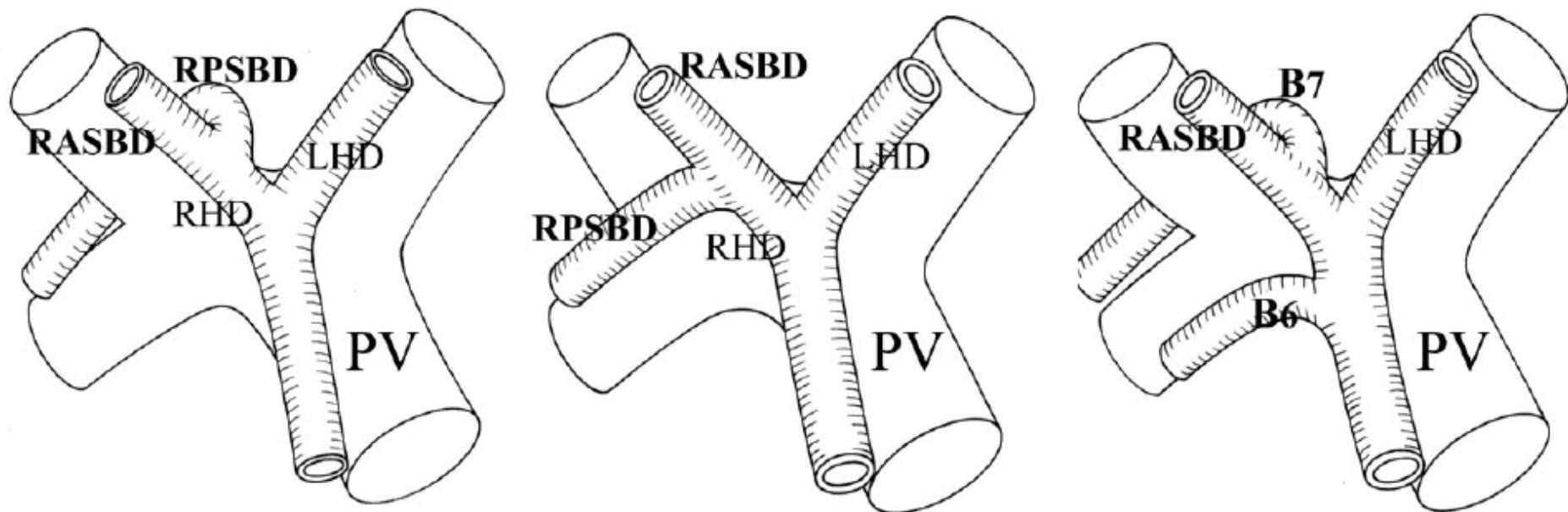


# ANATOMIC CONSIDERATIONS



# Clinical Significance of Biliary Vascular Anatomy of the Right Liver for Hilar Cholangiocarcinoma Applied to Left Hemihpectomy

Hiroaki Shimizu, MD, PhD, Shigeaki Sawada, MD, PhD, Fumio Kimura, MD, PhD, Hiroyuki Yoshidome, MD, PhD, Masayuki Ohtsuka, MD, PhD, Atsushi Kato, MD, PhD, and Masaru Miyazaki, MD, PhD



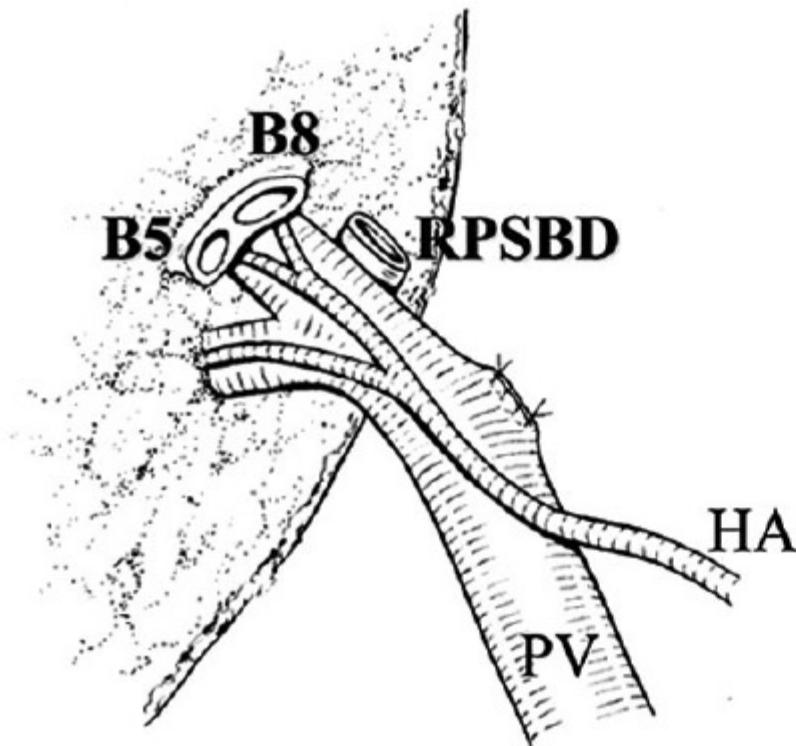
A:Supraportal type

B:Infraportal type

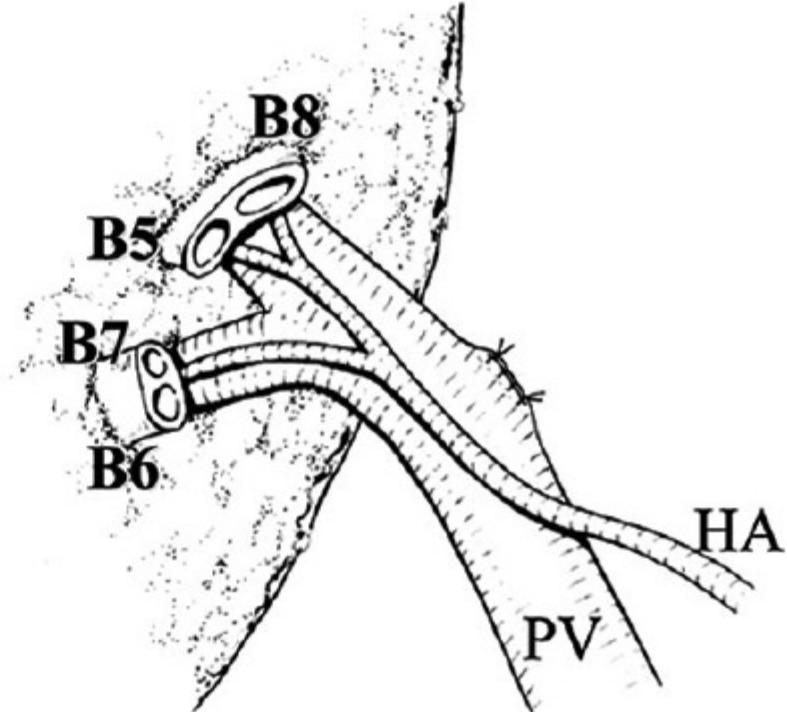
C:Combined type

# Clinical Significance of Biliary Vascular Anatomy of the Right Liver for Hilar Cholangiocarcinoma Applied to Left Hemimeatectomy

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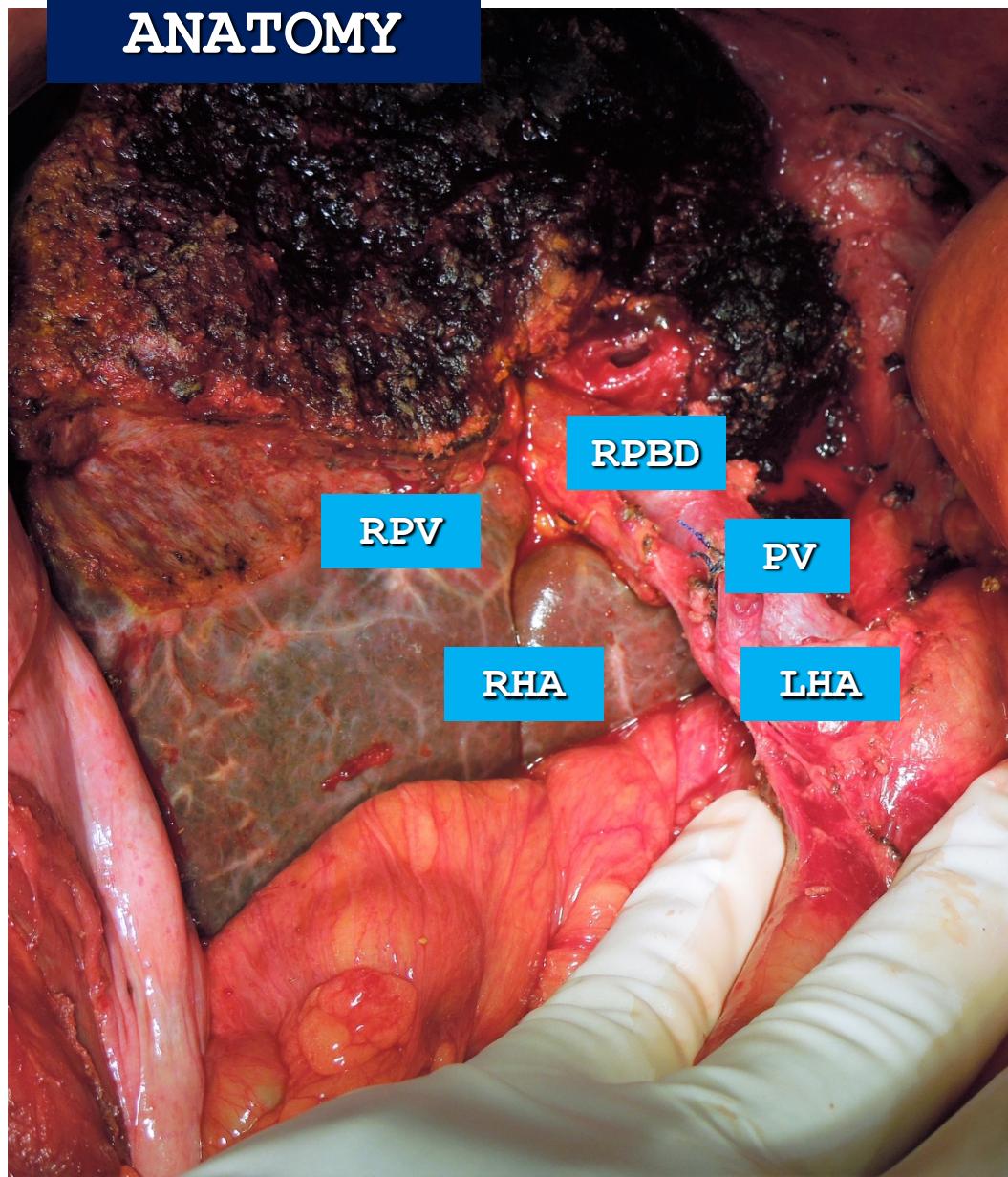


A: Supraportal type

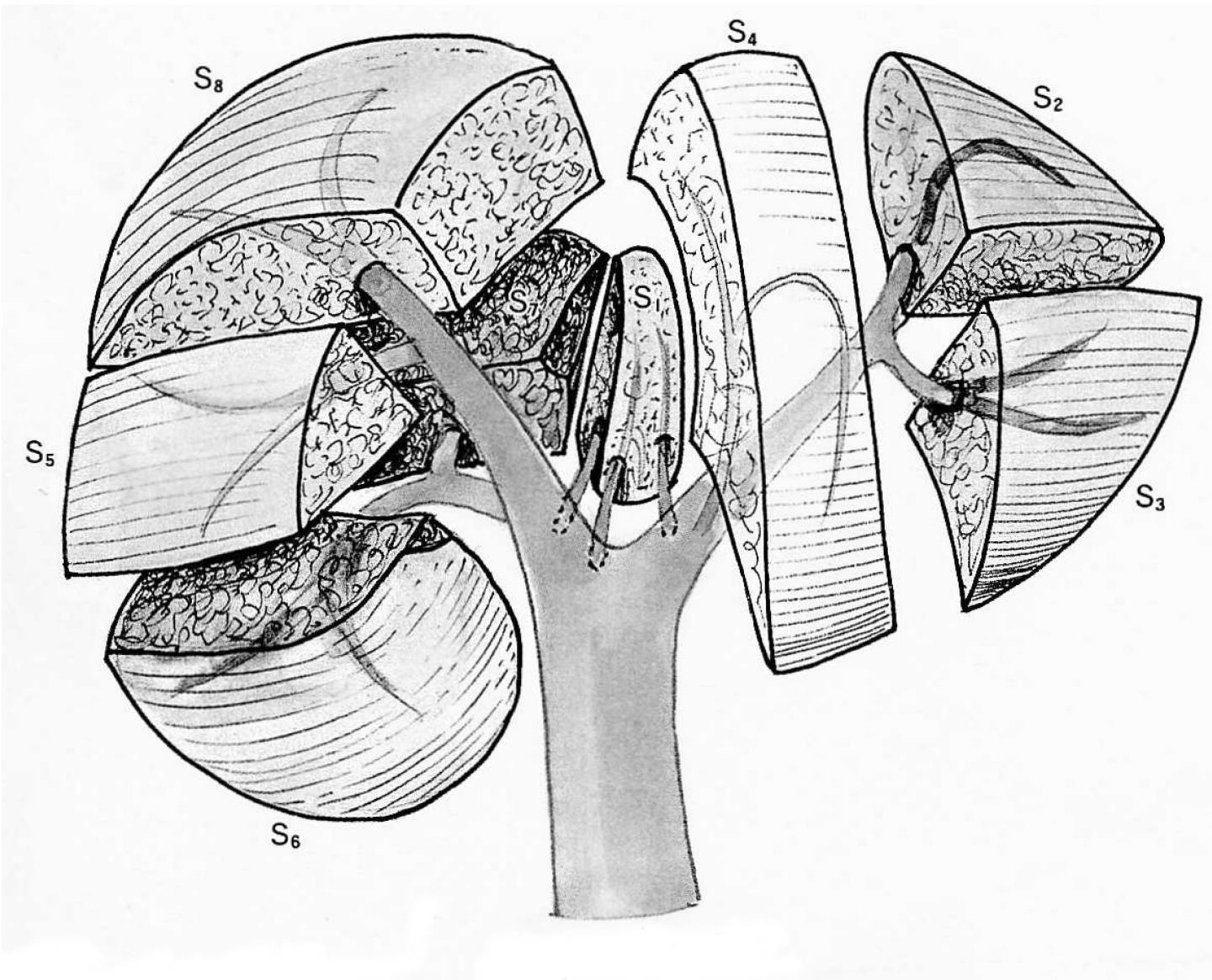


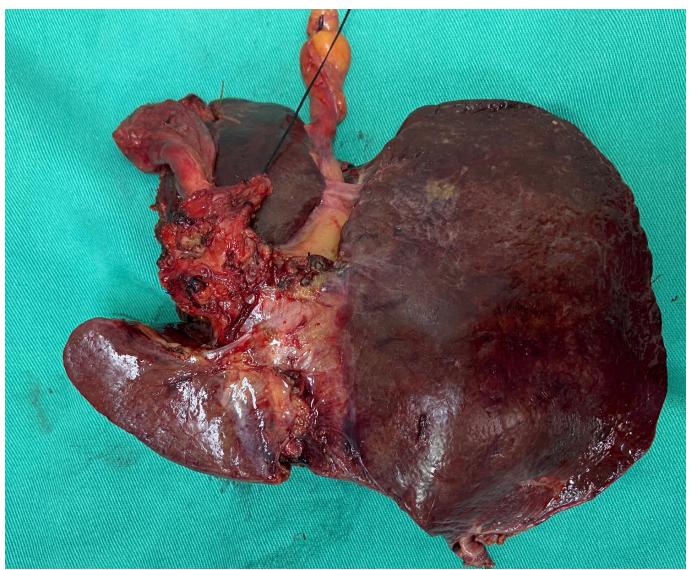
B: Infraportal type

# ANATOMY



# CAUDATE LOBE



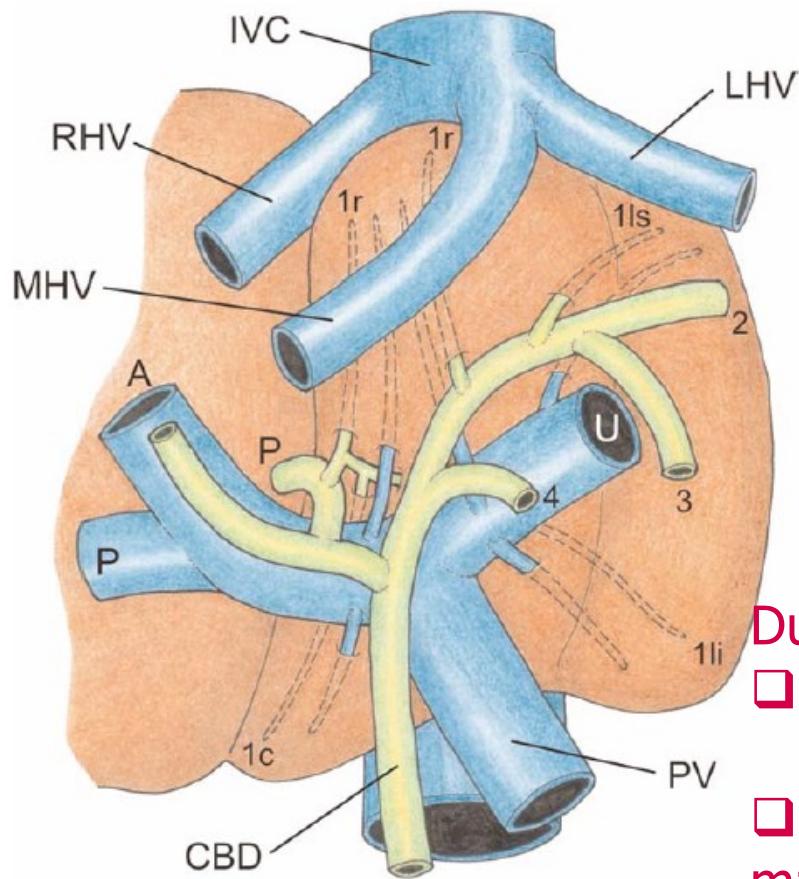


## CAUDATE LOBE



# CAUDATE LOBE

Vertical extension into the caudate duct



Due to:

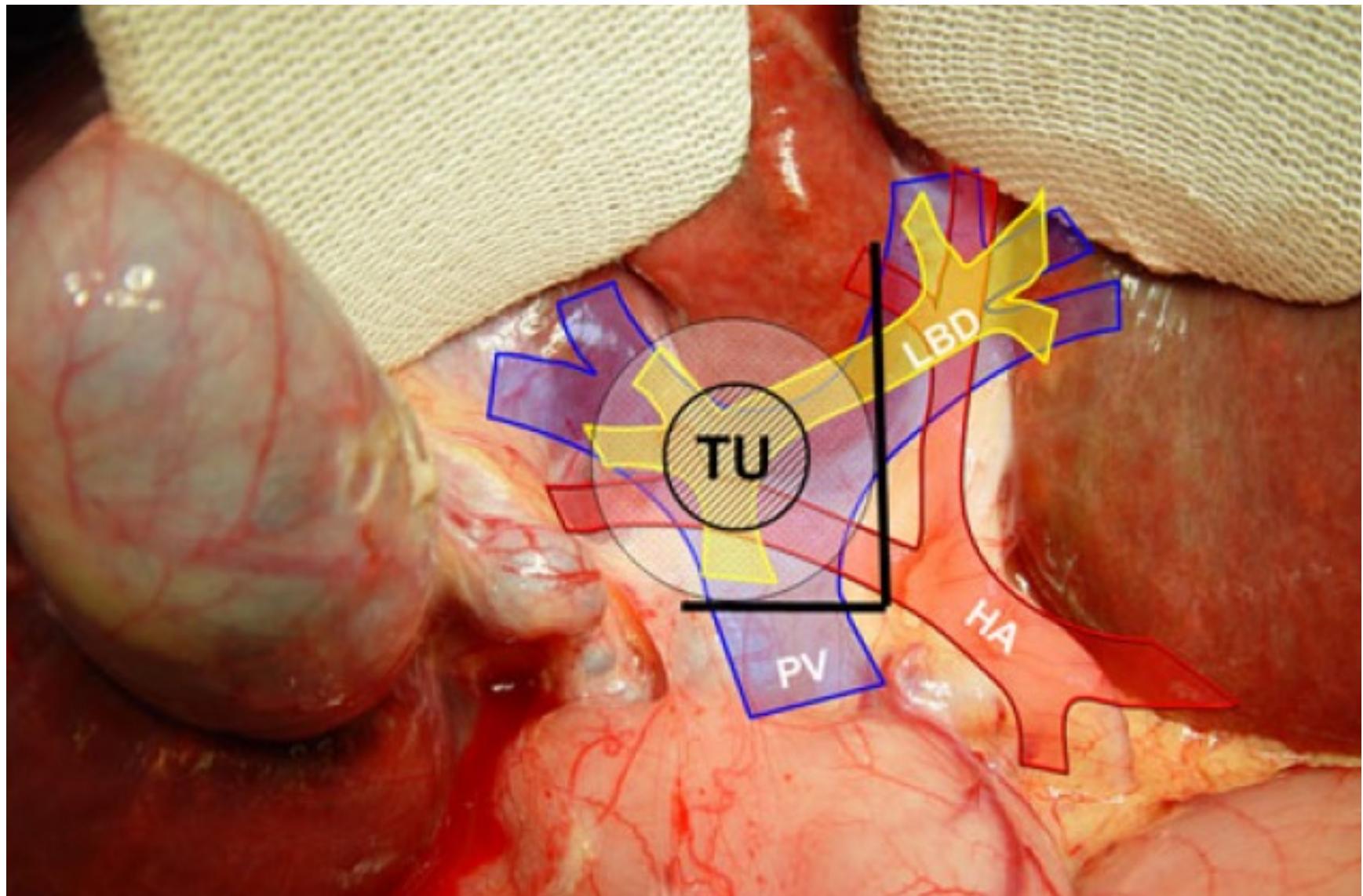
- lack of a strong muscular layer to restrict the tumor extension
- Caudate biliary ducts usually enter the main bile duct at the confluence posteriorly

# The value of caudate lobectomy in hilar cholangiocarcinoma treatment

## A meta-analysis

Ming Yang, MD<sup>a</sup> , Wei Wei Li, MD<sup>a</sup>, Jian Hua Chen, BS<sup>b</sup>, Miao Hang Cui, BS<sup>a</sup>, Jin Long Liu, MD<sup>a,\*</sup>

**Conclusion:** Combining caudate lobectomy can significantly increase the incidence of radical resection of HCCA and the postoperative survival time. The morbidity and mortality were not increased after the operation. Thus, caudate lobectomy should be included when performing partial hepatectomy for HCCA.

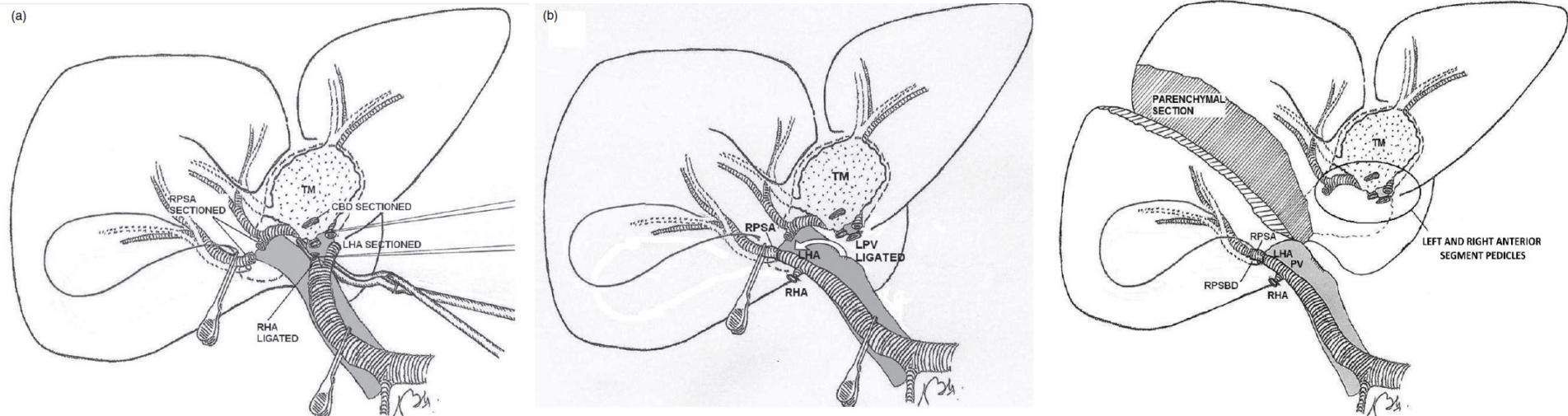


## TECHNICAL REPORT

## BISMUTH-CORLETTTE IIIb

# Hepatic artery reconstruction first for the treatment of hilar cholangiocarcinoma Bismuth type IIIB with contralateral arterial invasion: a novel technical strategy

Eduardo de Santibañes, Victoria Ardiles, Fernando A. Alvarez, Juan Pekolj, Claudio Brandi & Axel Beskow



## IMAGING STUDIES

- Level and extent of tumor within the biliary tree
- Vascular invasion (portal vein/arterial)
- Hepatic lobar atrophy
- Distant metastatic disease (and lymph nodes)

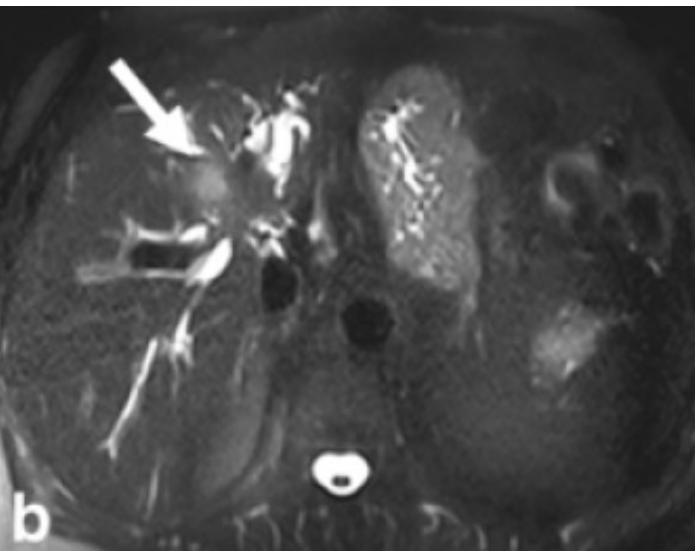
- Magnetic resonance cholangiopancreatography(MRCP)
  - Tumor
  - Level of biliary obstruction
  - Obstructed and isolated ducts
  - Presence of metastases
  - Lobar atrophy
- MR angiography
  - Assess involvement of hilar vascular structures

# IMAGING STUDIES

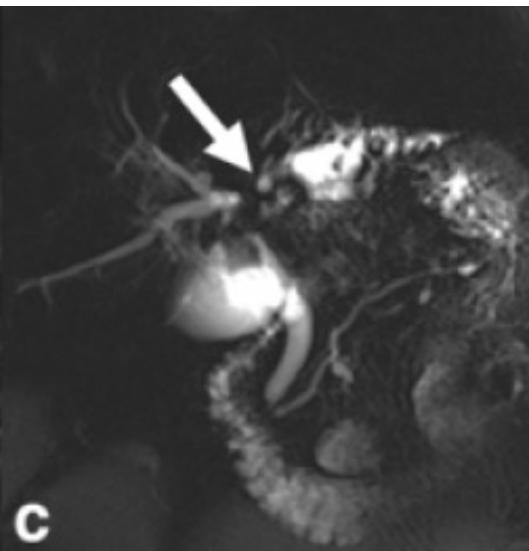
CT



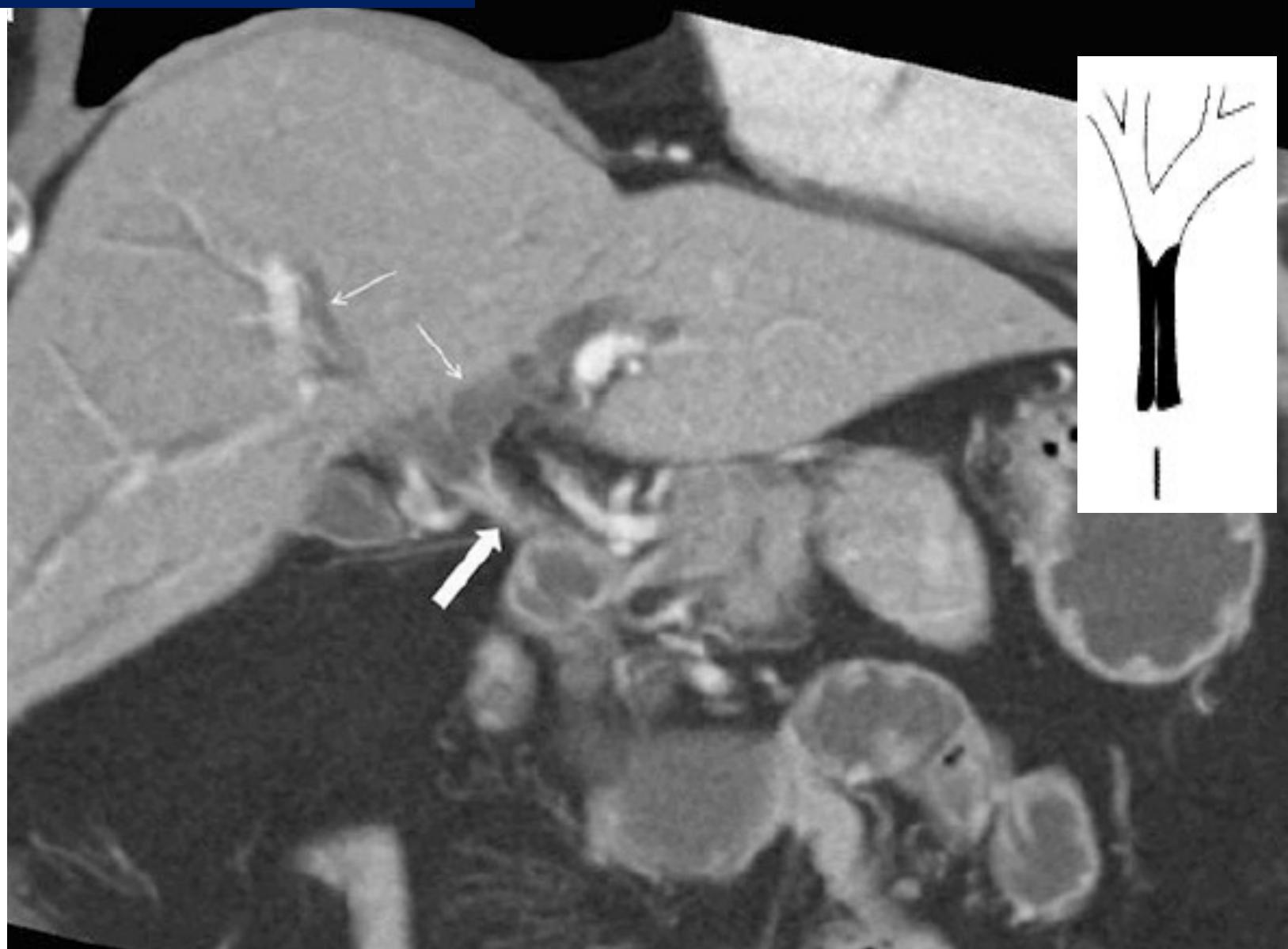
MRI

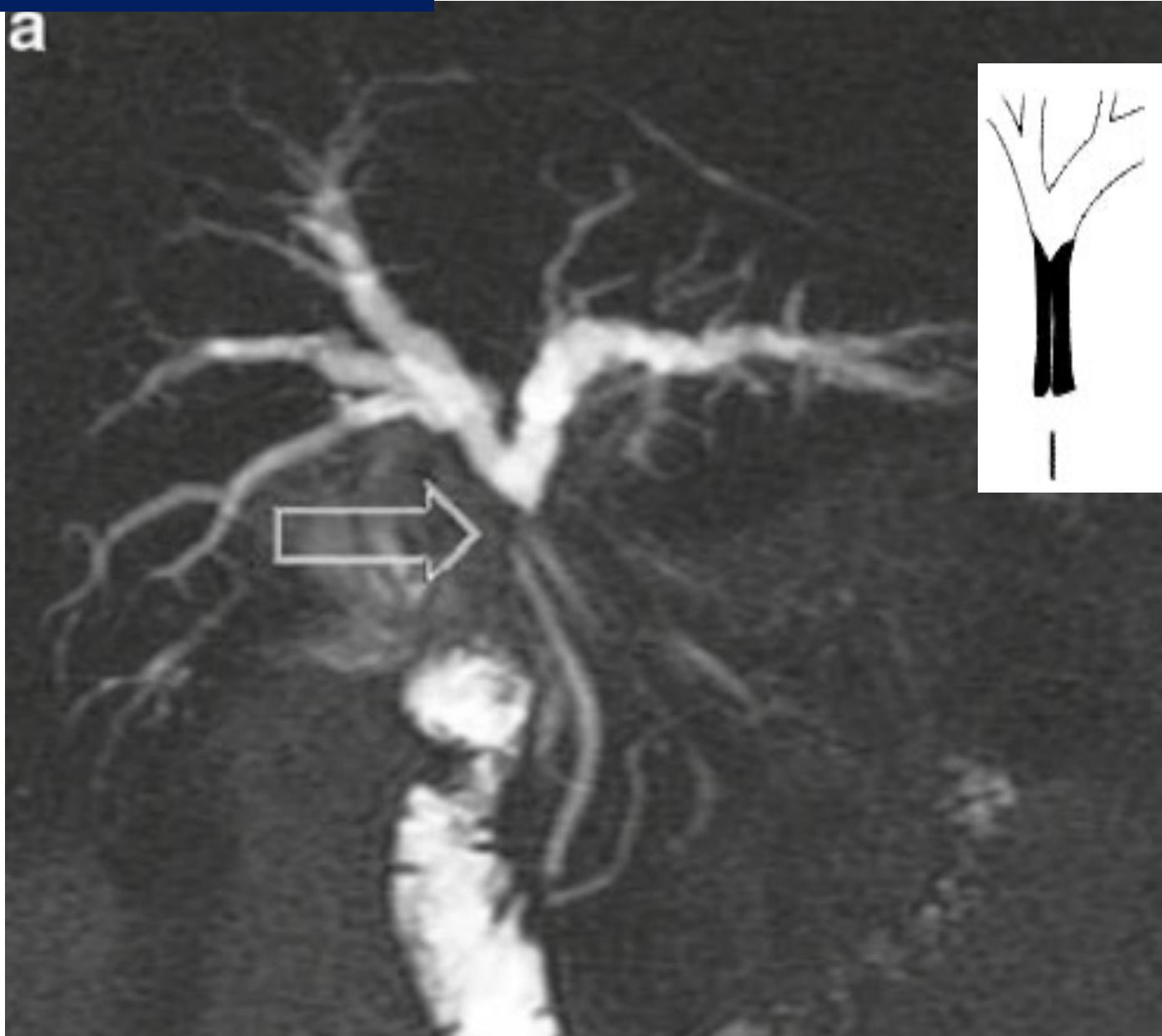


MRCP



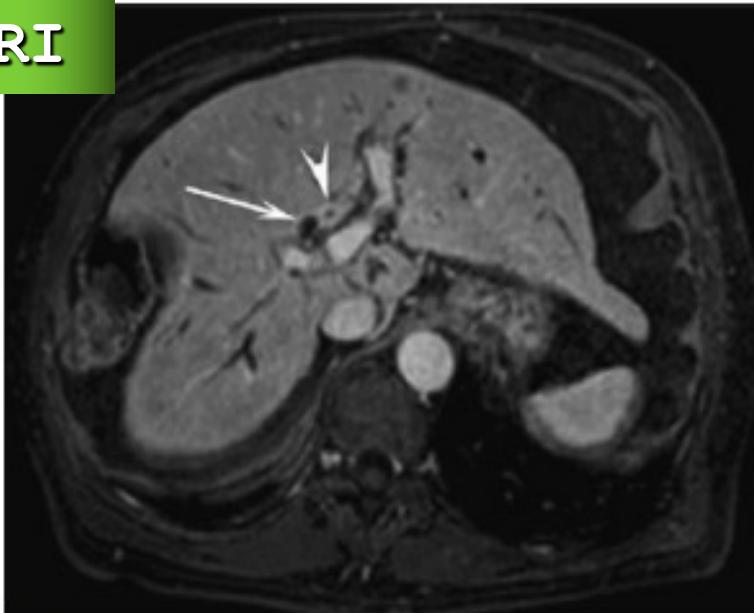
- Infiltrating pCCA of the left hepatic duct
- Dilation of the left hepatic ducts
- Extension to the confluence
- Mild dilatation of the right hepatic ducts



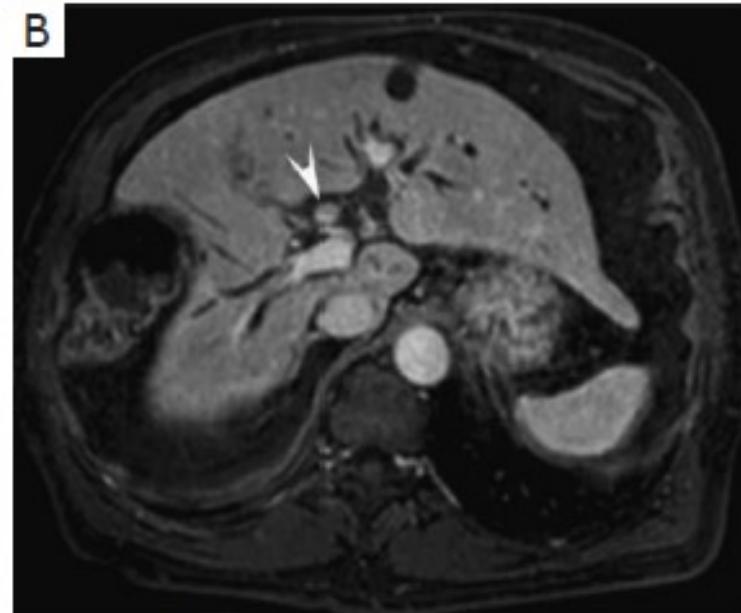




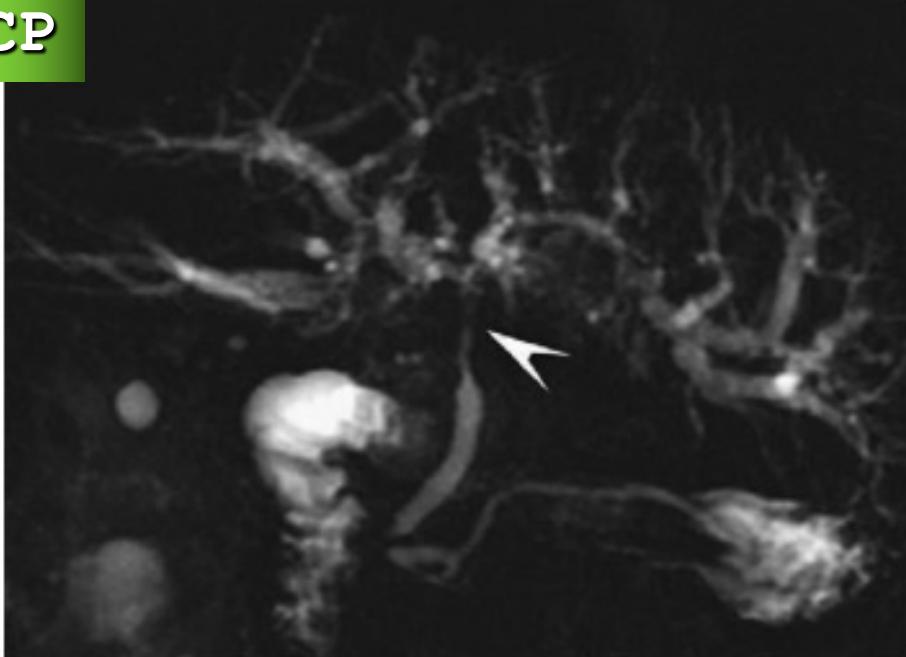
**MRI**



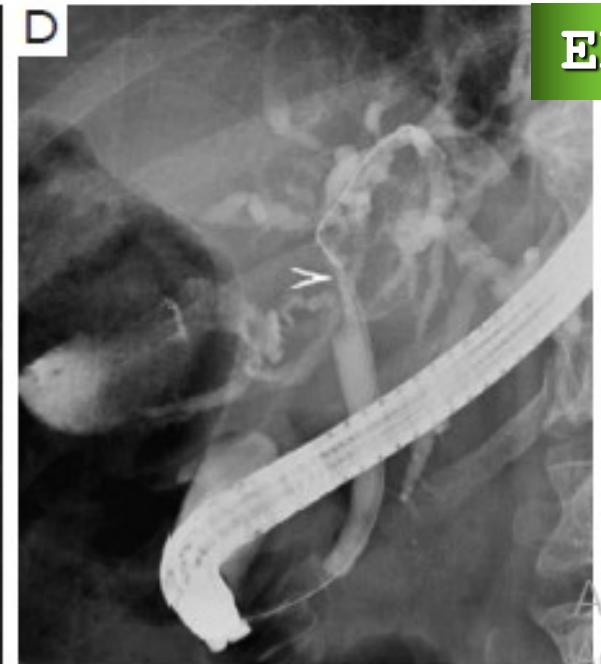
**B**



**MRCP**



**D**

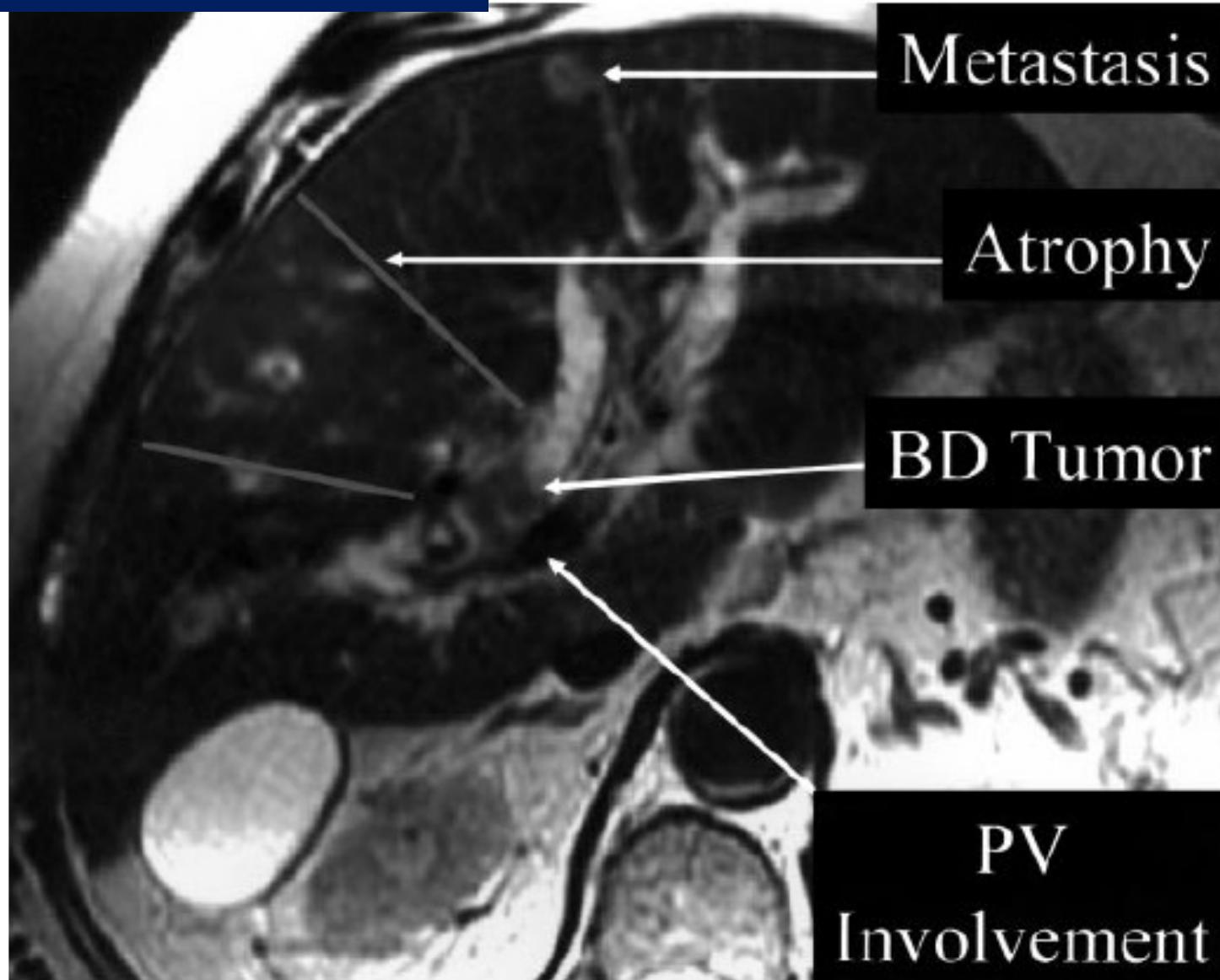


**ERCP**

# IMAGING STUDIES

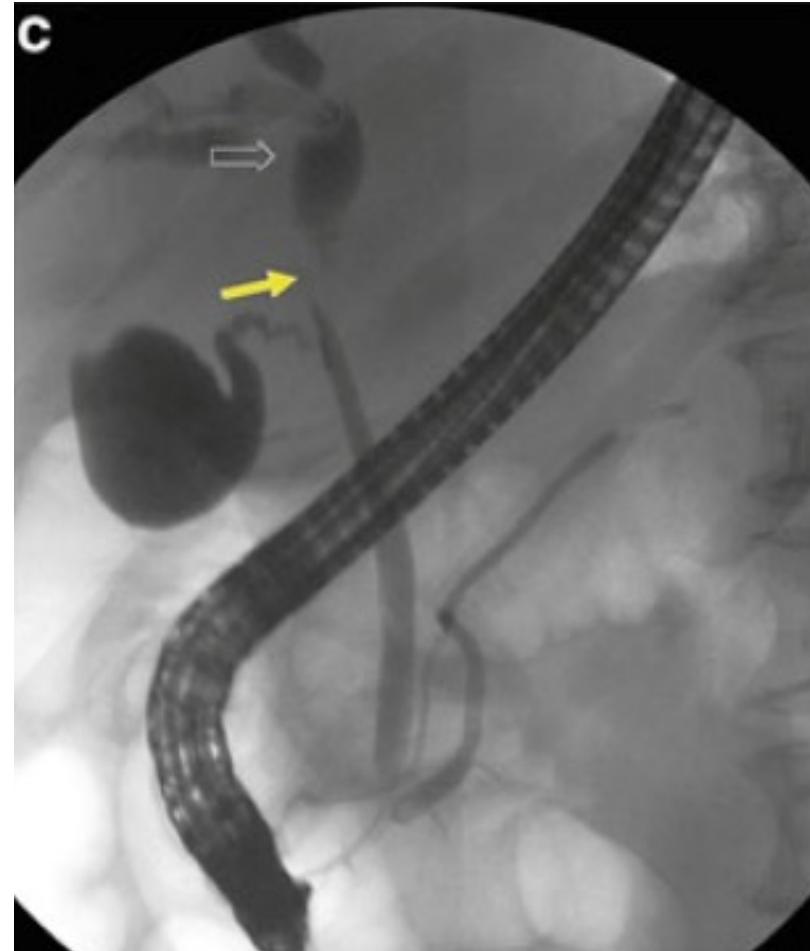
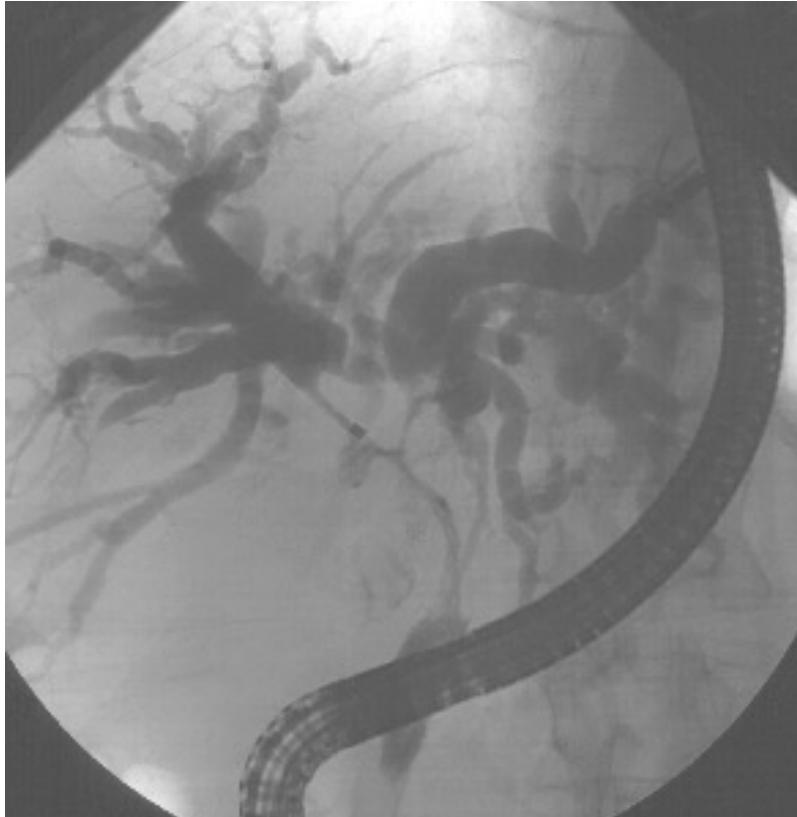
□ MRI and MRCP



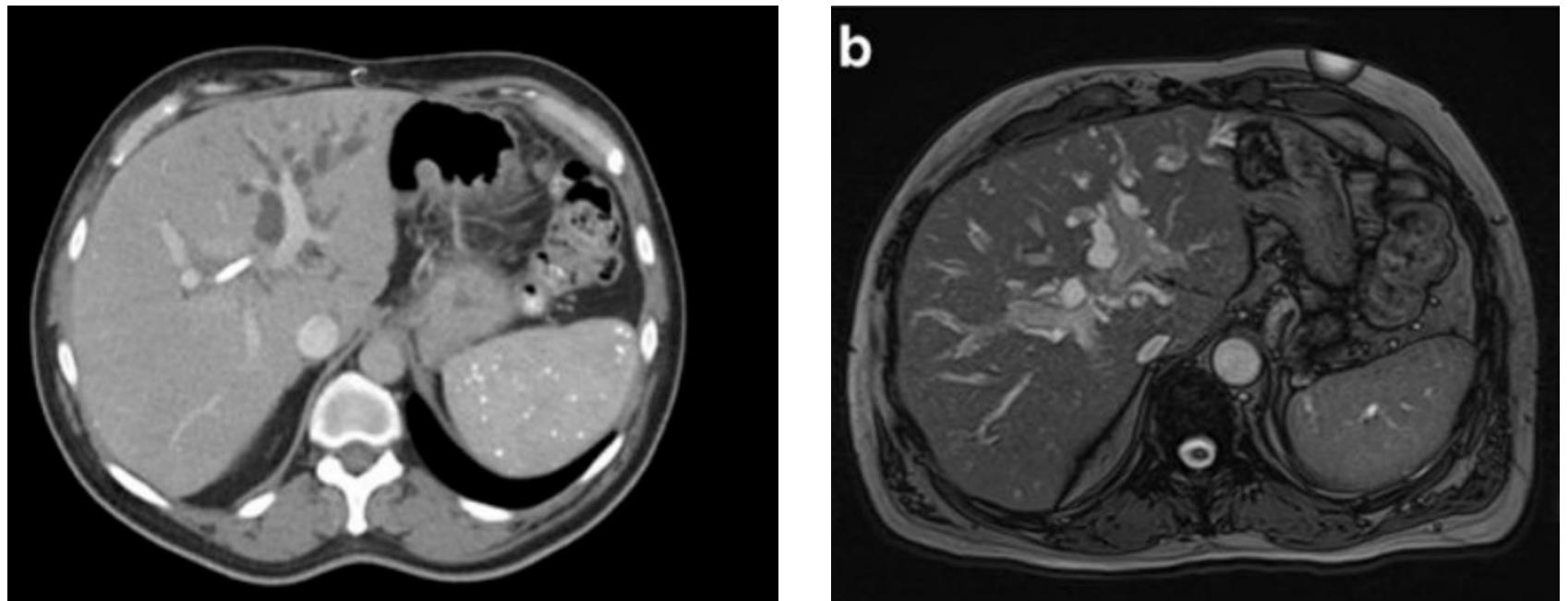


# IMAGING STUDIES

□ ERCP







**Fig. 1. Abdominal CT scan (a) and MRI (b) demonstrating left biliary tree dilatation in a 63-year-old male with hilar cholangiocarcinoma**

Im: 7  
QAx 529.7  
181 bpm  
trig 30%

F 54Y 1077674  
DOB: 12 Dec 1961  
09 Jun 2016  
09:02:46  
Mag = 1.4

ET:13

R  
I

L  
R

FRFSE-3L/90  
TR:7500  
TE:85.6/EF  
EC:1/1 31.2kHz

Body Flex(M)/FL:05C  
FOV:40x30  
10.0thk/1.0sp  
22/04:38  
320X192/3.00 NEX  
5 VB/ED/RTr/BC

P 174

W = 431 L = 285  
v>



# UNRESECTABILITY

## Patient factors

- Medically unfit or otherwise unable to tolerate a major operation
- Hepatic cirrhosis

# UNRESECTABILITY

## Local tumor-related factors

- Tumor extension to secondary biliary radicles bilaterally
- Encasement or occlusion of the main portal vein proximal to its bifurcation
- Atrophy of one hepatic lobe with contralateral portal vein branch encasement or occlusion
- Atrophy of one hepatic lobe with contralateral tumor extension to secondary biliary radicles
- Unilateral tumor extension to secondary biliary radicles with contralateral portal vein branch encasement or occlusion

# UNRESECTABILITY

## Metastatic disease

- Histologically proven metastases to lymph nodes beyond the hepatoduodenal ligament\*
- Lung, liver, or peritoneal metastases

\* Peripancreatic, peridiudodenal, celiac, superior mesenteric or posterior pancreaticoduodenal lymph nodes are considered not amenable to a potentially curative resection. Cystic duct, pericholedochal, hilar or portal lymph nodes do not constitute unresectability.

# JAUNDICE



## PRE-OPERATIVE BILIARY DRAINAGE

- Biliary sepsis (Cholangitis)
- Severe/Long-lasting jaundice
- Patients undergoing preoperative anti-neoplastic therapy
- Patients with hyperbilirubinaemia-induced malnutrition
- Hepatic insufficiency
- Renal insufficiency
- Patients undergoing PVE
- Delayed schedule of surgery

Not to do:

- No duct dilatation in the future liver remnant

## Potential benefit

### Improve hepatic functional reserve

Regeneration of liver remnant

Postoperative liver failure

### Improve non-hepatic functions

Cell-mediated immunity

Nutrition and coagulation parameters

Renal function

### Apply for other purposes

Cholangiography

Endoscopy (PTCS,POCS)

Tissue biopsy

Bile sampling

## Drawbacks

### ❑ Its own complications

Failure

Pancreatitis

Vascular injury

Catheter obstruction/dislodgement

### ❑ Bile contamination

Cholangitis of the drained lobe

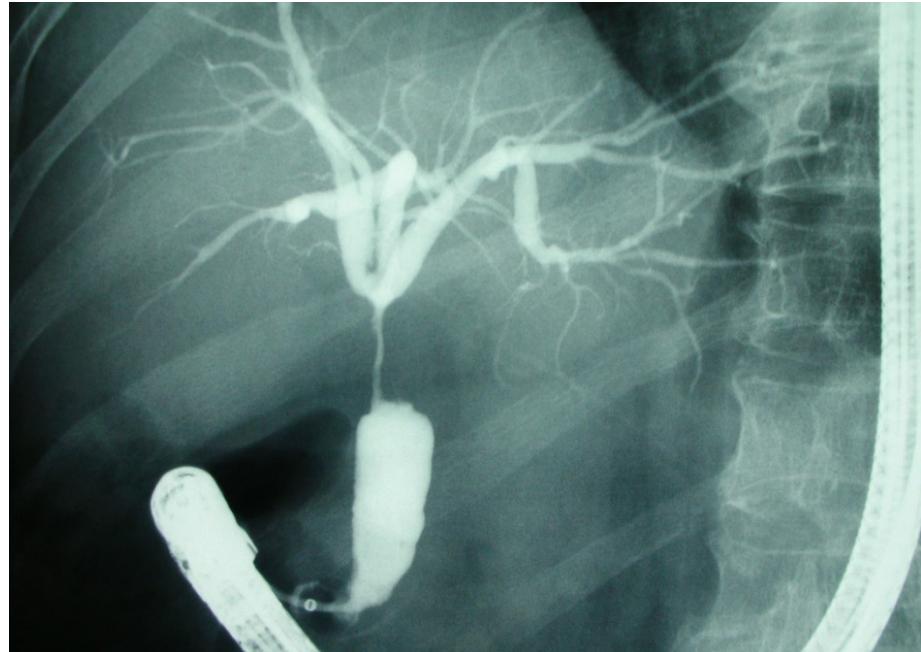
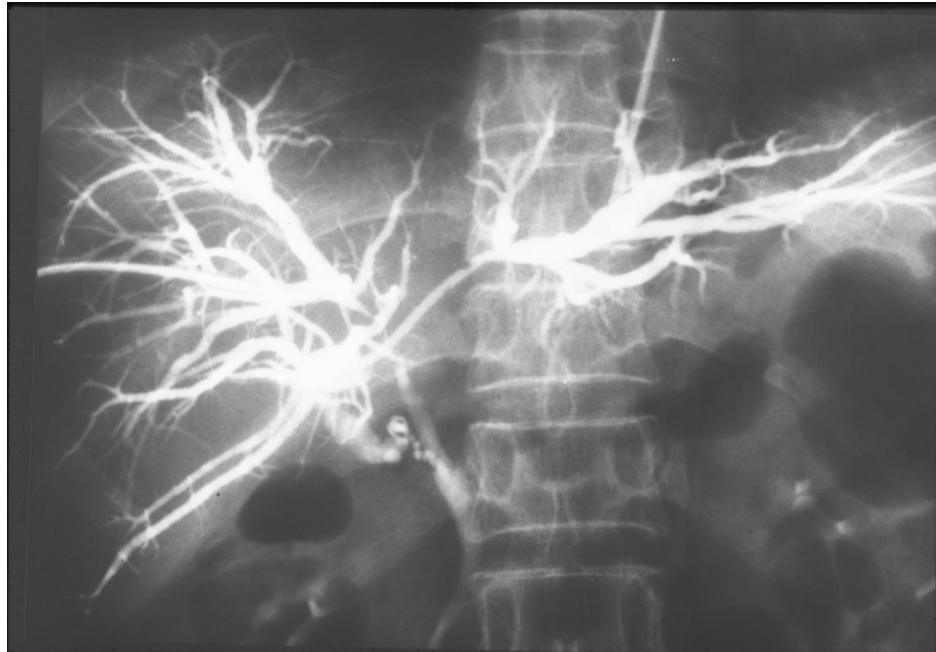
Cholangitis of the undrained lobe

### ❑ Postoperative complications

Surgical site infection

Organ/space infection

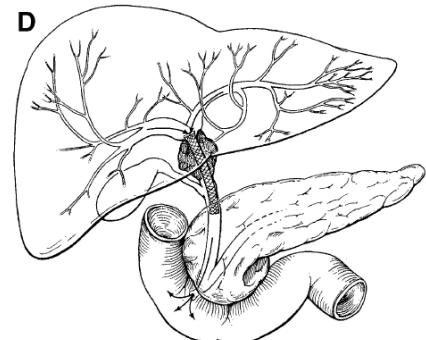
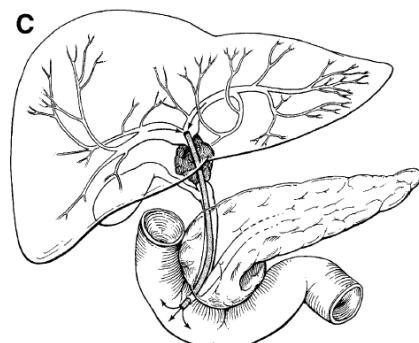
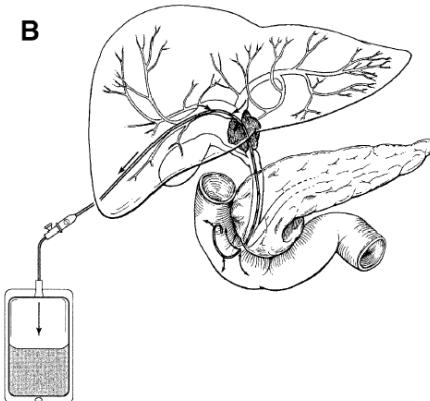
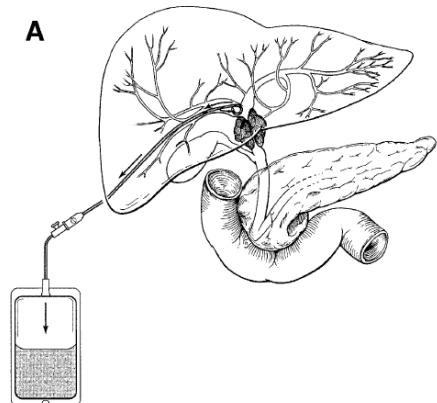
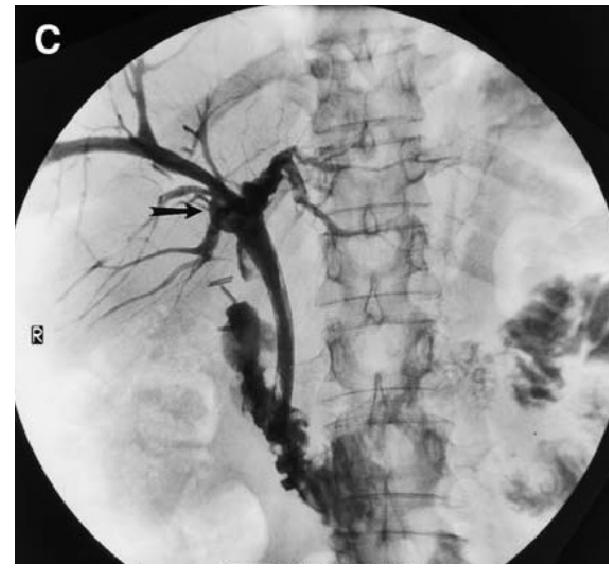
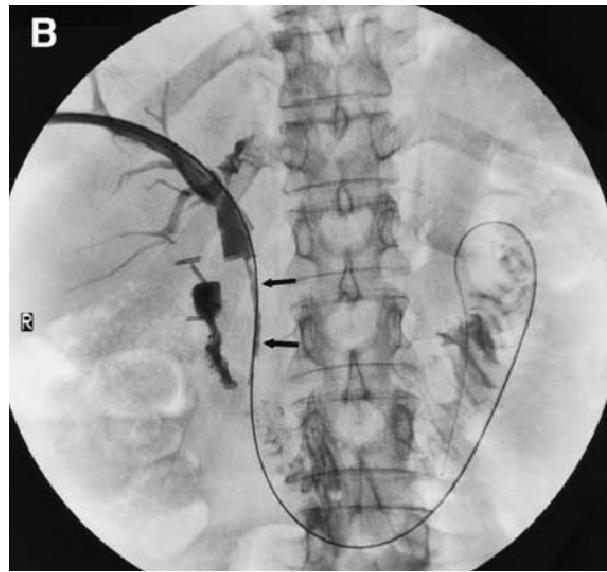
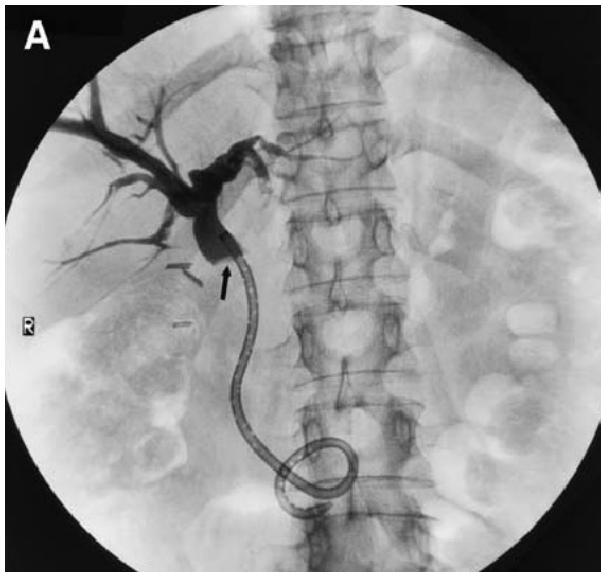
# PERCUTANEOUS OR ENDOSCOPIC?



REVIEW ARTICLE

**Percutaneous vs. endoscopic pre-operative biliary drainage in hilar cholangiocarcinoma – a systematic review and meta-analysis**

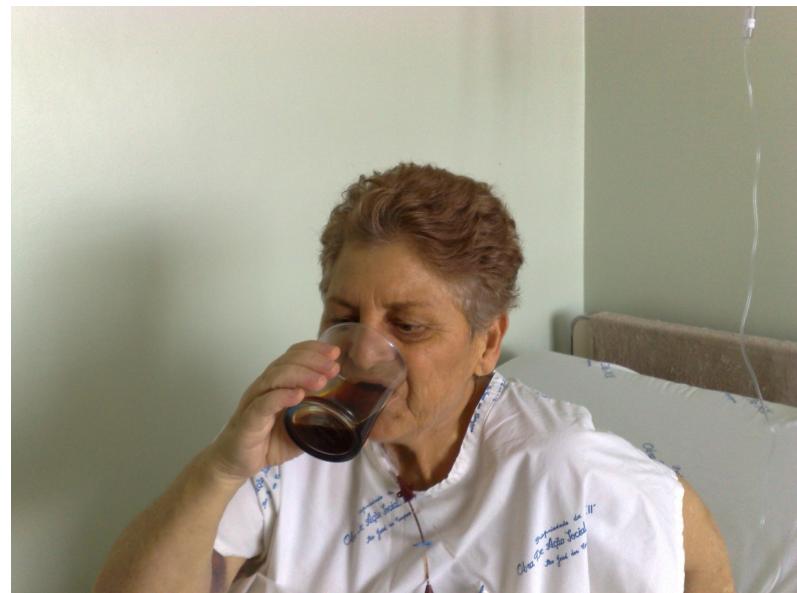
# Percutaneous biliary drainage



# PERCUTANEOUS BILIARY DRAINAGE



# PERCUTANEOUS BILIARY DRAINAGE



Courtesy: Dr. Eduardo Fernandes (RJ)

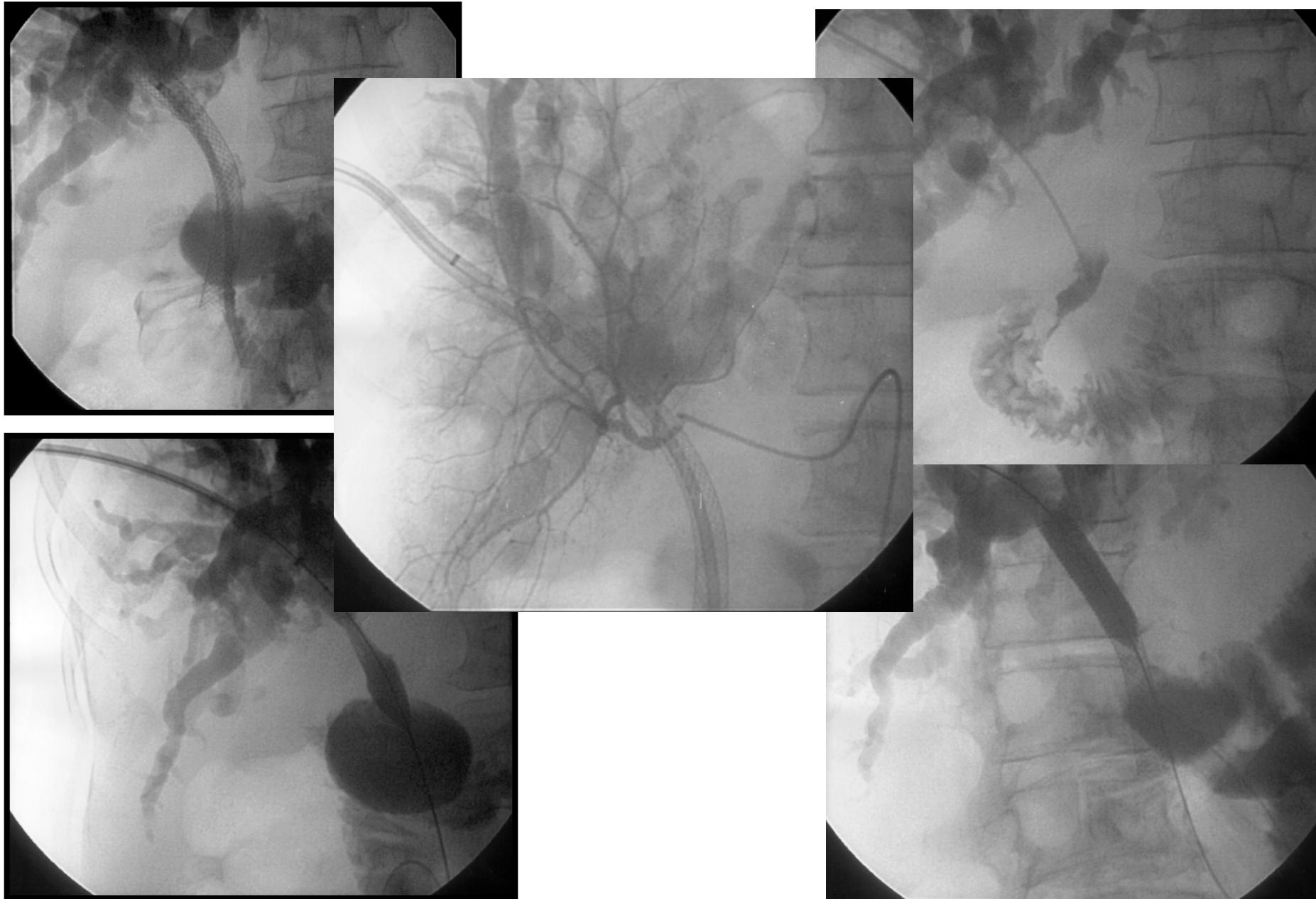
# Evolution of Surgical Treatment for Perihilar Cholangiocarcinoma

*A Single-Center 34-Year Review of 574 Consecutive Resections*

Masato Nagino, MD, PhD,\* Tomoki Ebata, MD, PhD,\* Yukihiro Yokoyama, MD, PhD,\* Tsuyoshi Igami, MD, PhD,\* Gen Sugawara, MD, PhD,\* Yu Takahashi, MD, PhD,\* and Yuji Nimura, MD, PhD†

## PRE-OPERATIVE BILIARY DRAINAGE

- Before 2005 - PTBD
  - Possibility of seeding metastasis
- After 2005 - ENBD
  - PTBD when endoscopic drainage is not feasible

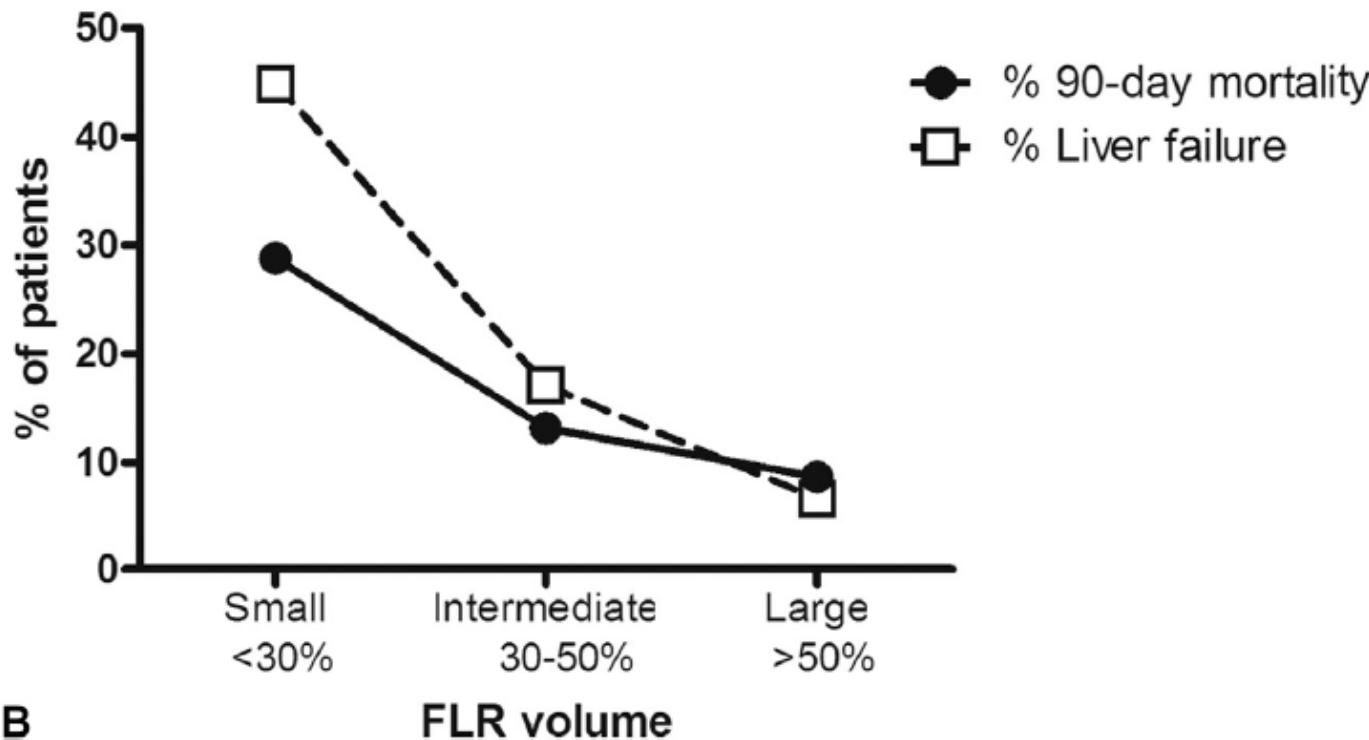


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# Postoperative Mortality after Liver Resection for Perihilar Cholangiocarcinoma: Development of a Risk Score and Importance of Biliary Drainage of the Future Liver Remnant



Jimme K Wiggers, MD, PhD, Bas Groot Koerkamp, MD, PhD, Kasia P Cieslak, MD, Alexandre Doussot, MD, David van Klaveren, PhD, Peter J Allen, MD, FACS, Marc G Besselink, MD, PhD, Olivier R Busch, MD, PhD, Michael I D'Angelica, MD, FACS, Ronald P DeMatteo, MD, FACS, Dirk J Gouma, MD, PhD, T Peter Kingham, MD, FACS, Thomas M van Gulik, MD, PhD, William R Jarnagin, MD, FACS



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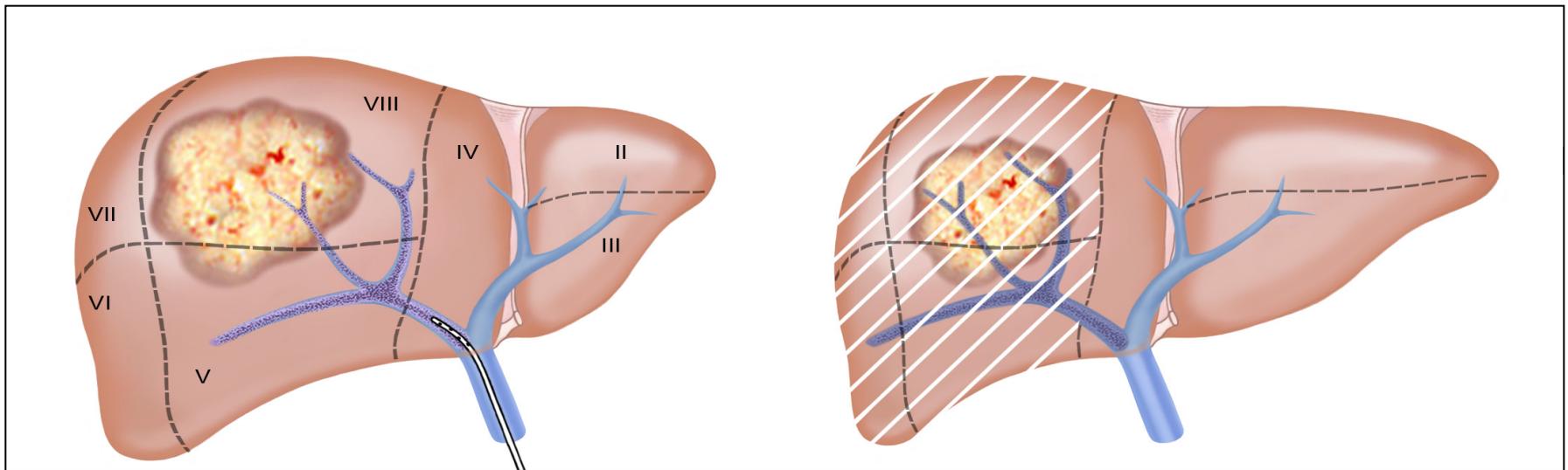
**Table 3.** Developed Mortality Risk Score to Predict 90-Day Postoperative Mortality after Liver Resection for Perihilar Cholangiocarcinoma

Risk factor	Points
Age	
Younger than 50 y	0
50–59 y	1
60–69 y	2
70–79 y	3
80 y and older	4
Preoperative cholangitis	2
FLR <30%	1
Incomplete drainage + FLR <50%	1
Portal vein reconstruction	1

**Table 4.** Risks Predicted by the Mortality Risk Score

Group	Point total	n*	Predicted risk of postoperative mortality, %
Low-risk	0	4	1
	1	23	1
	2	45	3
Intermediate-risk	3	60	6
	4	55	14
High-risk	5	34	28
	6	16	47
	7	5	67
	8	1	82
	9	0	NA

# PORTAL VEIN EMBOLIZATION



Makuuchi M, et al. J Jpn Surg Assoc 1984;45:1558-64  
Makuuchi M, et al. Surgery 1990;107:521-7

# PORTAL VEIN EMBOLIZATION

J Hepatobiliary Pancreat Sci (2014) 21:542–549  
DOI: 10.1002/jhbp.77

TOPIC

## Indications for portal vein embolization in perihilar cholangiocarcinoma

Ryota Higuchi · Masakazu Yamamoto

FLR < 40%

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# Postoperative Liver Failure Risk Score: Identifying Patients with Resectable Perihilar Cholangiocarcinoma Who Can Benefit from Portal Vein Embolization



Pim B Olthof, MD, PhD, Jimme K Wiggers, MD, PhD, Bas Groot Koerkamp, MD, PhD, Robert J Coelen, MD, PhD, Peter J Allen, MD, FACS, Marc G Besselink, MD, PhD, Olivier R Busch, MD, PhD, Michael I D'Angelica, MD, FACS, Ronald P DeMatteo, MD, FACS, T Peter Kingham, MD, FACS, Krijn P van Lienden, MD, PhD, William R Jarnagin, MD, FACS, Thomas M van Gulik, MD, PhD

**Table 3.** Preoperative Risk Score for Post-Hepatectomy Liver Failure

Risk factor	Points	Prevalence post-hepatectomy liver failure, %
Jaundice at presentation	2	30
Preoperative cholangitis	2	43
Future liver remnant volume		
$\geq 45\%$	0	17
30% to 45%	1	23
$< 30\%$	2	44
Immediate preoperative bilirubin $> 50 \mu\text{mol/L}^*$	2	52

\* $> 2.9 \text{ mg/dL}$ .

FLRV, future liver remnant volume; PHLF, post-hepatectomy liver failure.

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# Postoperative Liver Failure Risk Score: Identifying Patients with Resectable Perihilar Cholangiocarcinoma Who Can Benefit from Portal Vein Embolization

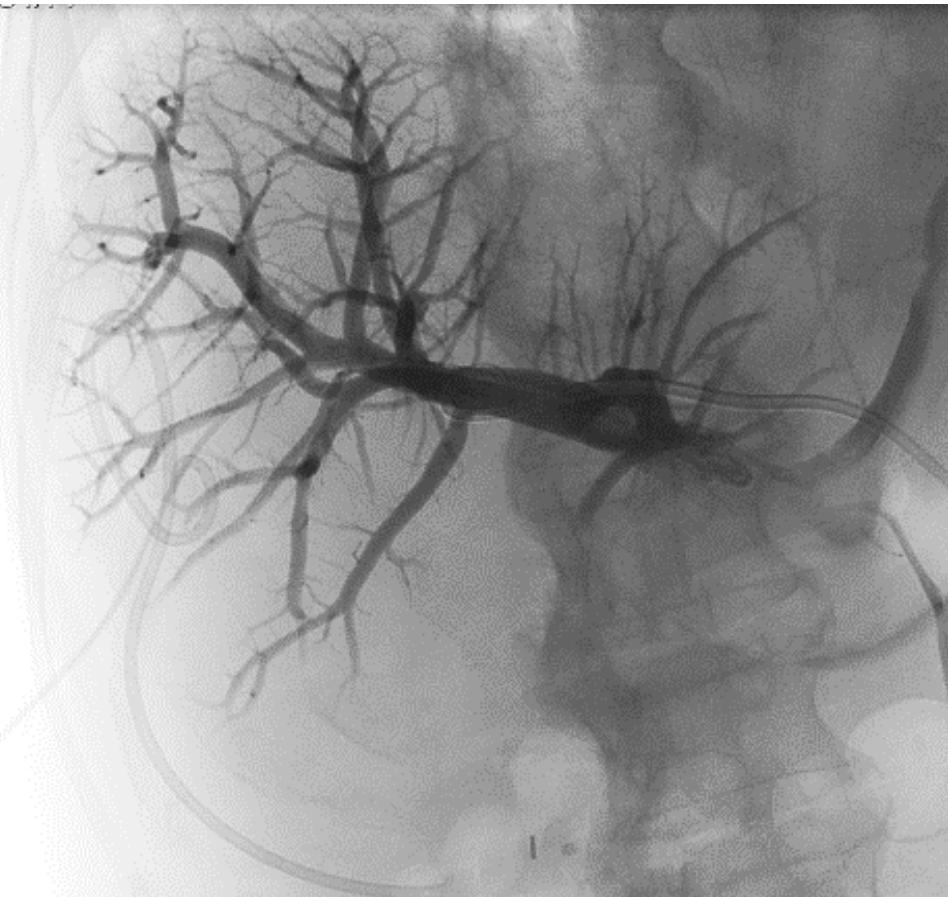


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**Table 4.** Calculated Risk of Post-Hepatectomy Liver Failure According to the Developed Risk Score

Total risk score	n	Predicted risk, %	Group	Predicted risk, %	Observed risk, %
0	34	4	Low risk	4	5
1	10	7	Low risk		
2	44	12	Moderate risk	14	14
3	20	20	Moderate risk		
4	53	33	High risk	44	44
5	18	48	High risk		
6	11	64	High risk		
7	1	77	High risk		
8	7	87	High risk		

# PORTAL VEIN EMBOLIZATION

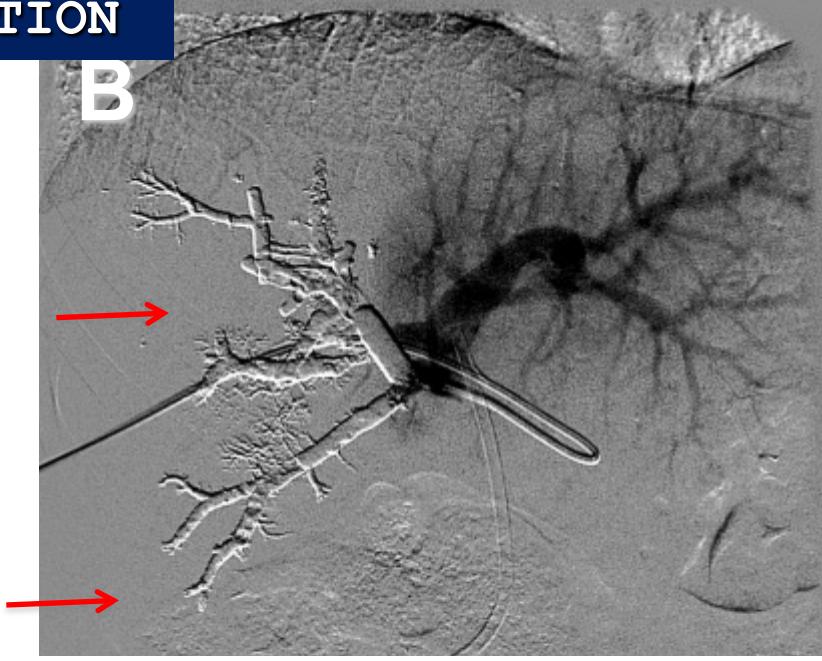


## PORTAL VEIN EMBOLIZATION

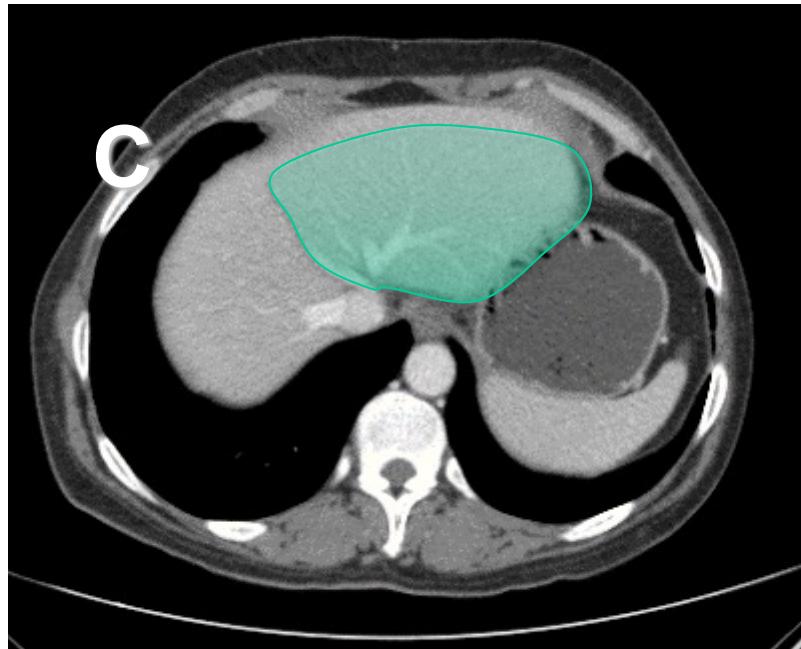
A



B



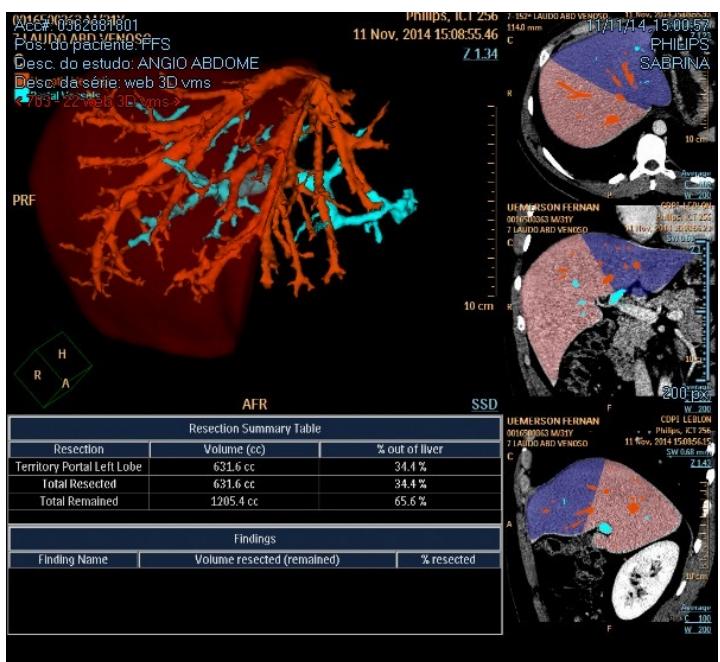
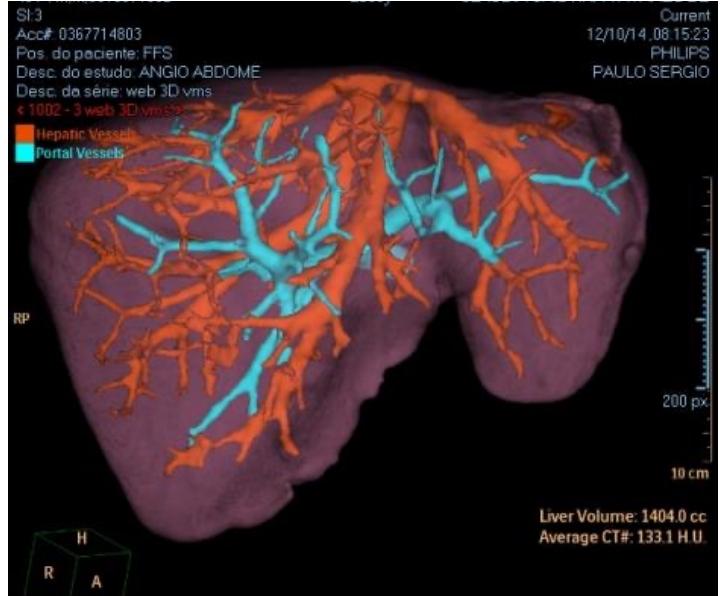
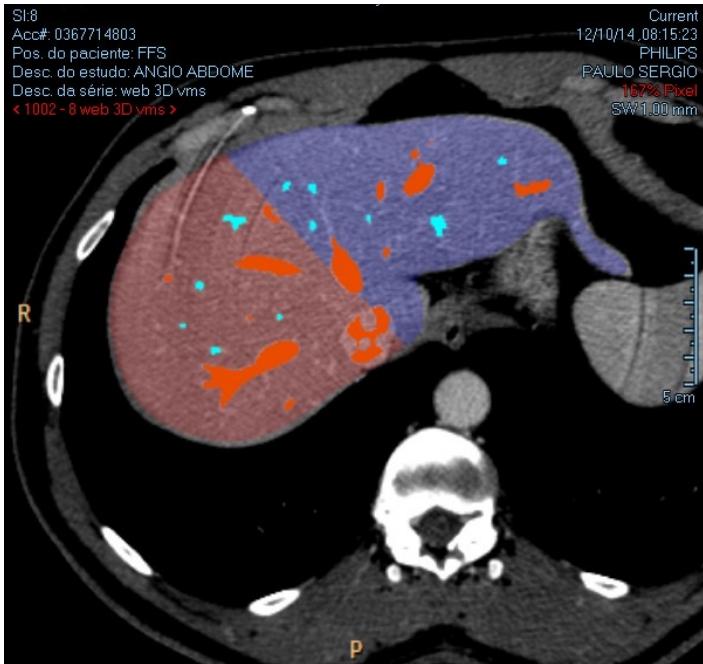
C



D



# VOLUMETRY

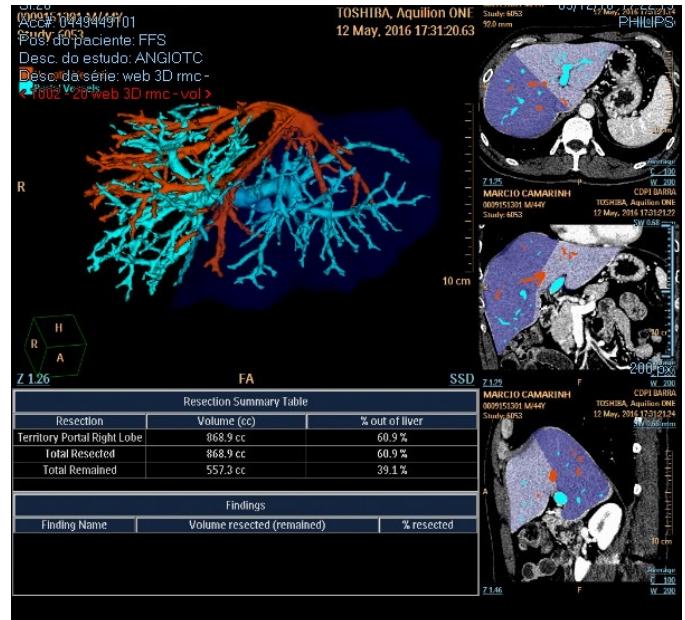
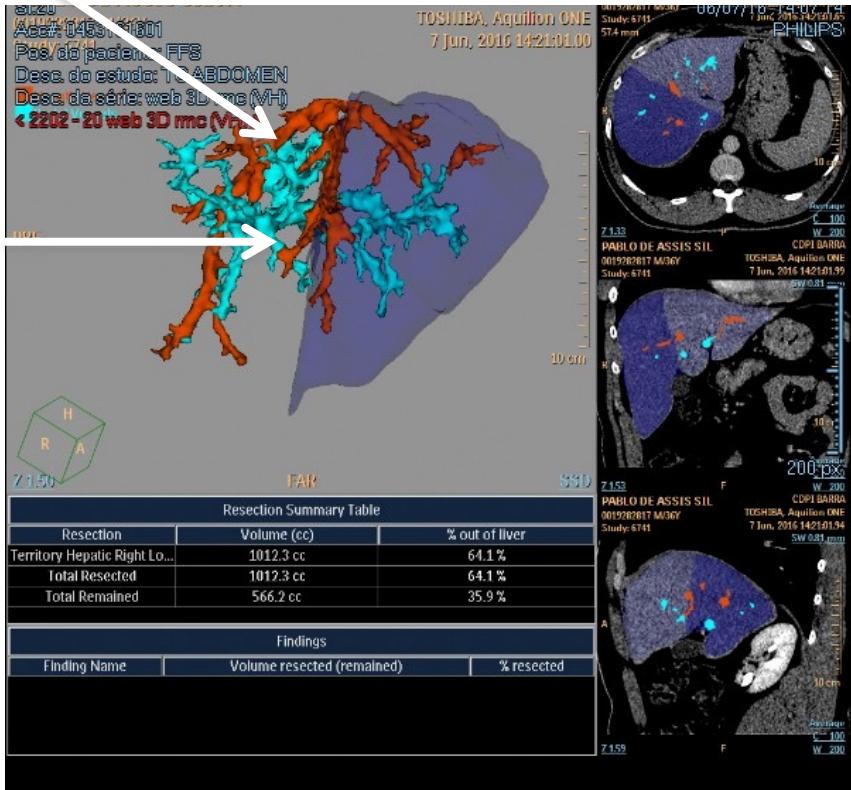


**Left hepatectomy + caudate**

**VIRTUAL HEPATECTOMY**

**V8**

# VOLUME

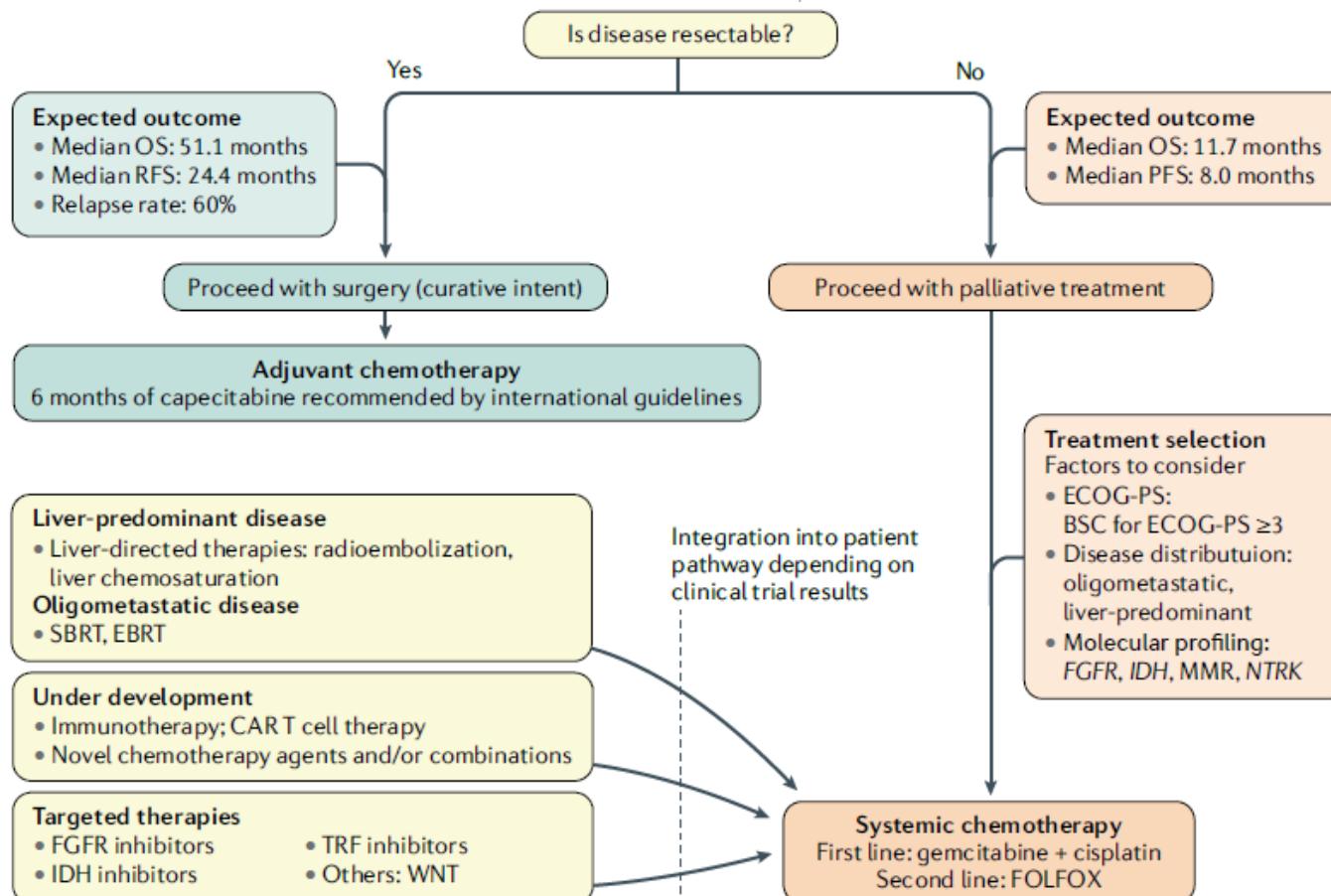
**V5**

**Right hepatectomy + caudate**

**VIRTUAL HEPATECTOMY**

OPEN

## Cholangiocarcinoma 2020: the next horizon in mechanisms and management



# SURGICAL MANAGEMENT

- Local excision
- Liver resection
- Liver transplantation

## STANDARD THERAPY

- Major hepatectomy
- Extrahepatic biliary tree resection
- Lymphadenectomy
- Caudate resection
- Biliary reconstruction
- Portal vein resection (?)
- R0 resection

## Comparison study for surgical outcomes of right versus left side hemihepatectomy to treat hilar cholangiocellular carcinoma

»<sup>1,2</sup>

<https://doi.org/10.1016/j.hpb.2019.07.003>

HPB

ORIGINAL ARTICLE

## Left- versus right-sided hepatectomy with hilar en-bloc resection in perihilar cholangiocarcinoma

Ann Hepatobiliary Pancreat Surg 2018;22:350-358  
<https://doi.org/10.14701/ahbps.2018.22.4.350>

Original Article

## Comparison analysis of left-side versus right-side resection in bismuth type III hilar cholangiocarcinoma

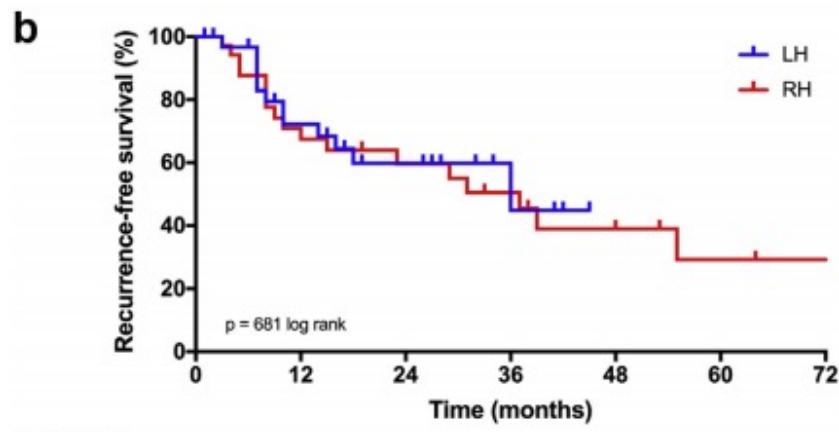
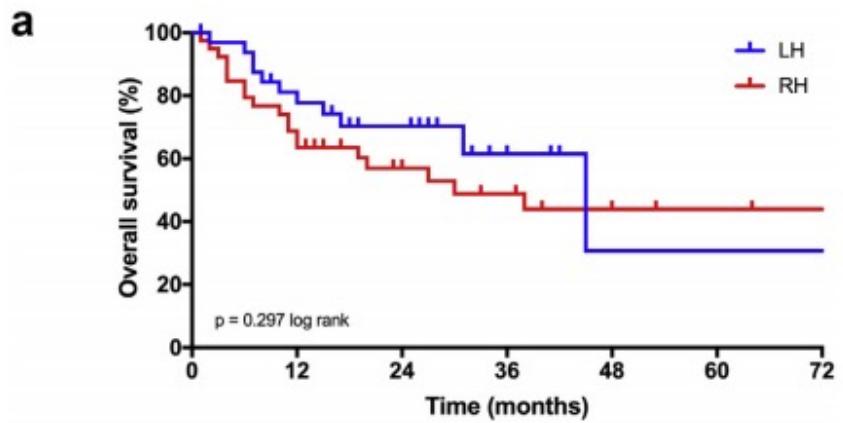
Hong SS, et al. Ann Surg Treat Res 2020

Bednarsch J, et al. HPB 2019

Li Y, et al. Ann Hepatobiliary Pancreat Surg 2018

Right or Left?

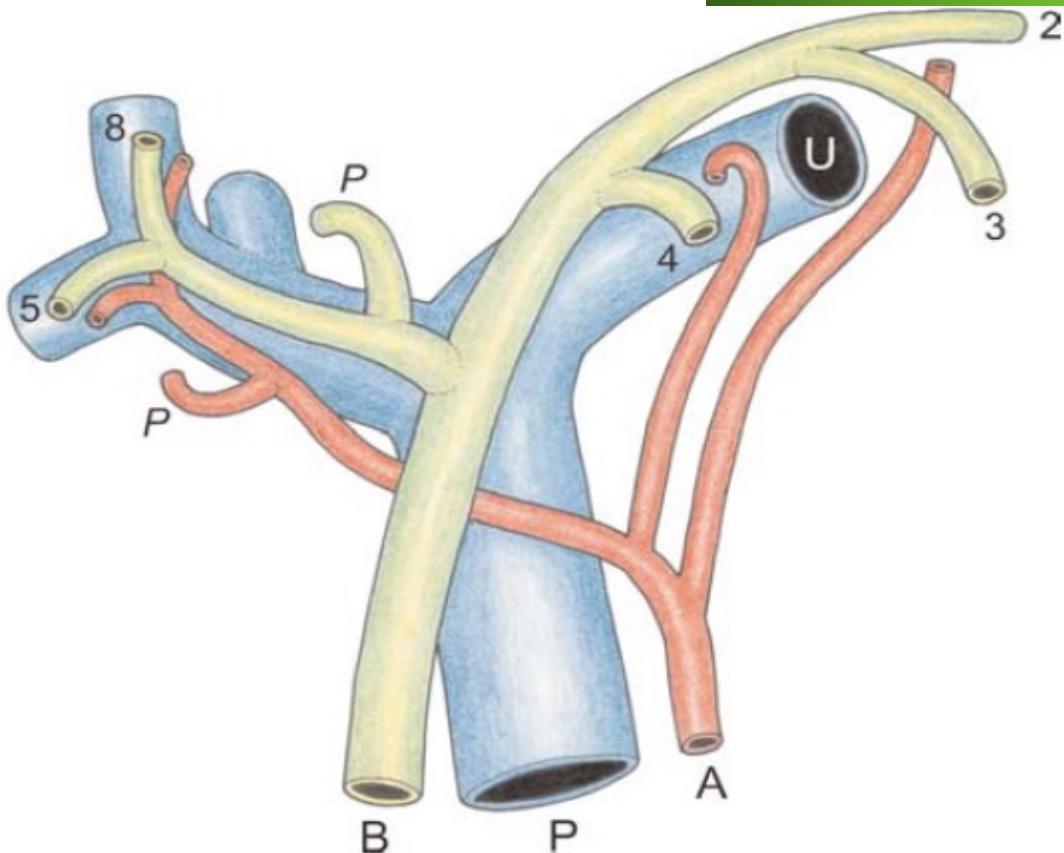
# RIGHT OR LEFT?





# ANATOMIC CONSIDERATIONS

- Right hemihepatectomy
- Right hepatic trisectionectomy

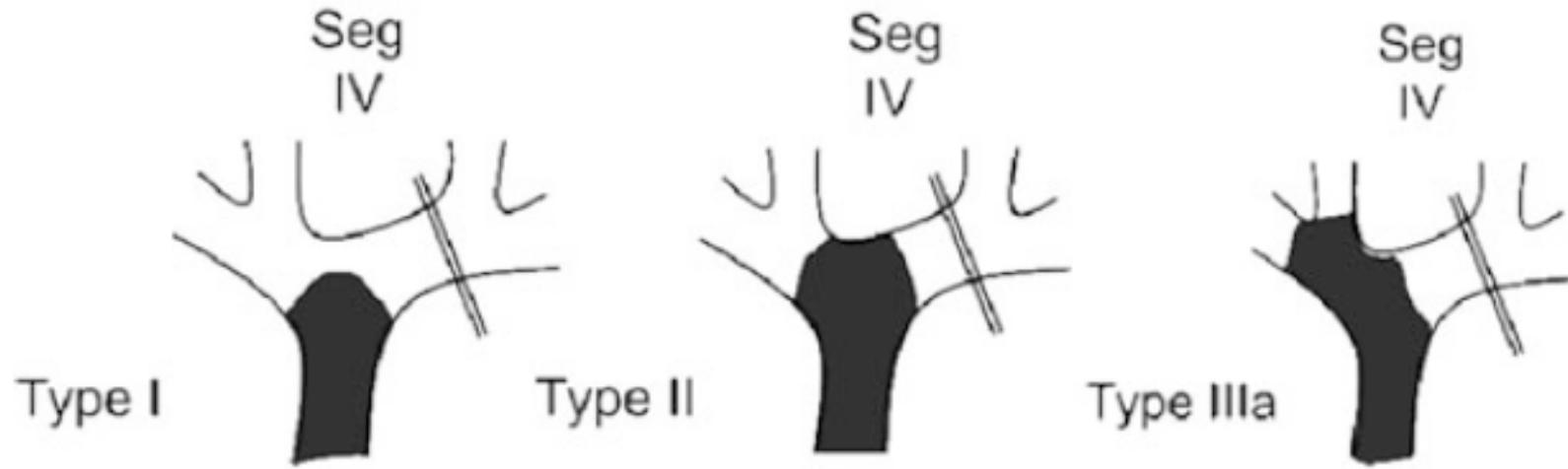


U – umbilical portion  
P – posterior branch

- The extrahepatic portion of the left hepatic duct is longer than that of the right hepatic duct.
- The right hepatic artery passes behind the common hepatic duct (often involved).
- Systematic caudate lobectomy can be performed more securely and easily.

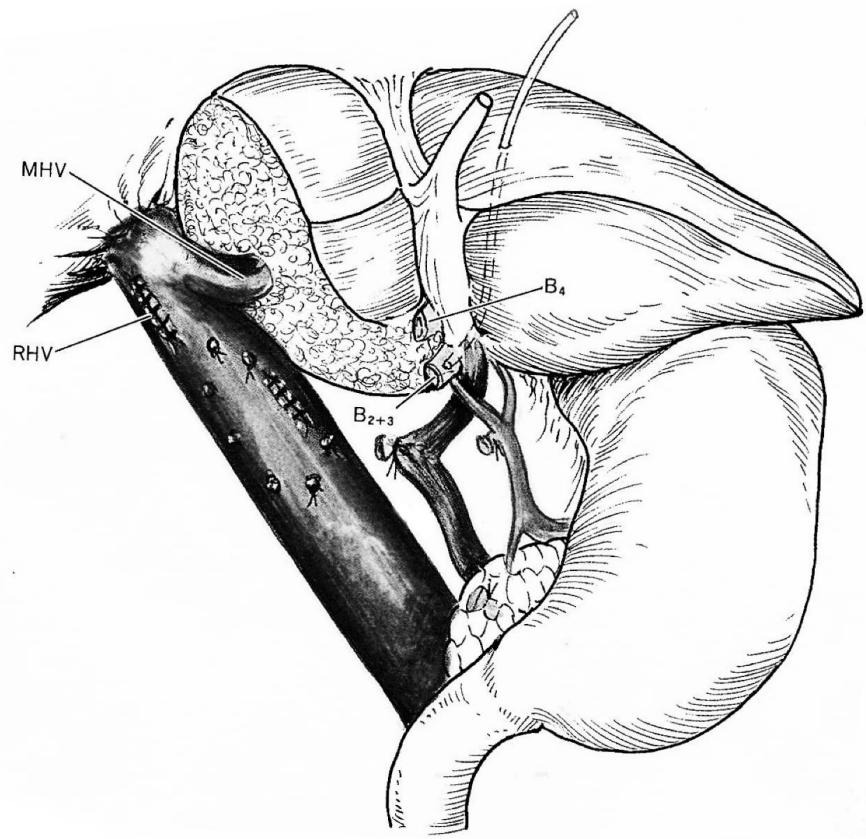
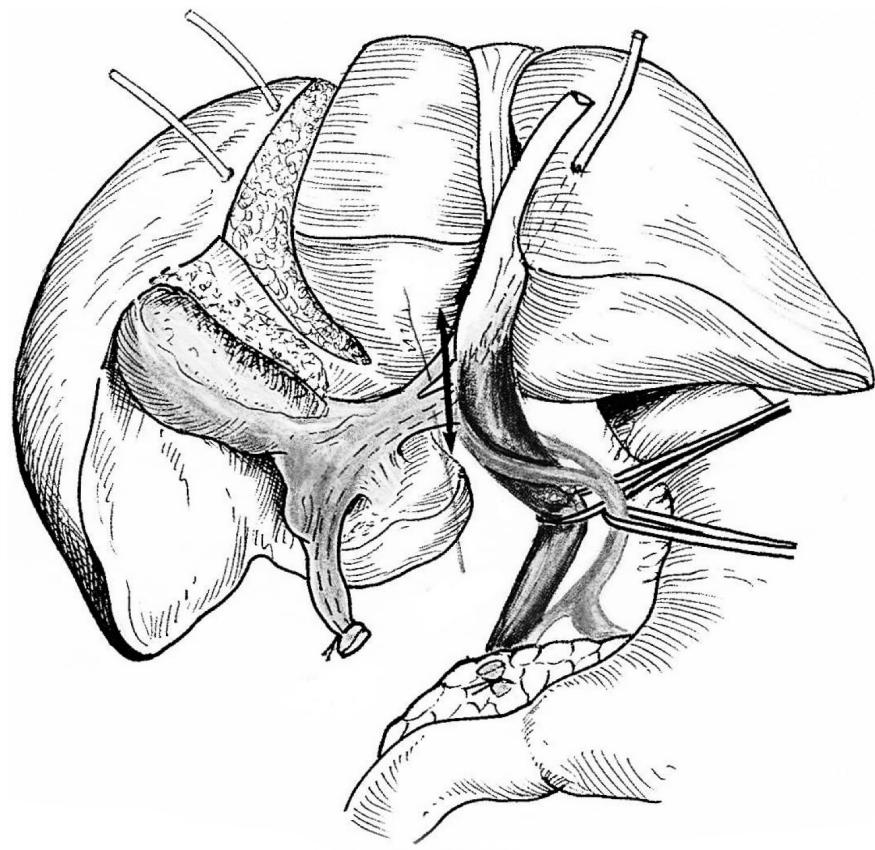
# BISMUTH-CORLETTTE I, II, and IIIa

- Right hepatectomy
- Extended right hepatectomy

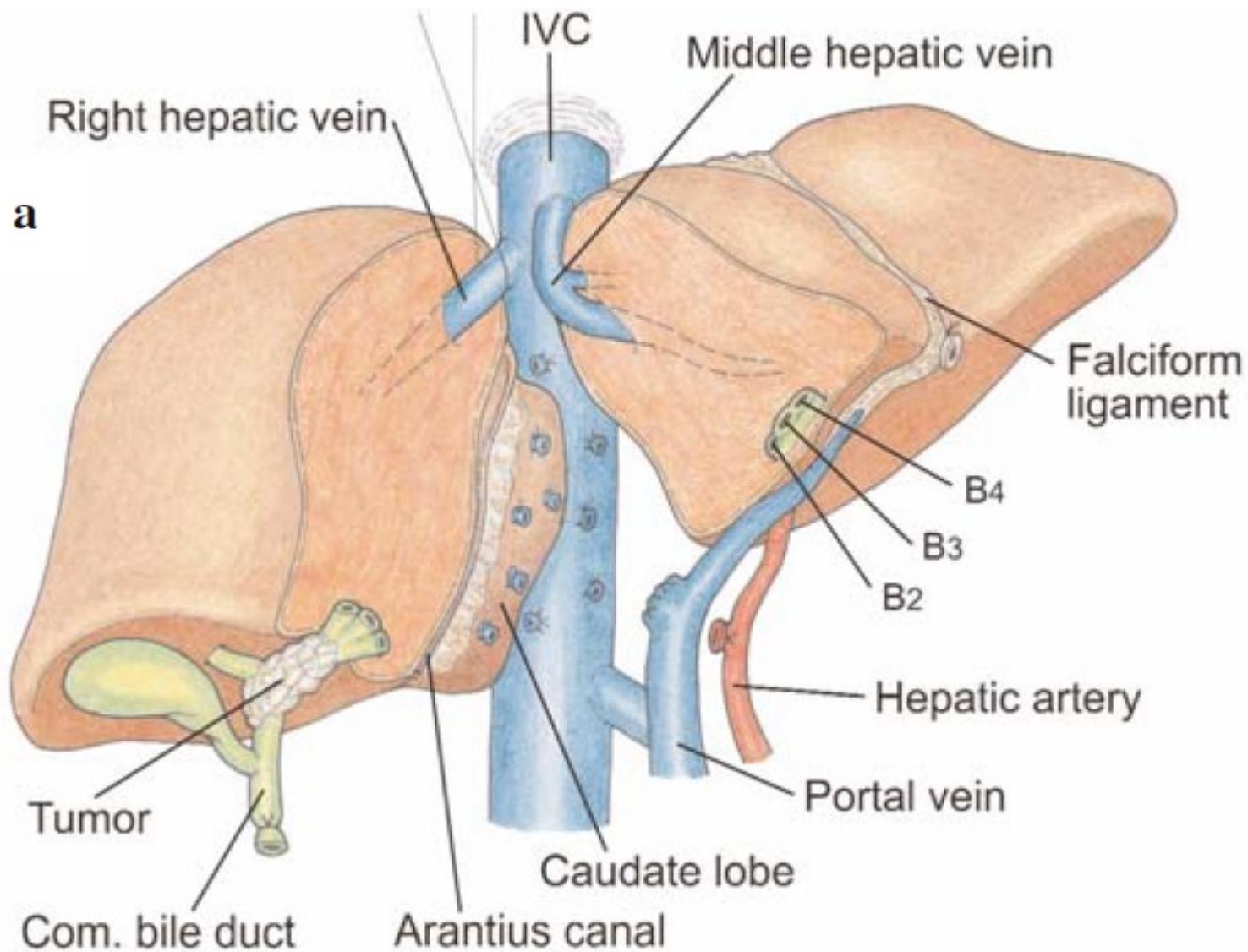


Extended right hepatectomy

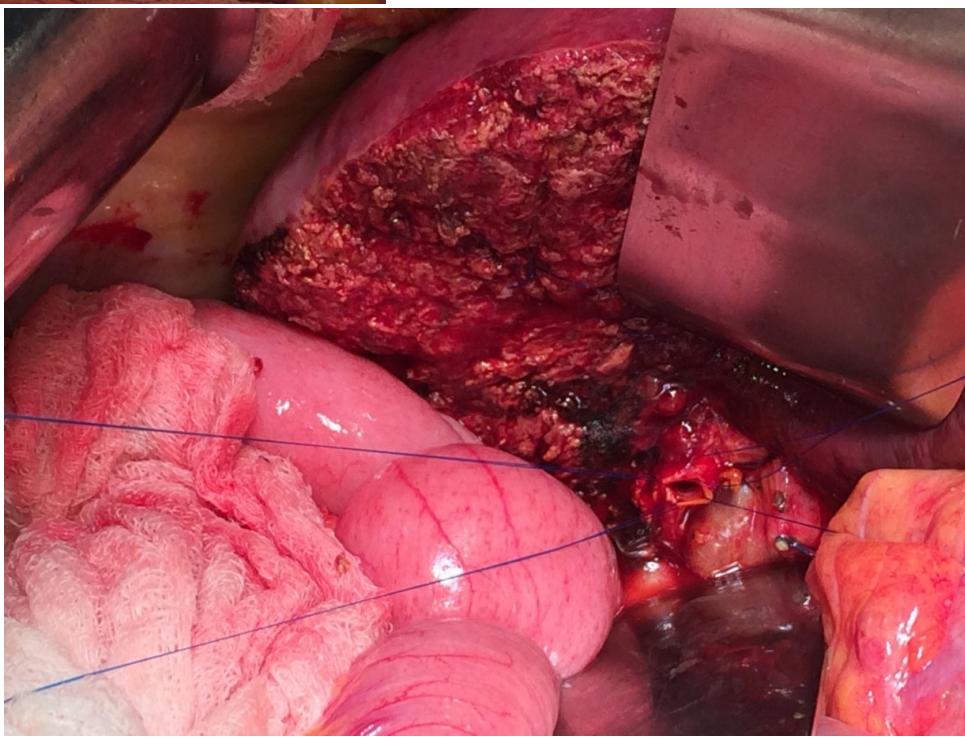
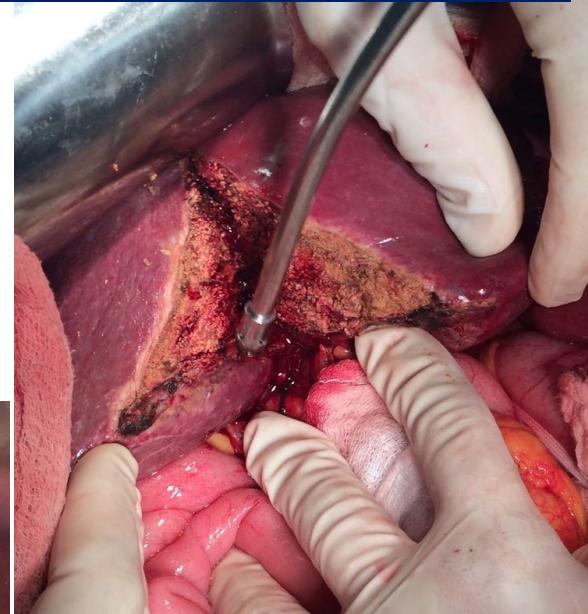
RIGHT HEPATECTOMY + CAUDATE



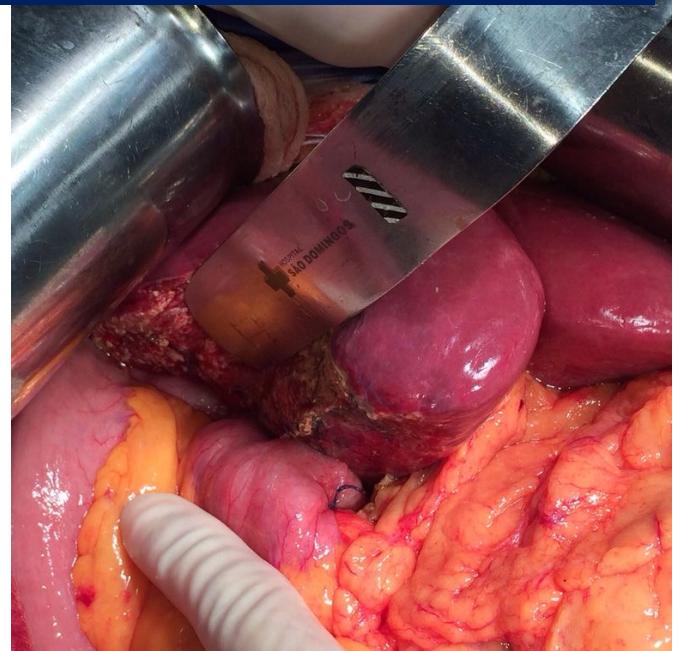
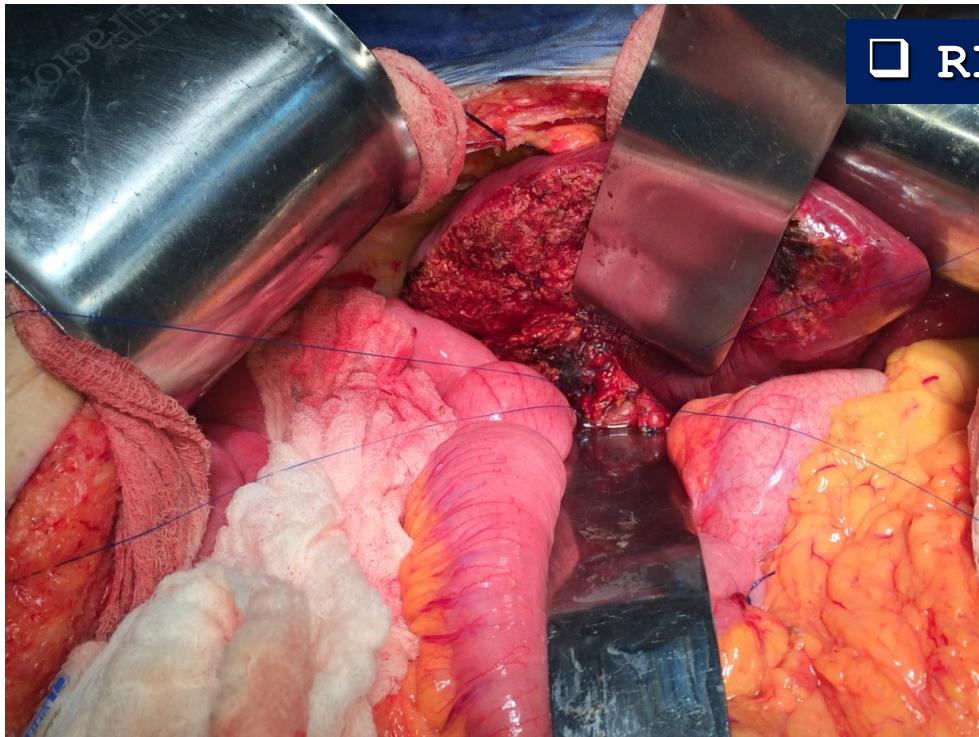
## RIGHT HEPATECTOMY + CAUDATE



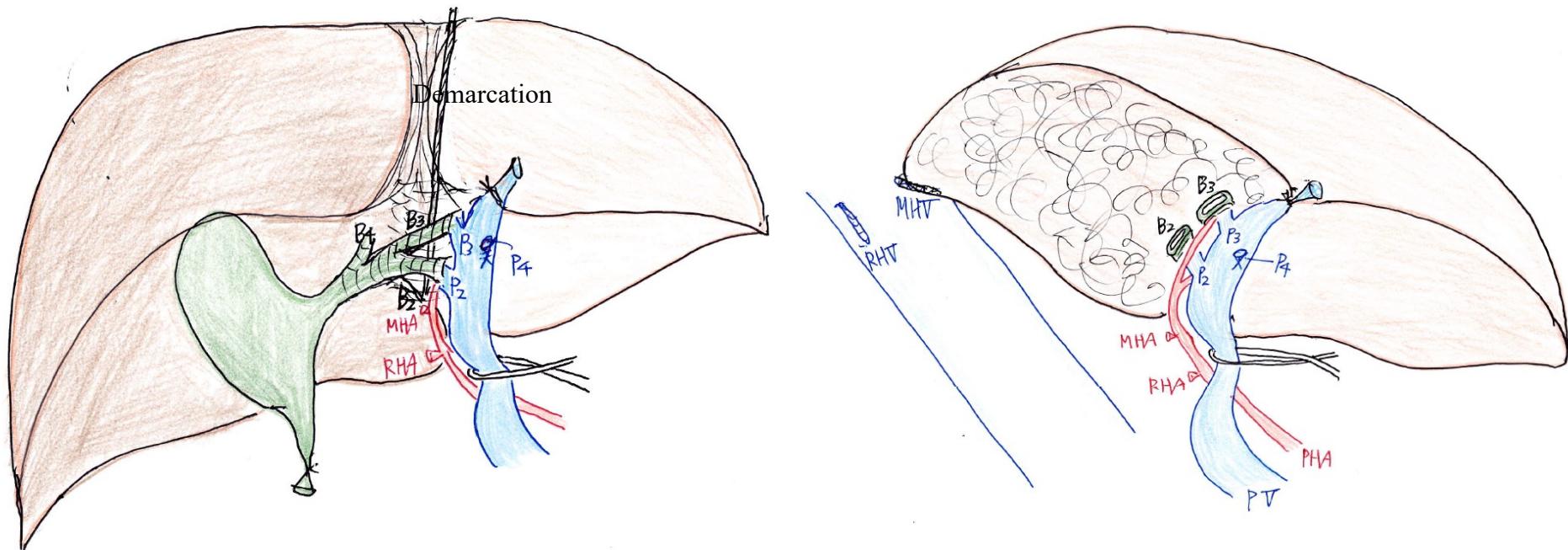
RIGHT HEPATECTOMY + CAUDATE



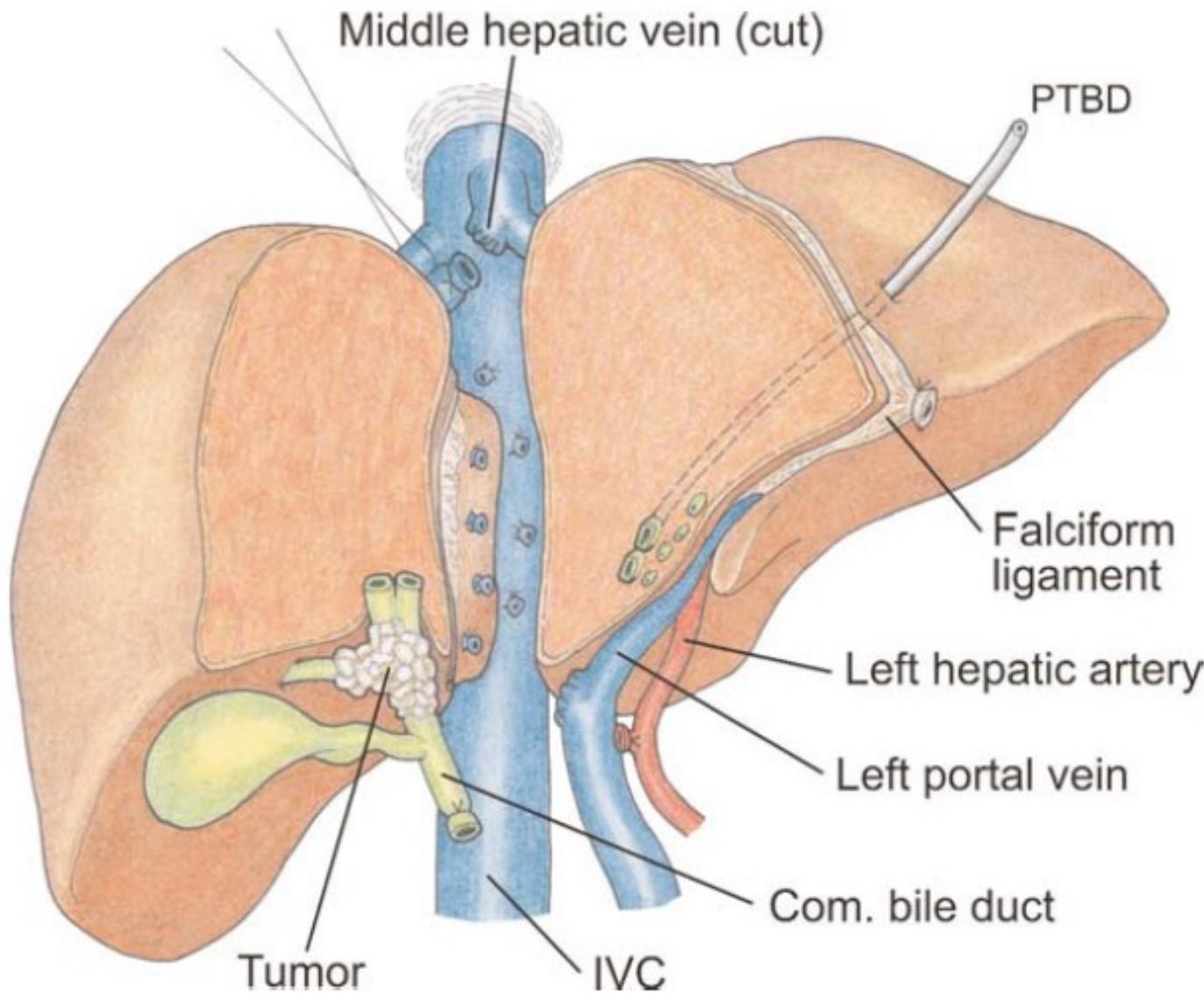
RIGHT HEPATECTOMY + CAUDATE



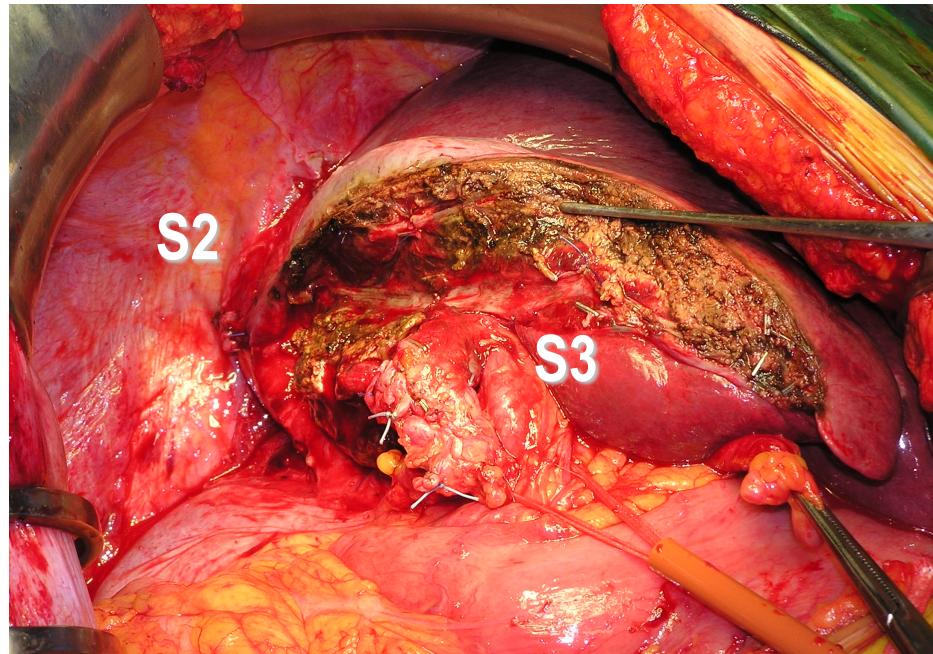
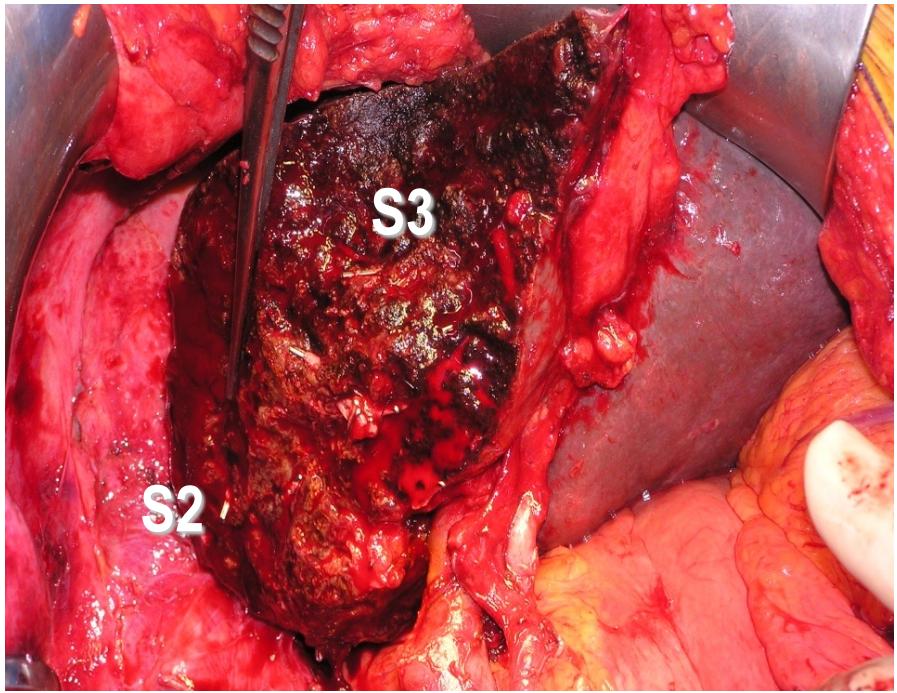
## EXTENDED RIGHT HEPATECTOMY



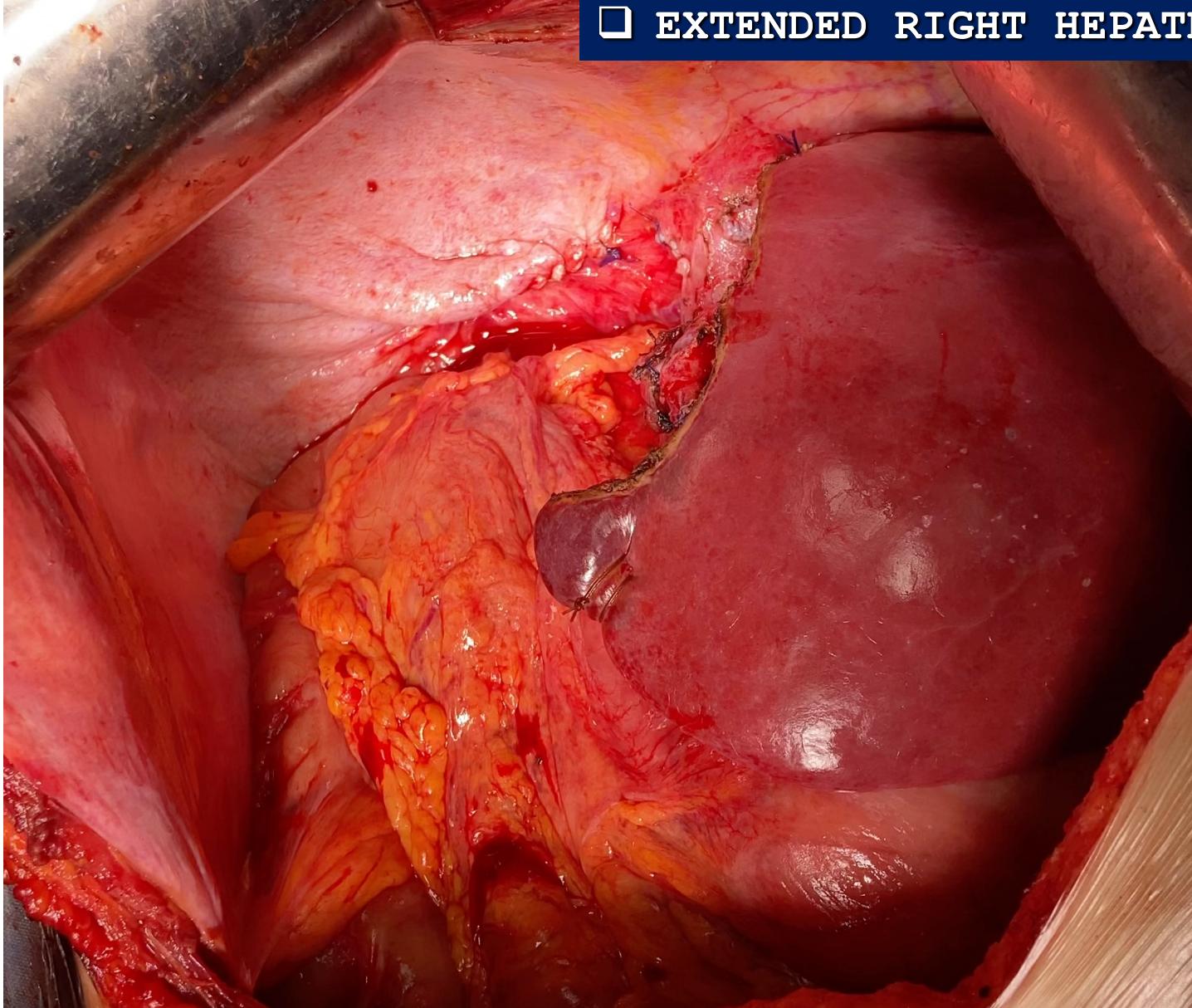
## EXTENDED RIGHT HEPATECTOMY



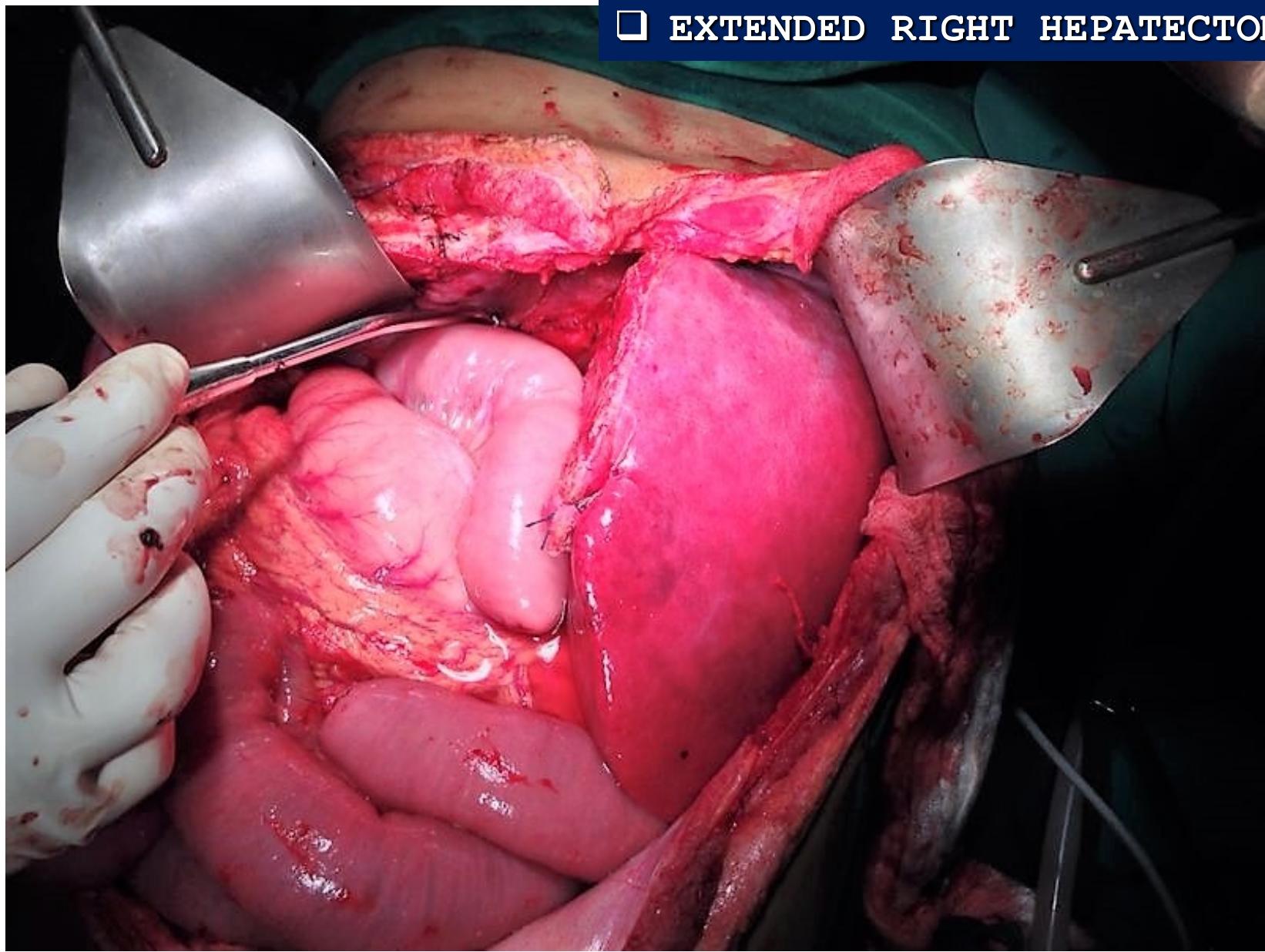
EXTENDED RIGHT HEPATECTOMY



EXTENDED RIGHT HEPATECTOMY

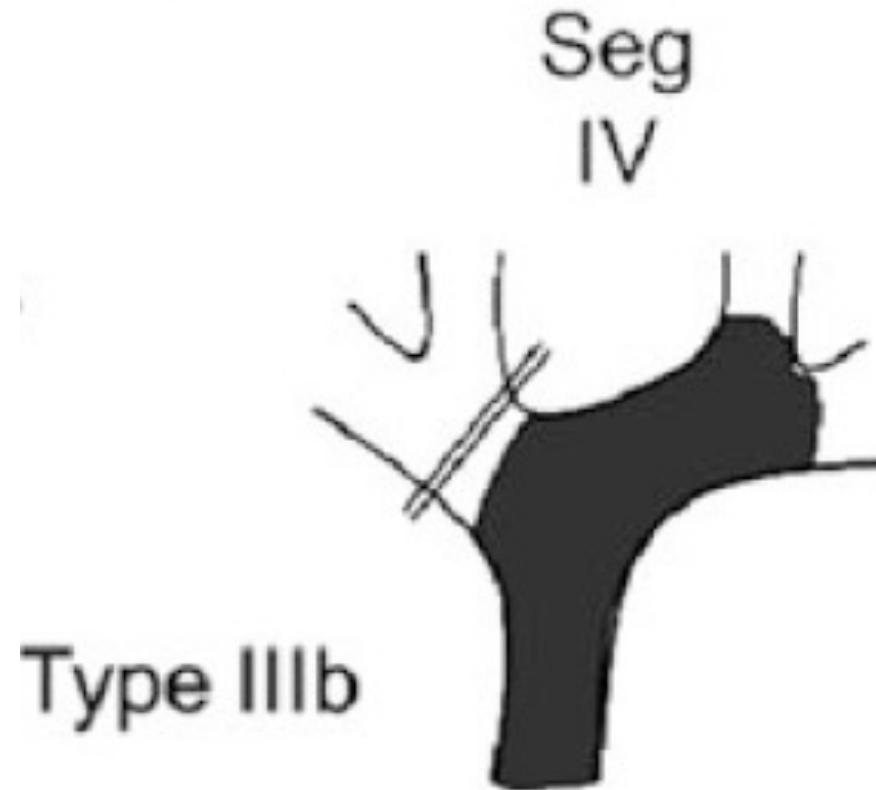


EXTENDED RIGHT HEPATECTOMY

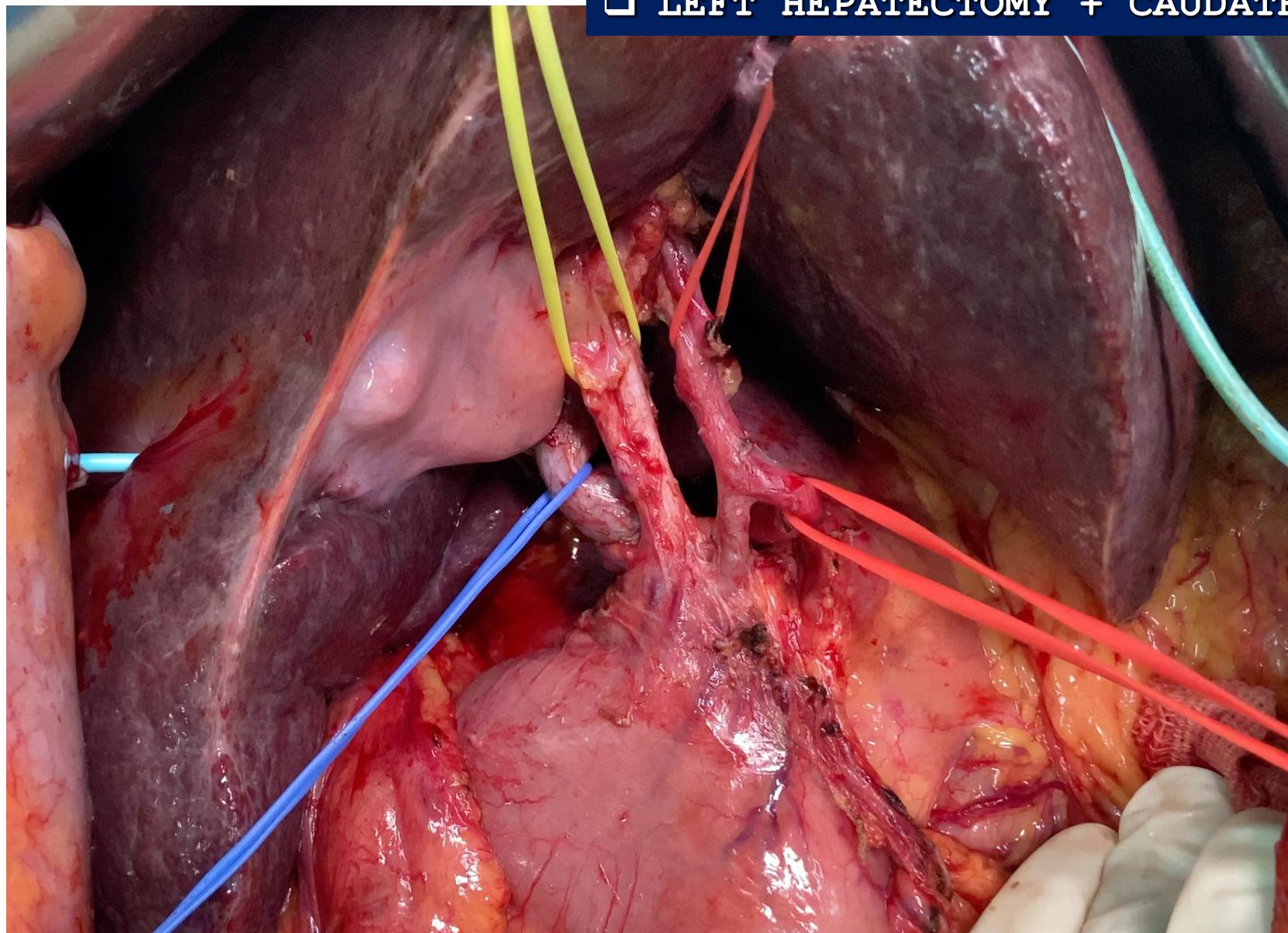


# BISMUTH-CORLETTTE IIIb

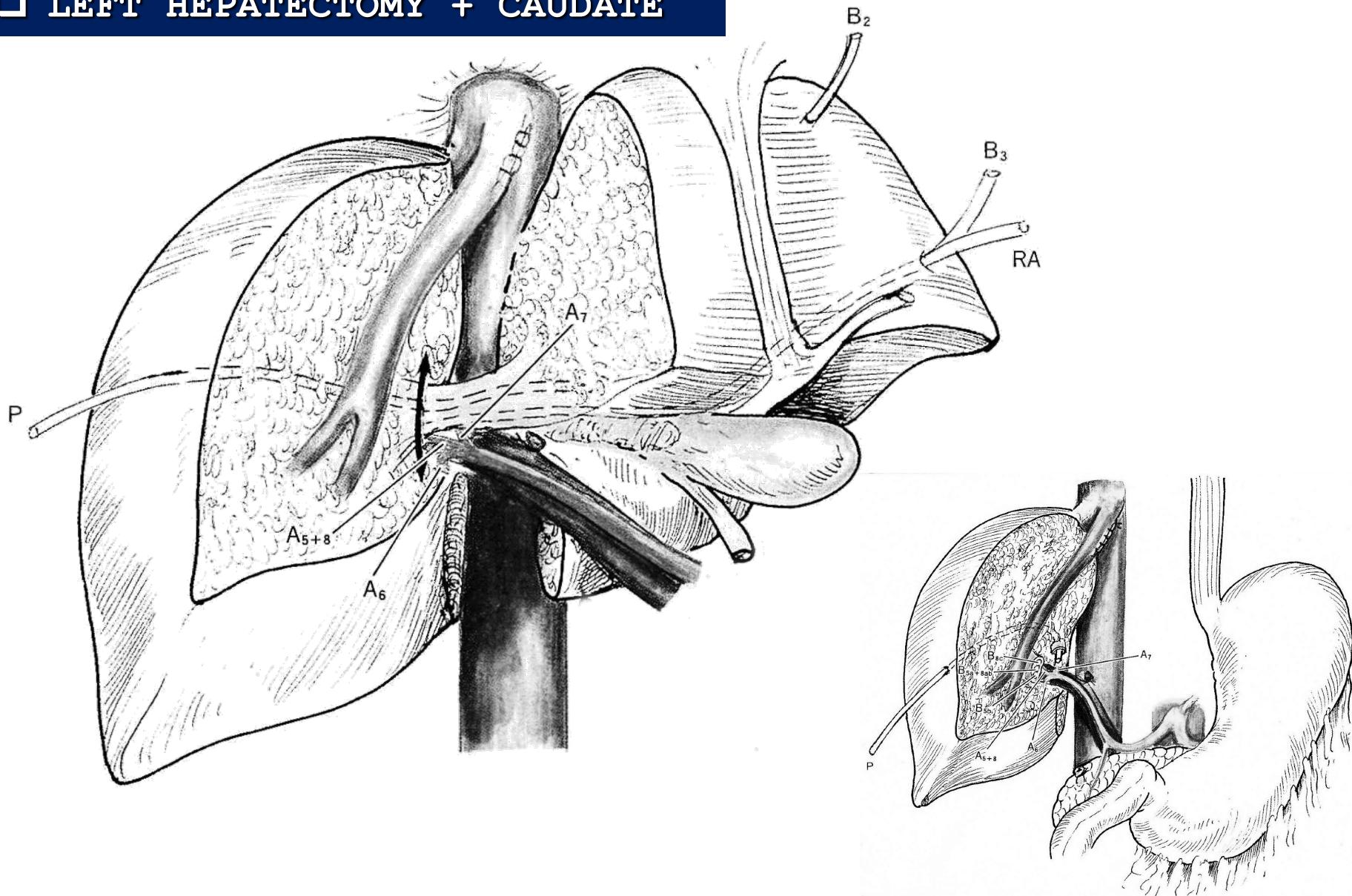
- Left hepatectomy
- Extended left hepatectomy



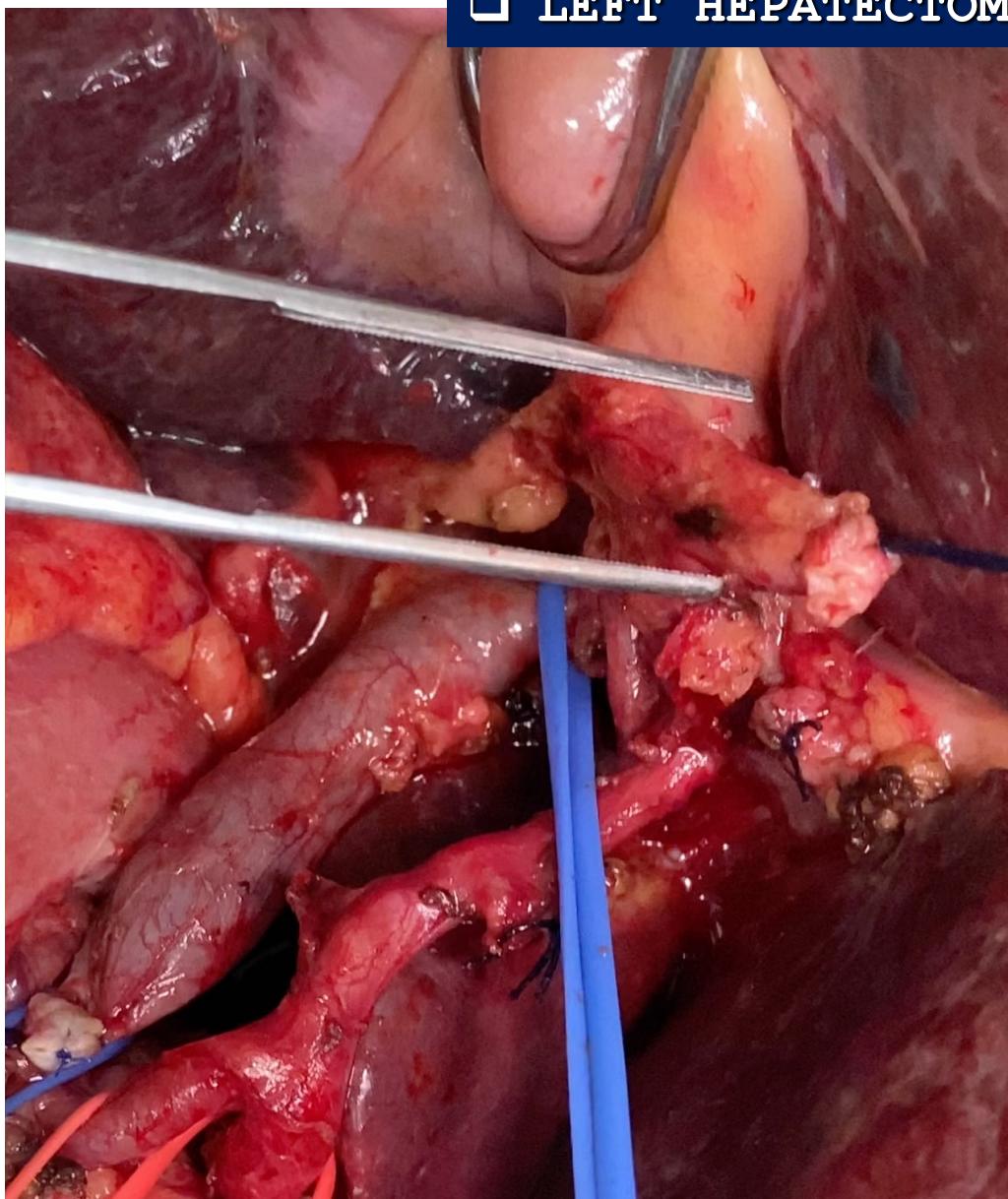
LEFT HEPATECTOMY + CAUDATE



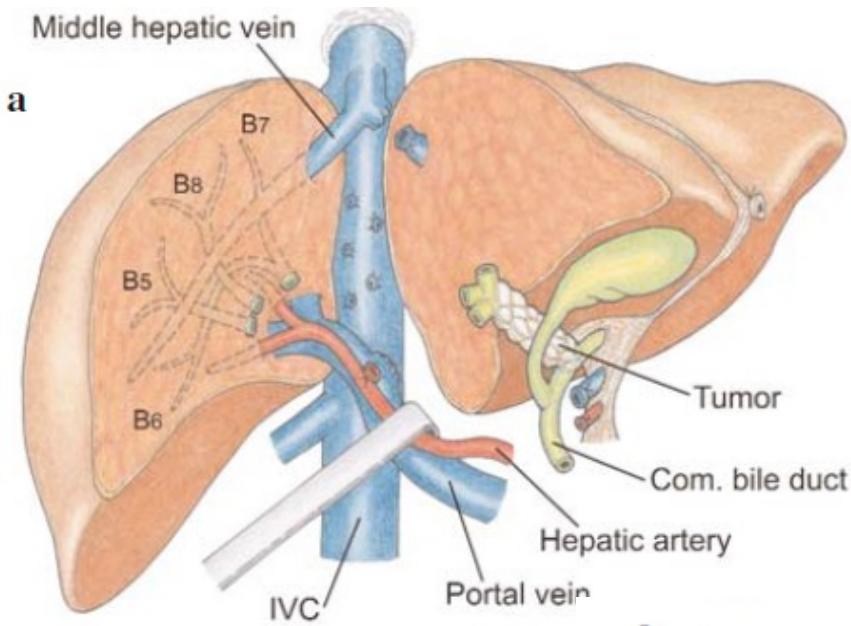
## □ LEFT HEPATECTOMY + CAUDATE



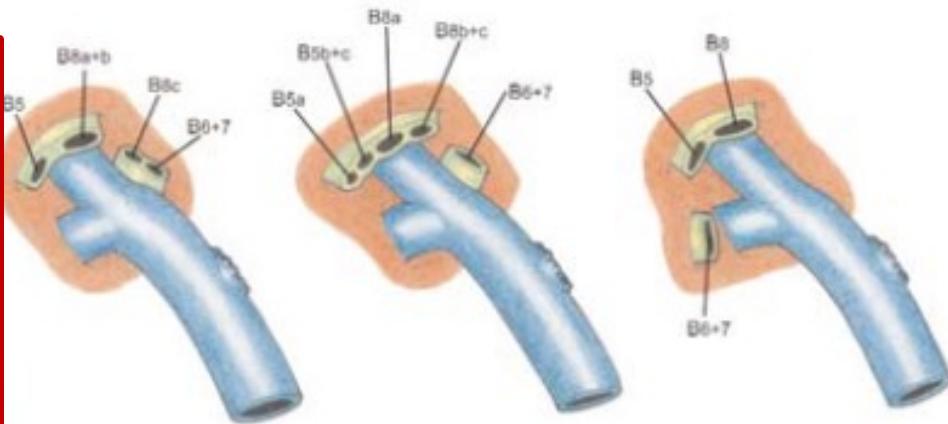
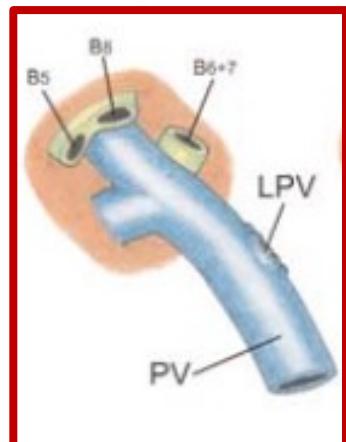
LEFT HEPATECTOMY + CAUDATE



## □ LEFT HEPATECTOMY + CAUDATE

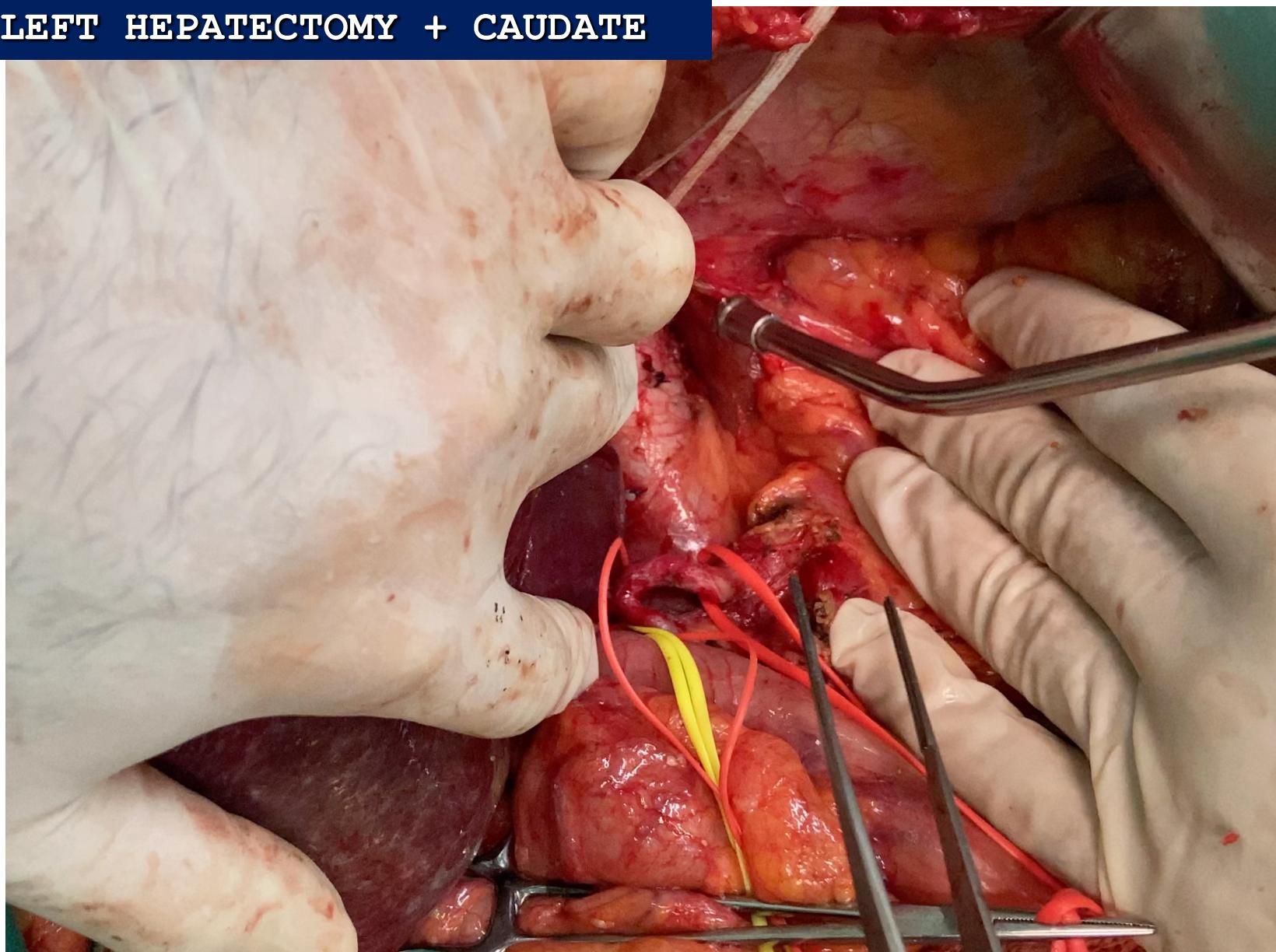


b

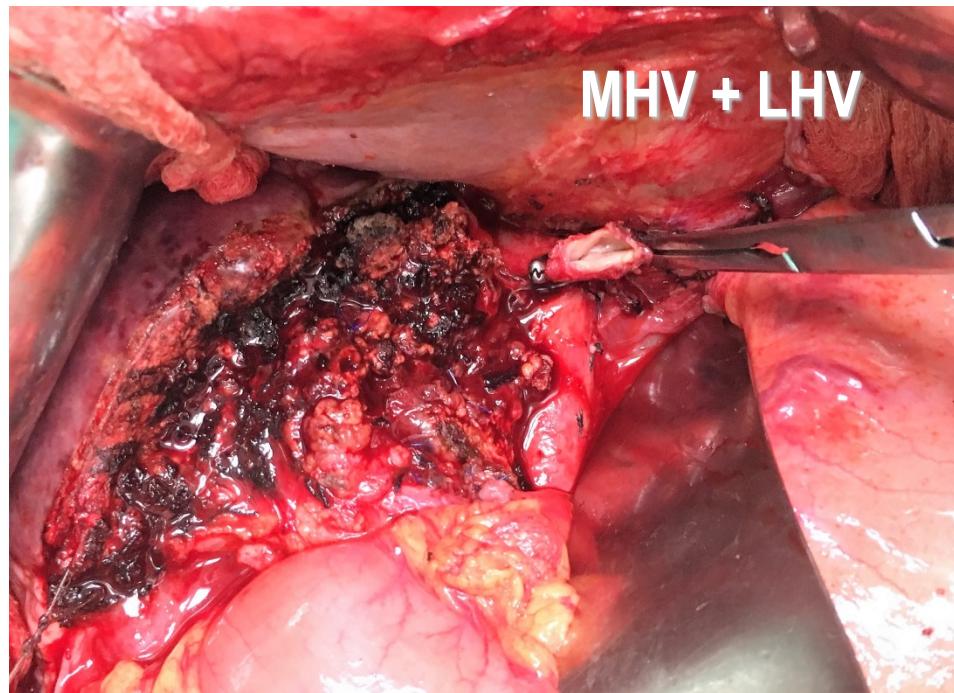


□ The right anterior and posterior bile duct (B5,B8/B6,B7) and different possibilities

## LEFT HEPATECTOMY + CAUDATE

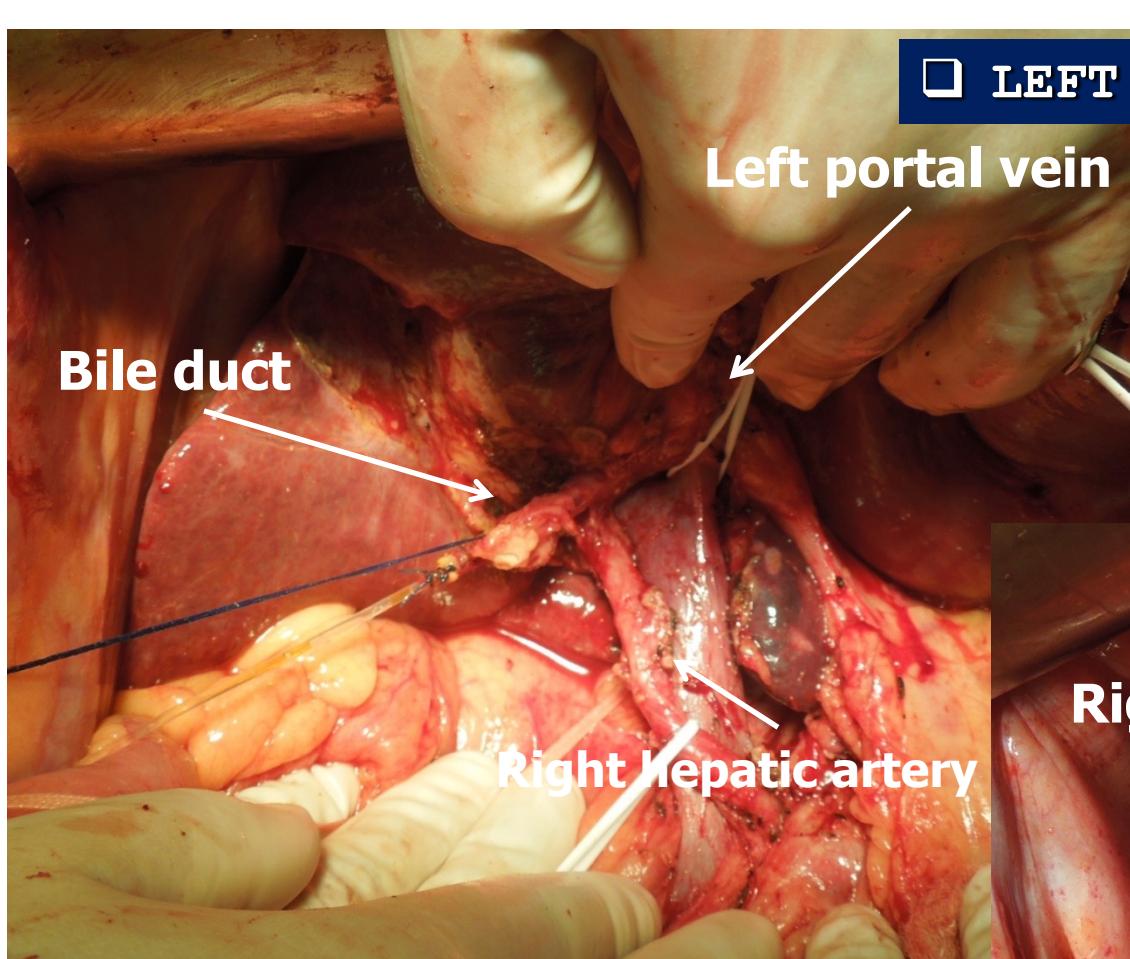


LEFT HEPATECTOMY + CAUDATE



Hanging

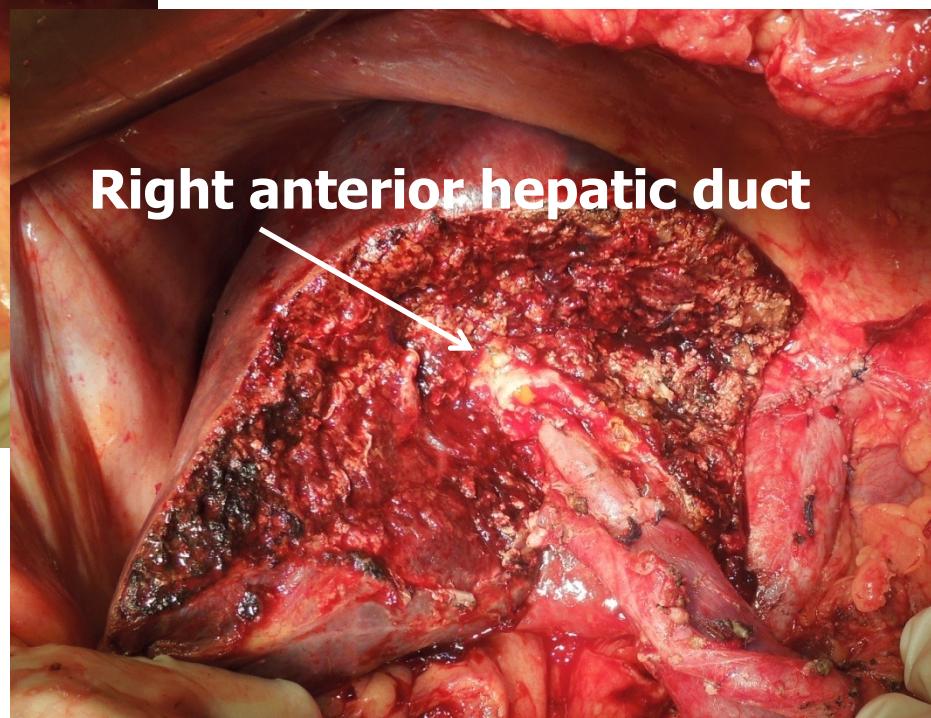
LEFT HEPATECTOMY + CAUDATE



Left portal vein

Bile duct

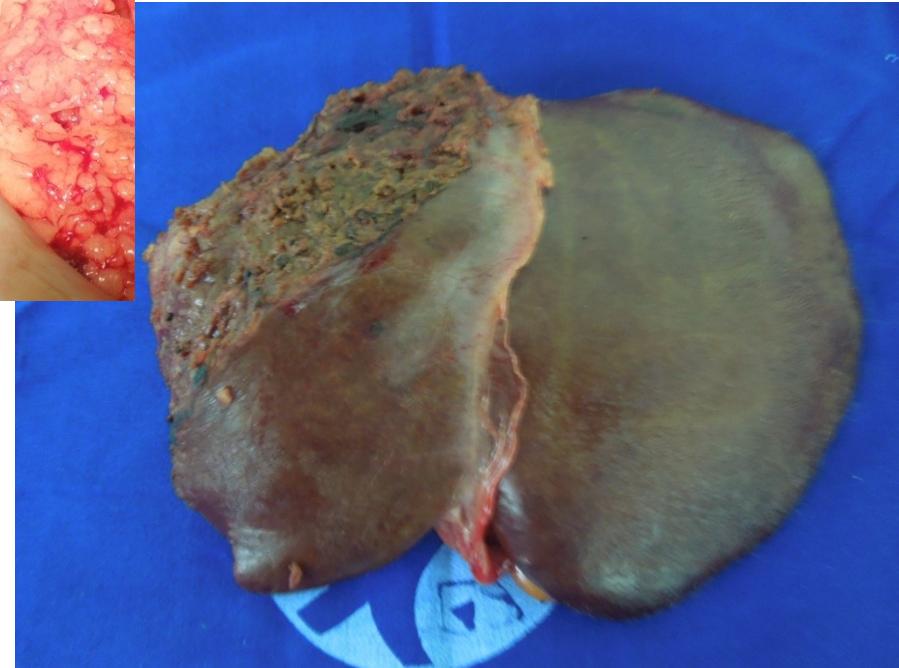
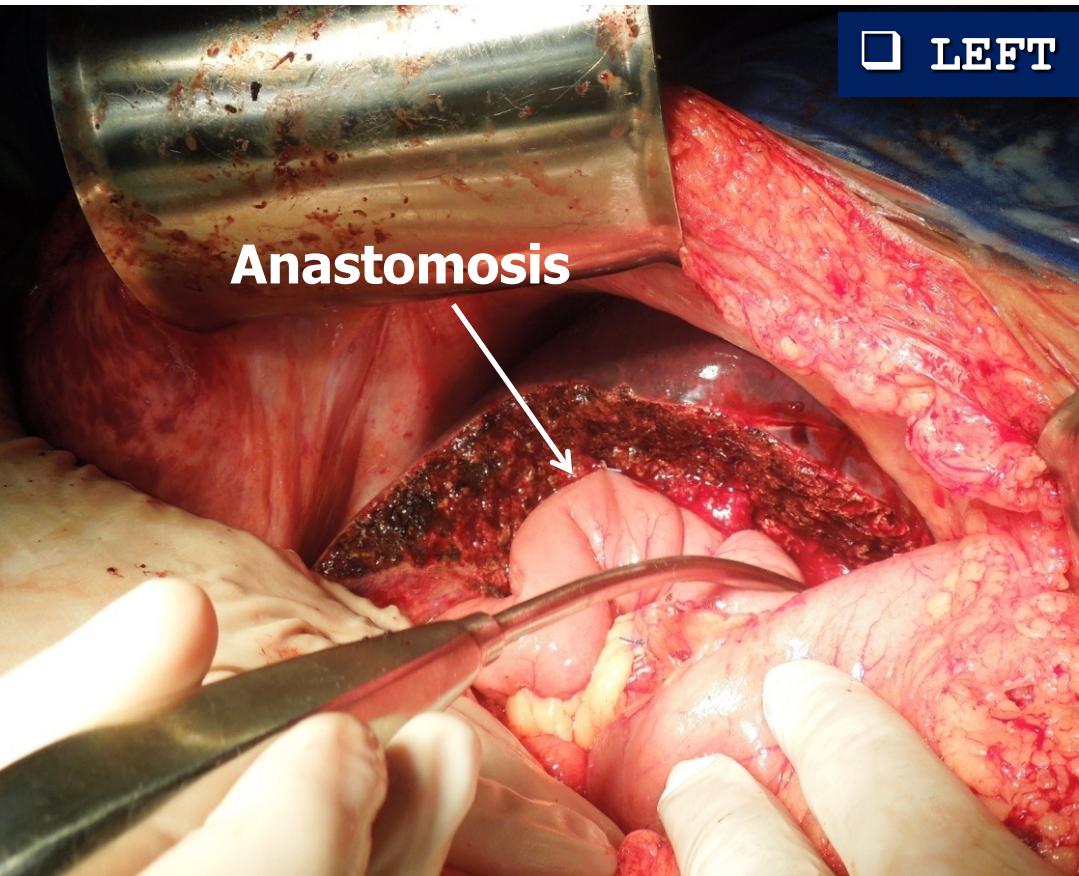
Right hepatic artery



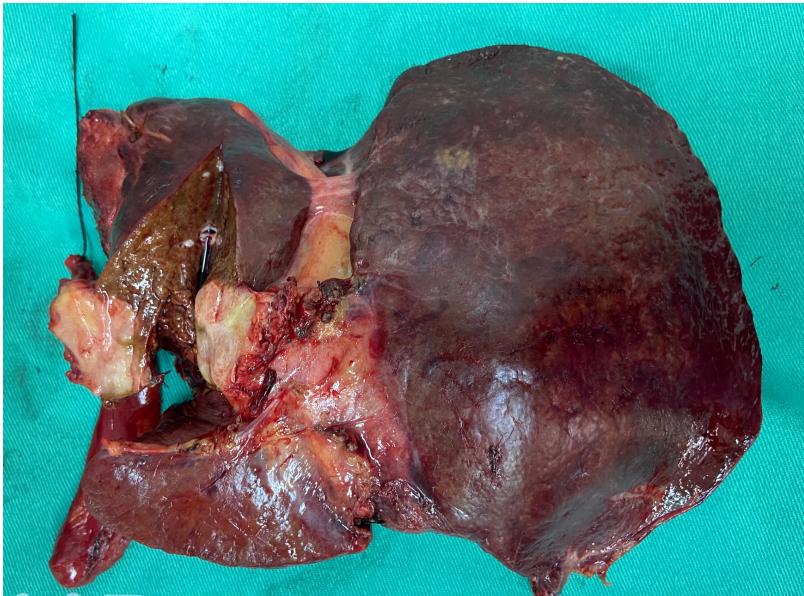
Right anterior hepatic duct

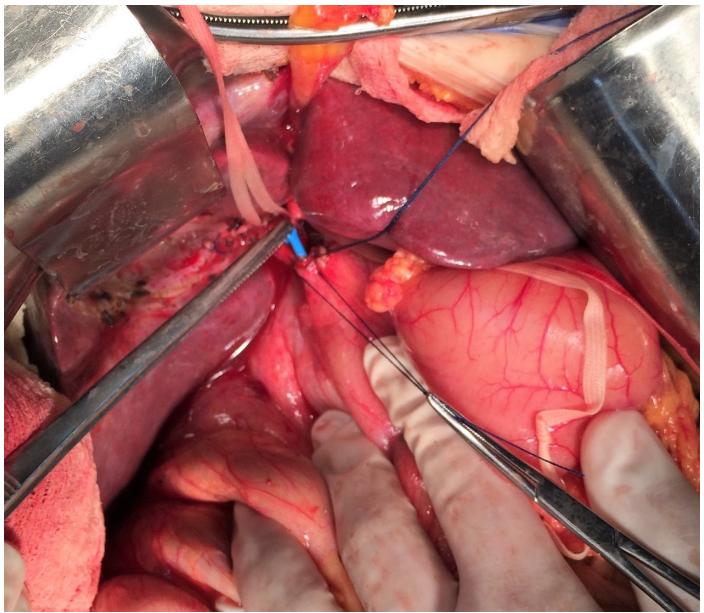
LEFT HEPATECTOMY + CAUDATE

Anastomosis



LEFT HEPATECTOMY + CAUDATE

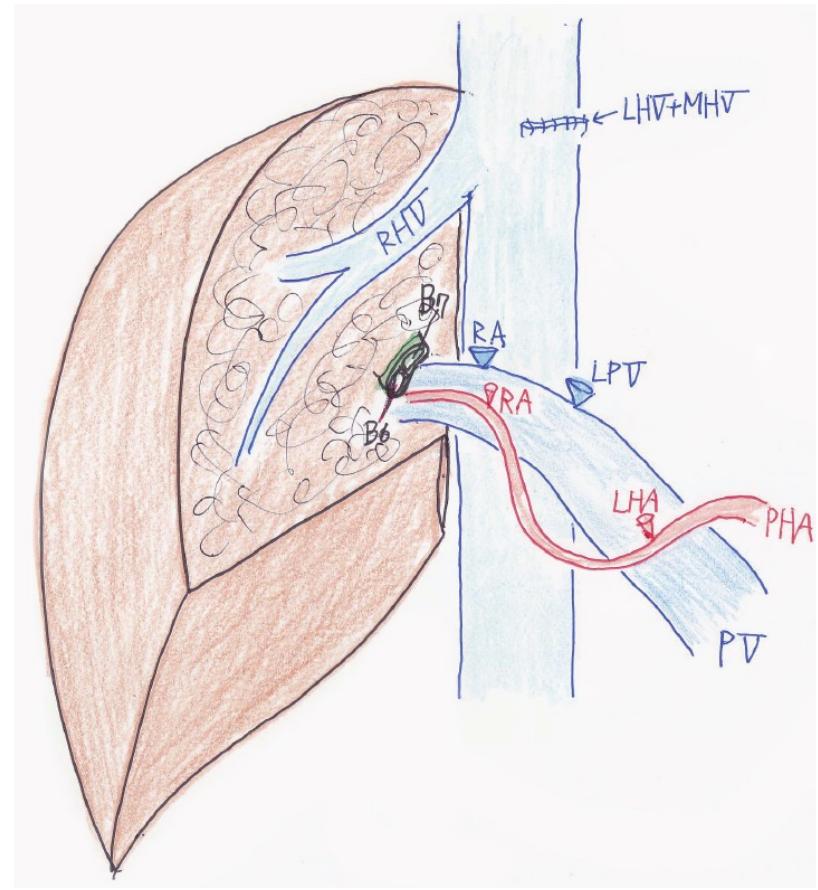
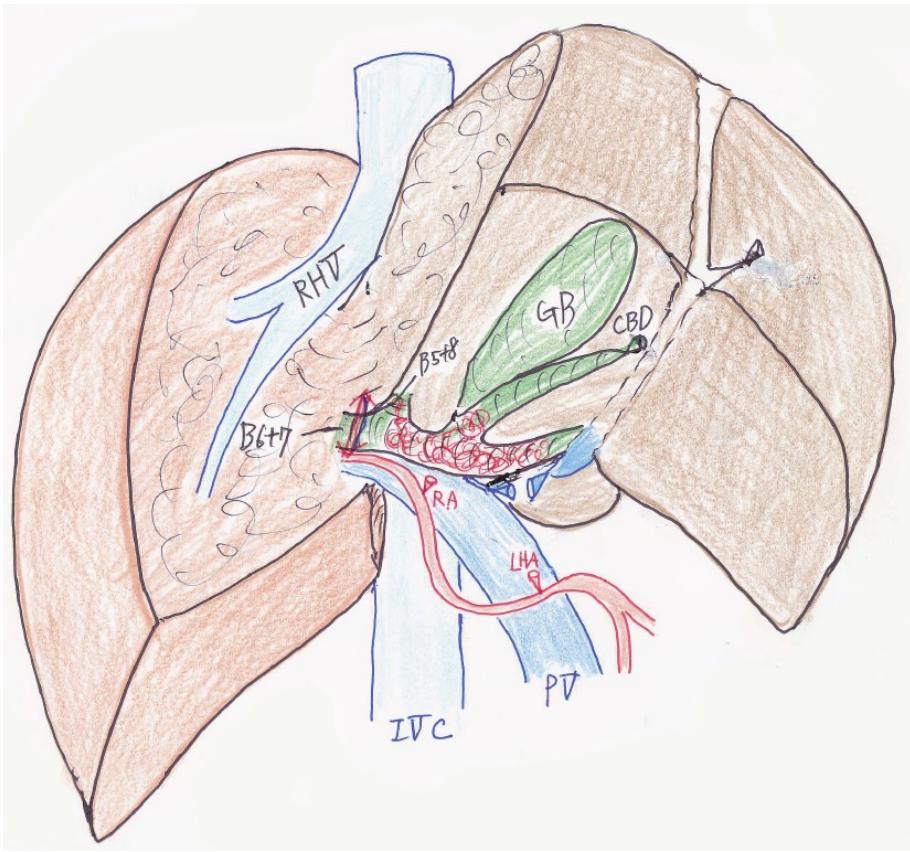




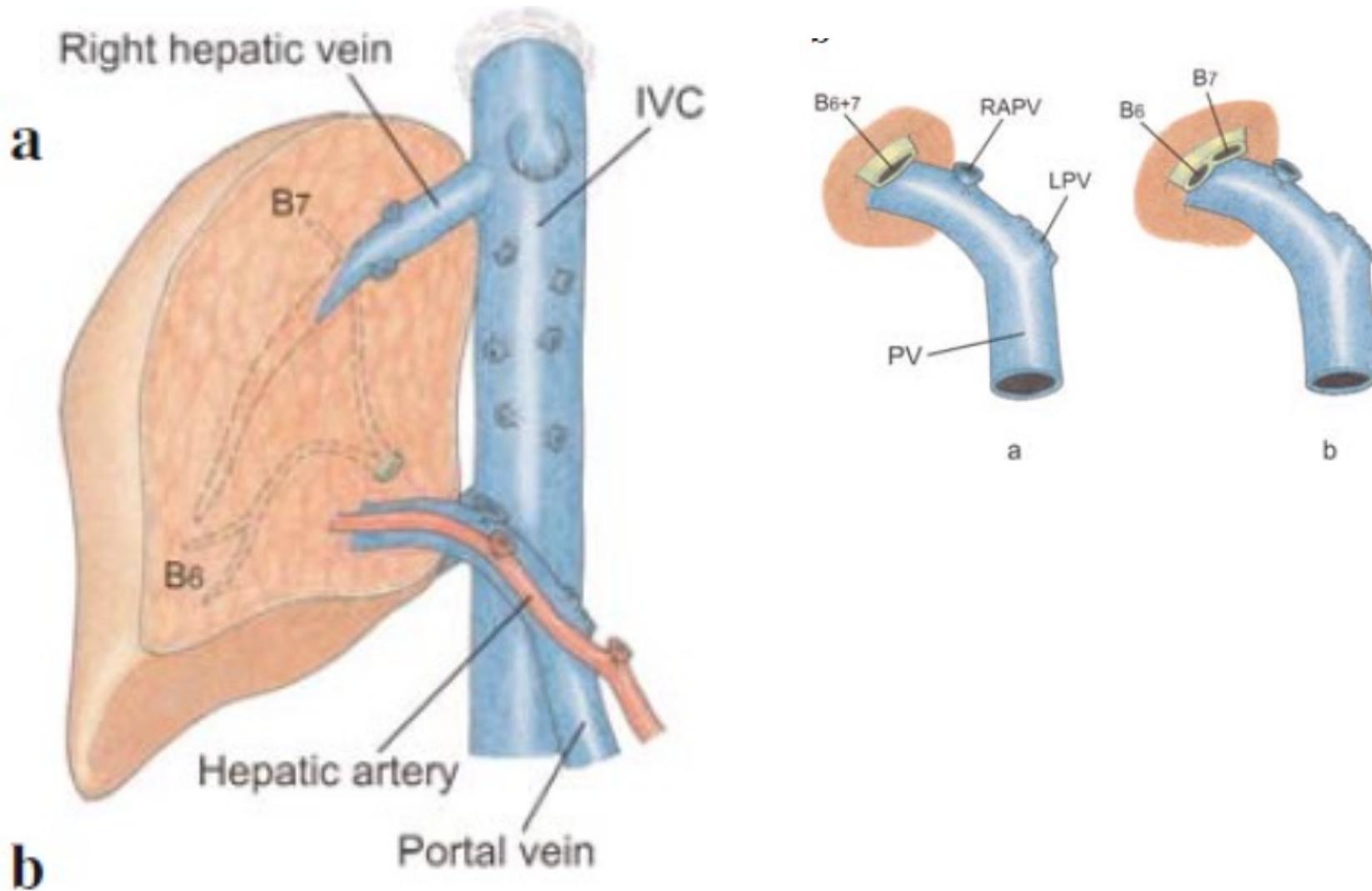
LEFT HEPATECTOMY + CAUDATE



## EXTENDED LEFT HEPATECTOMY



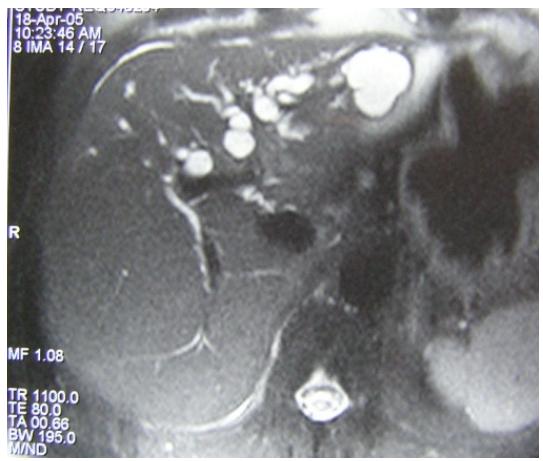
## □ EXTENDED LEFT HEPATECTOMY



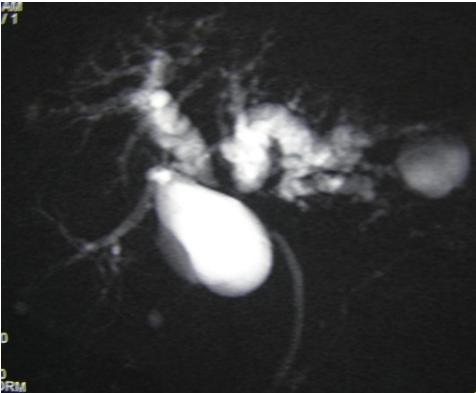
□ The posterior segmental ducts (B6,B7) may be unique or separated



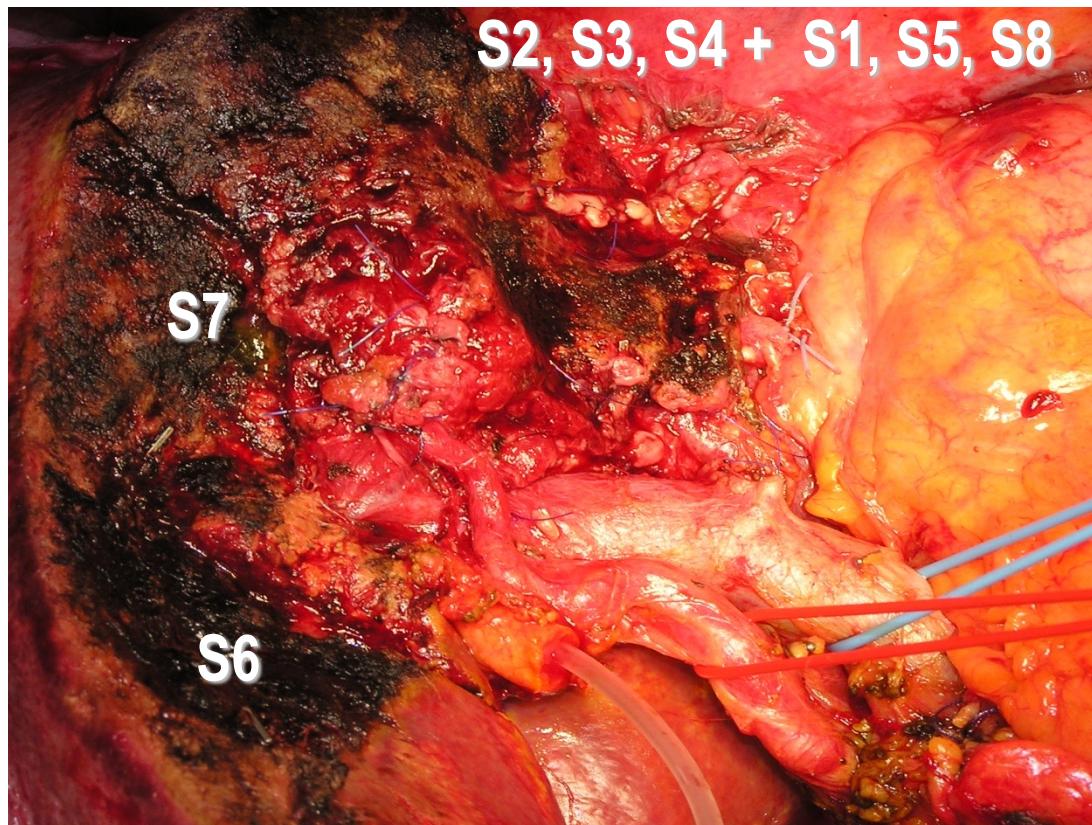
**MRI**



**MRCP**



EXTENDED LEFT HEPATECTOMY



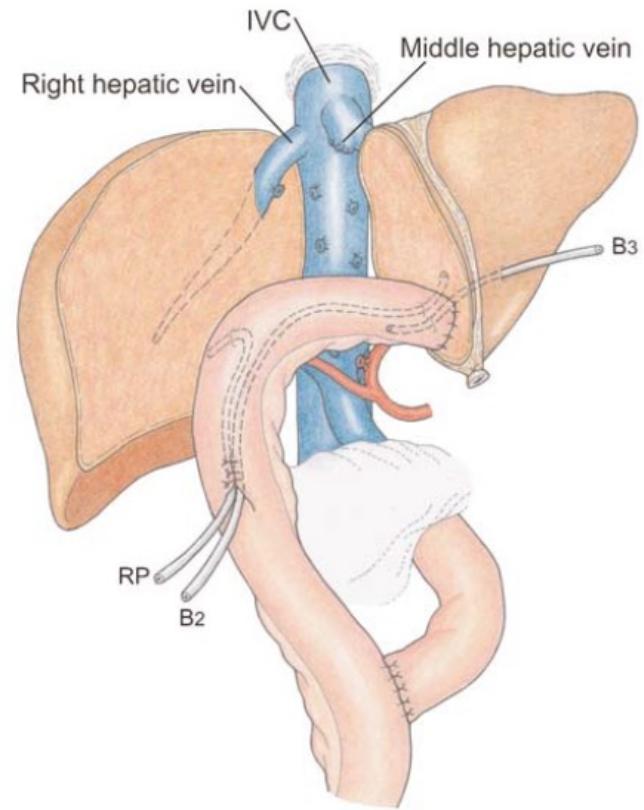
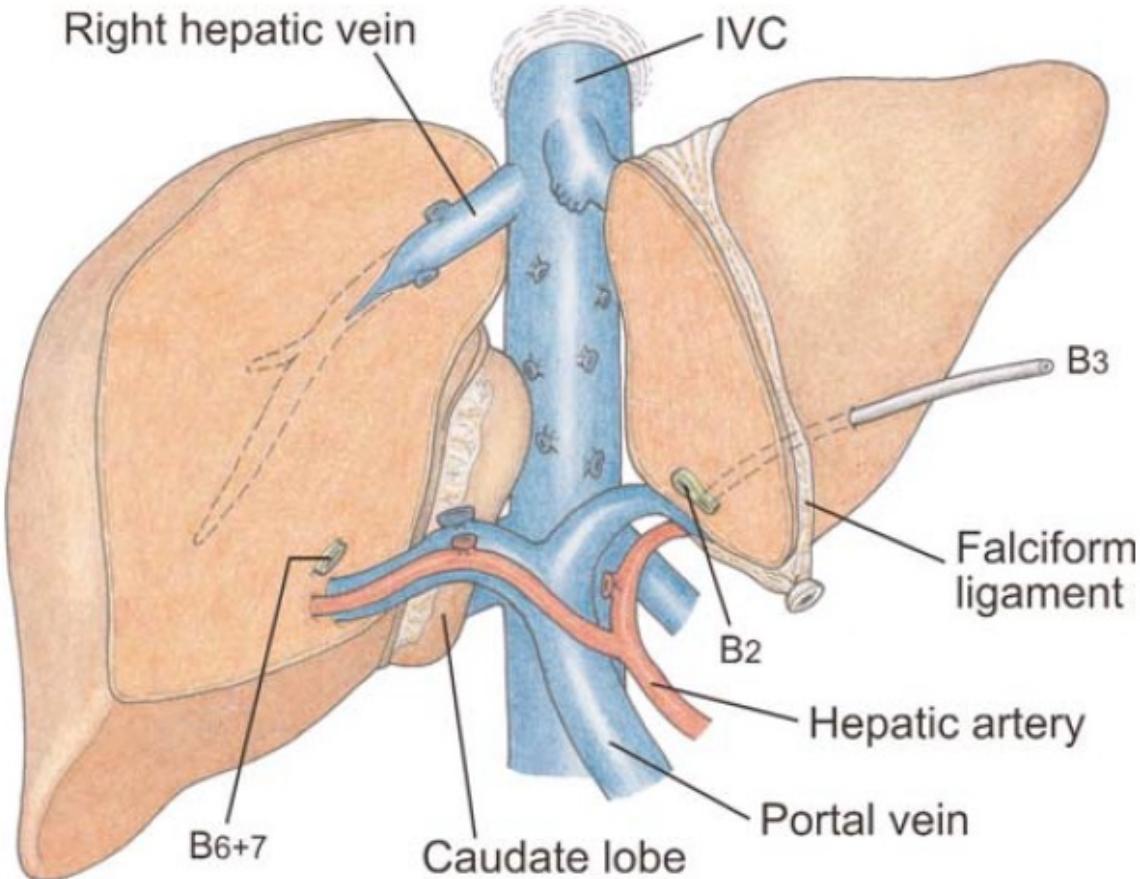
Serviço de Cirurgia do Aparelho Digestivo



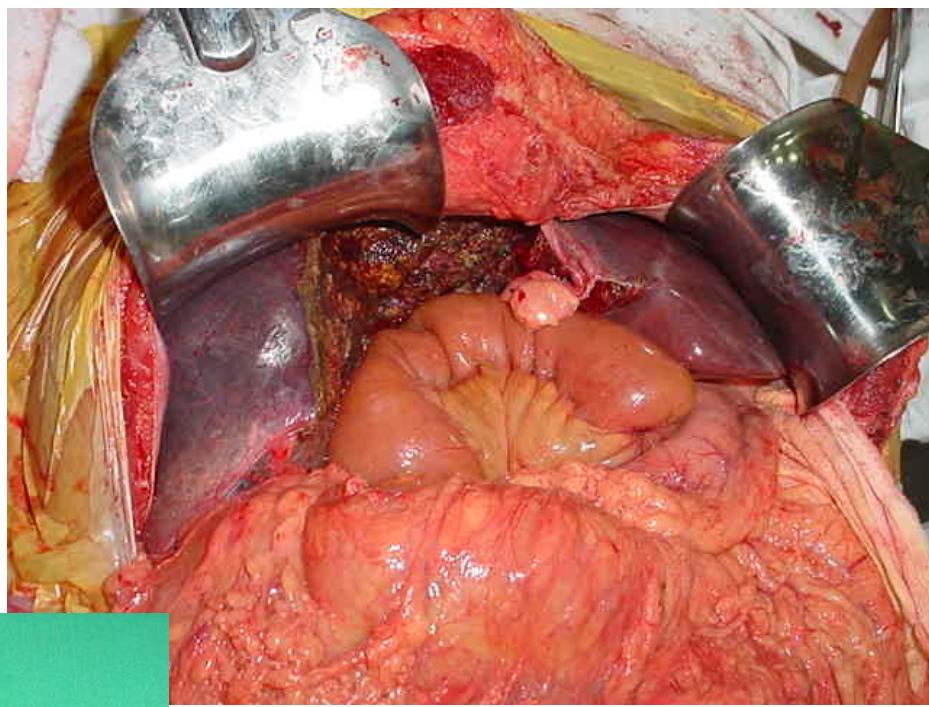
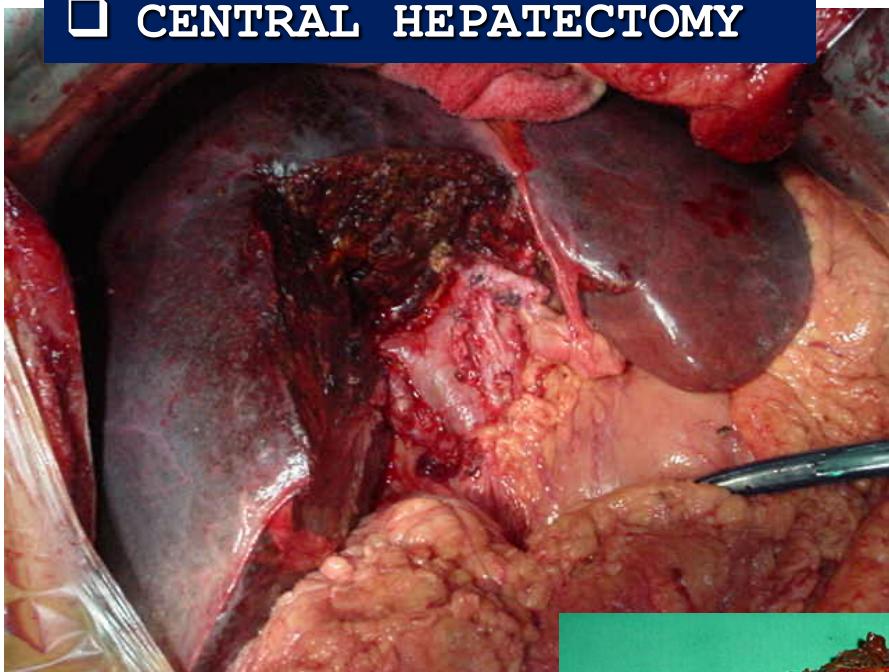
EXTENDED LEFT HEPATECTOMY



## CENTRAL HEPATECTOMY

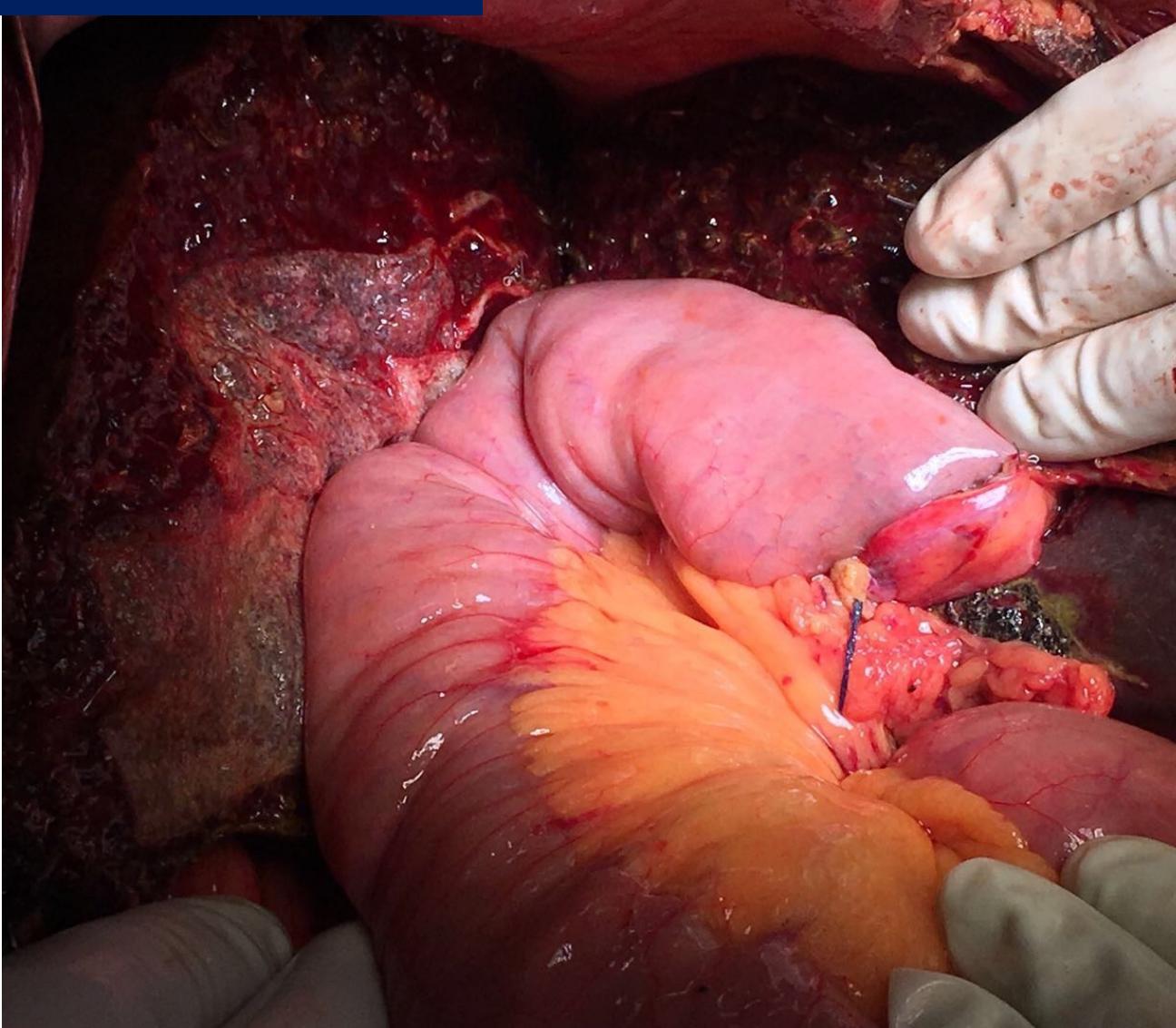


## CENTRAL HEPATECTOMY

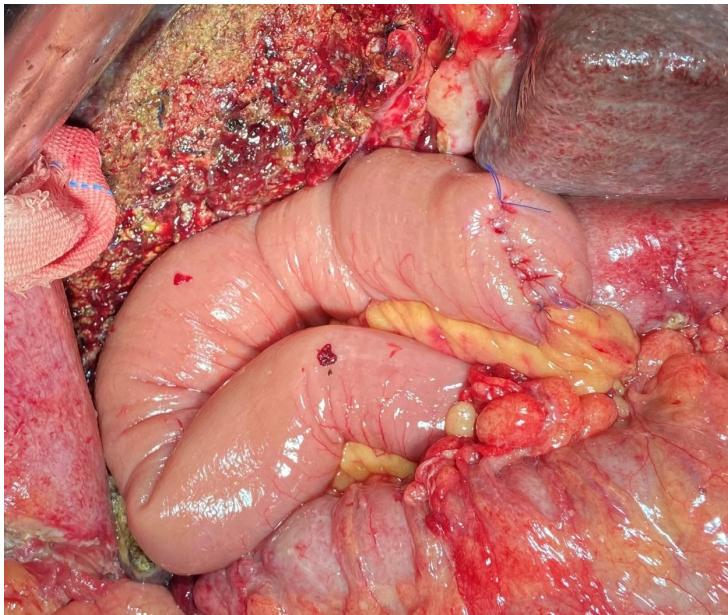
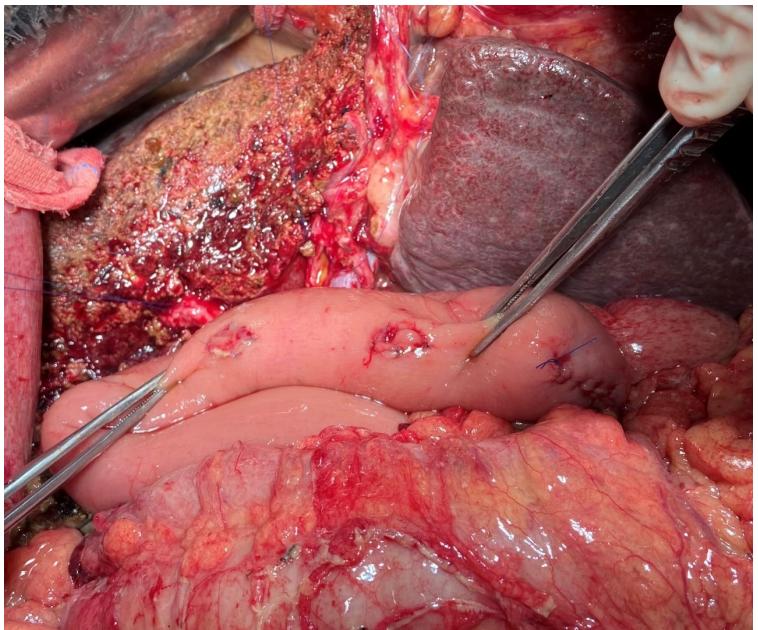
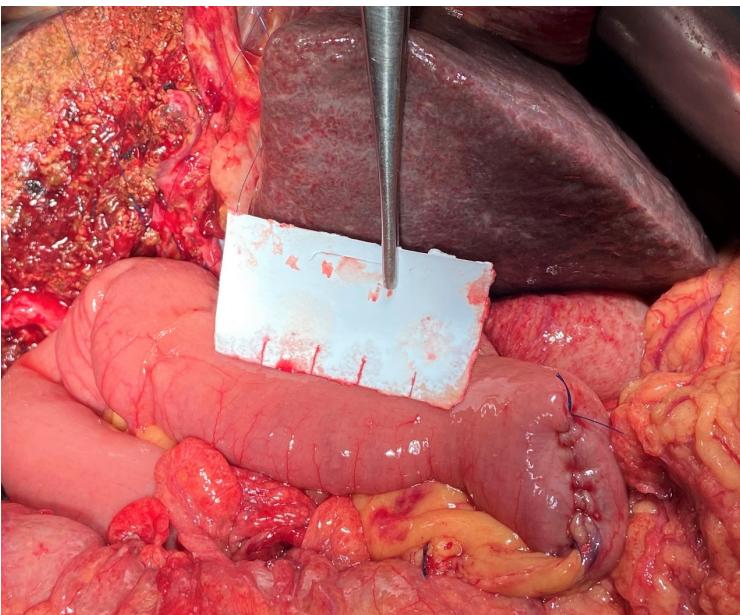
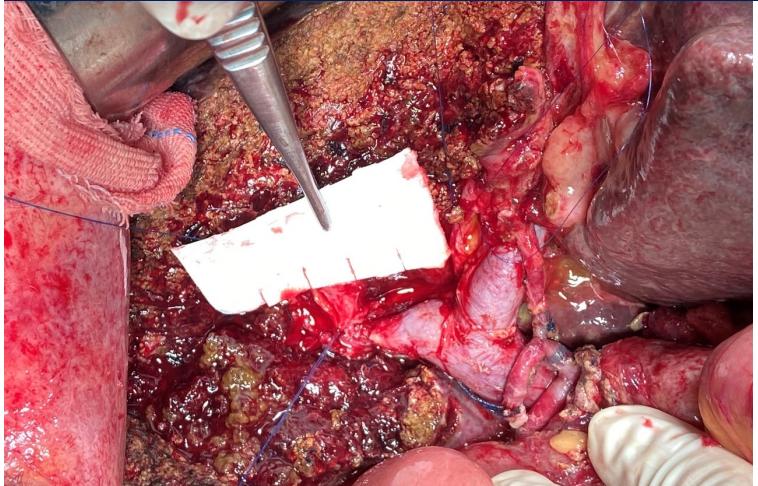


Courtesy: Dr. Eduardo Fernandes (RJ)

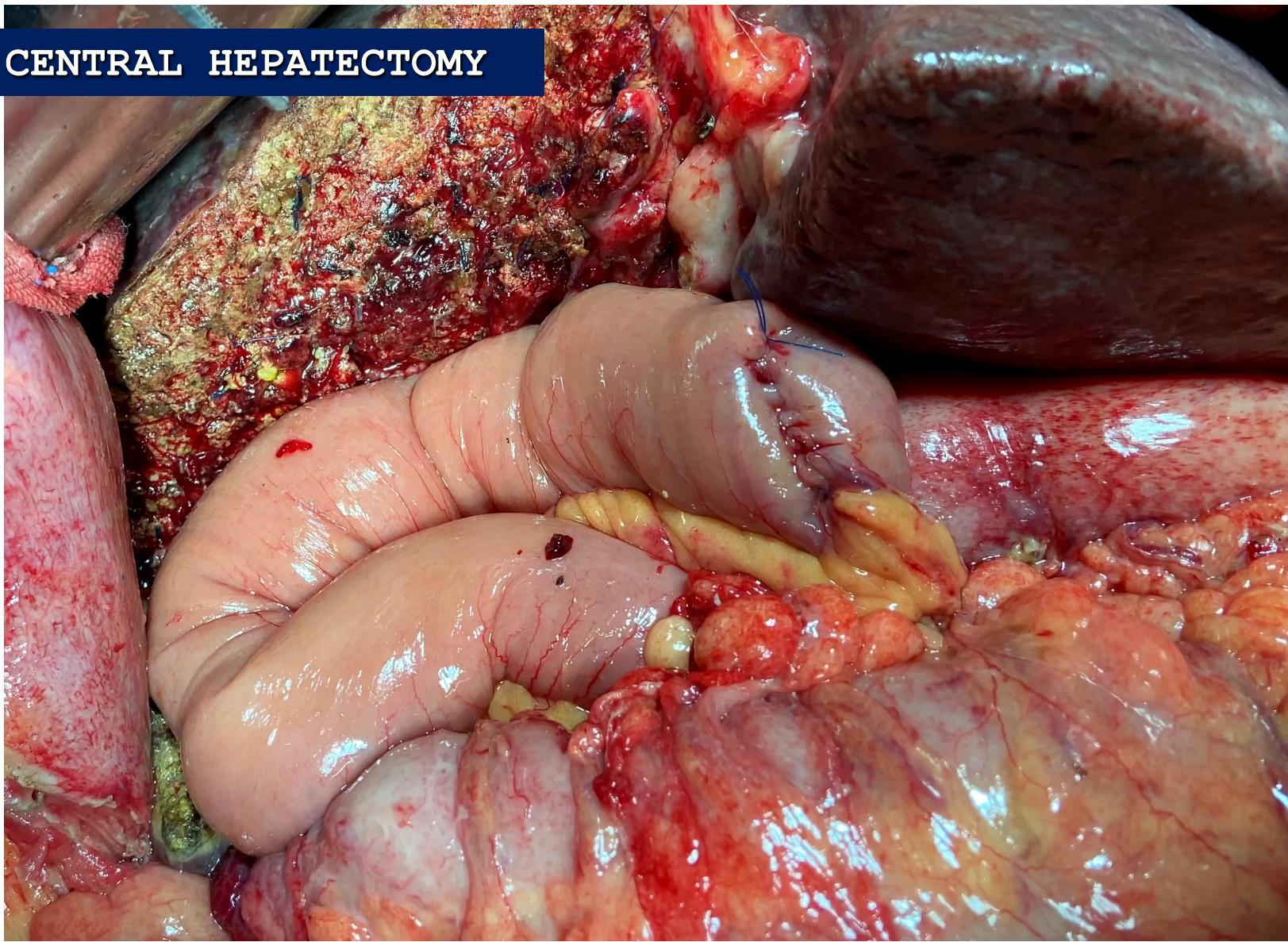
## CENTRAL HEPATECTOMY



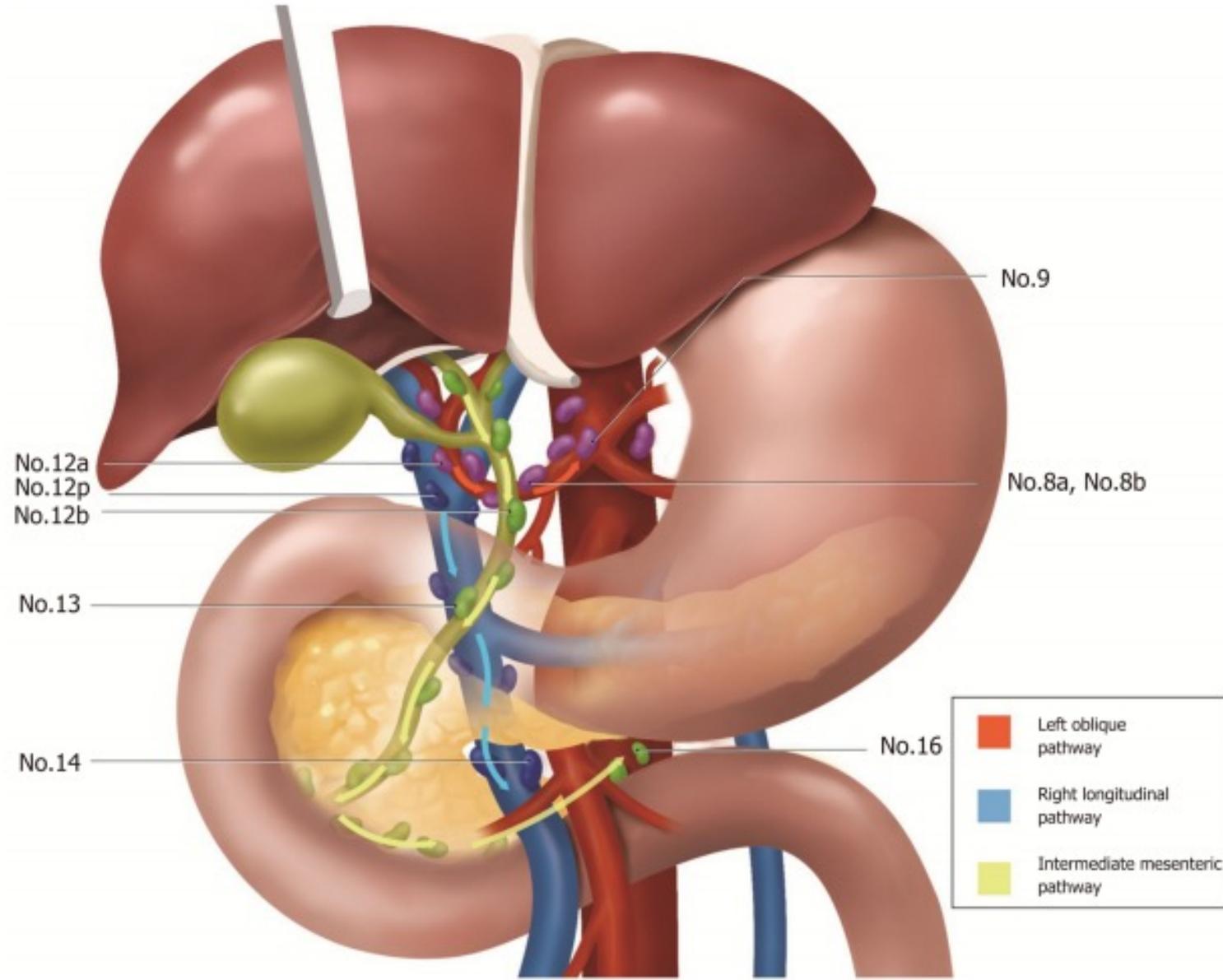
## CENTRAL HEPATECTOMY



## CENTRAL HEPATECTOMY



# EXTENT OF LYMPH NODE DISSECTION



# LYMPHADENECTOMY

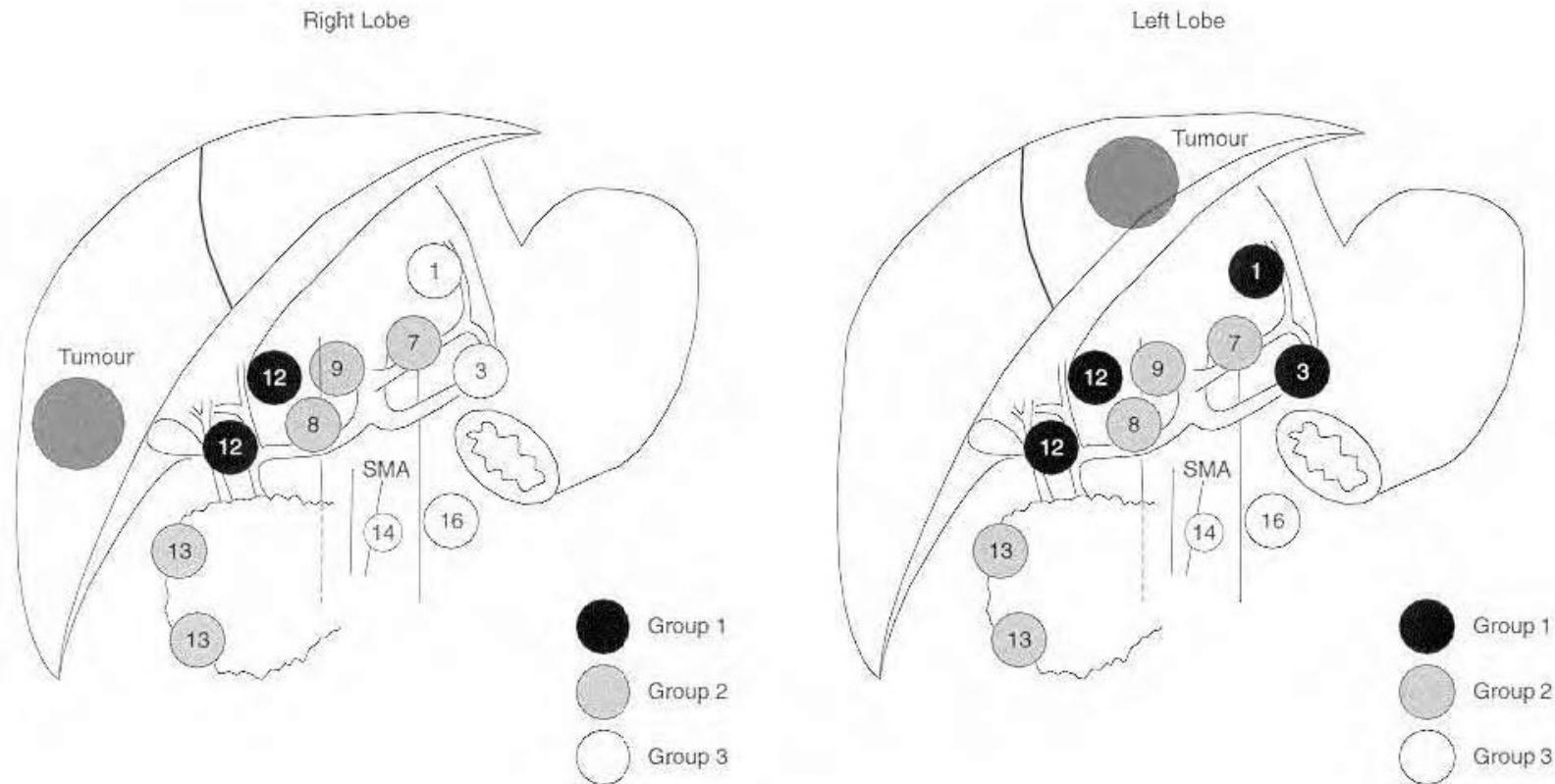


FIGURE 14.4

"Right" and "left" nodal drainage pathways. Nozaki, Y et al. *Cancer* 1998, 83:1923-1929

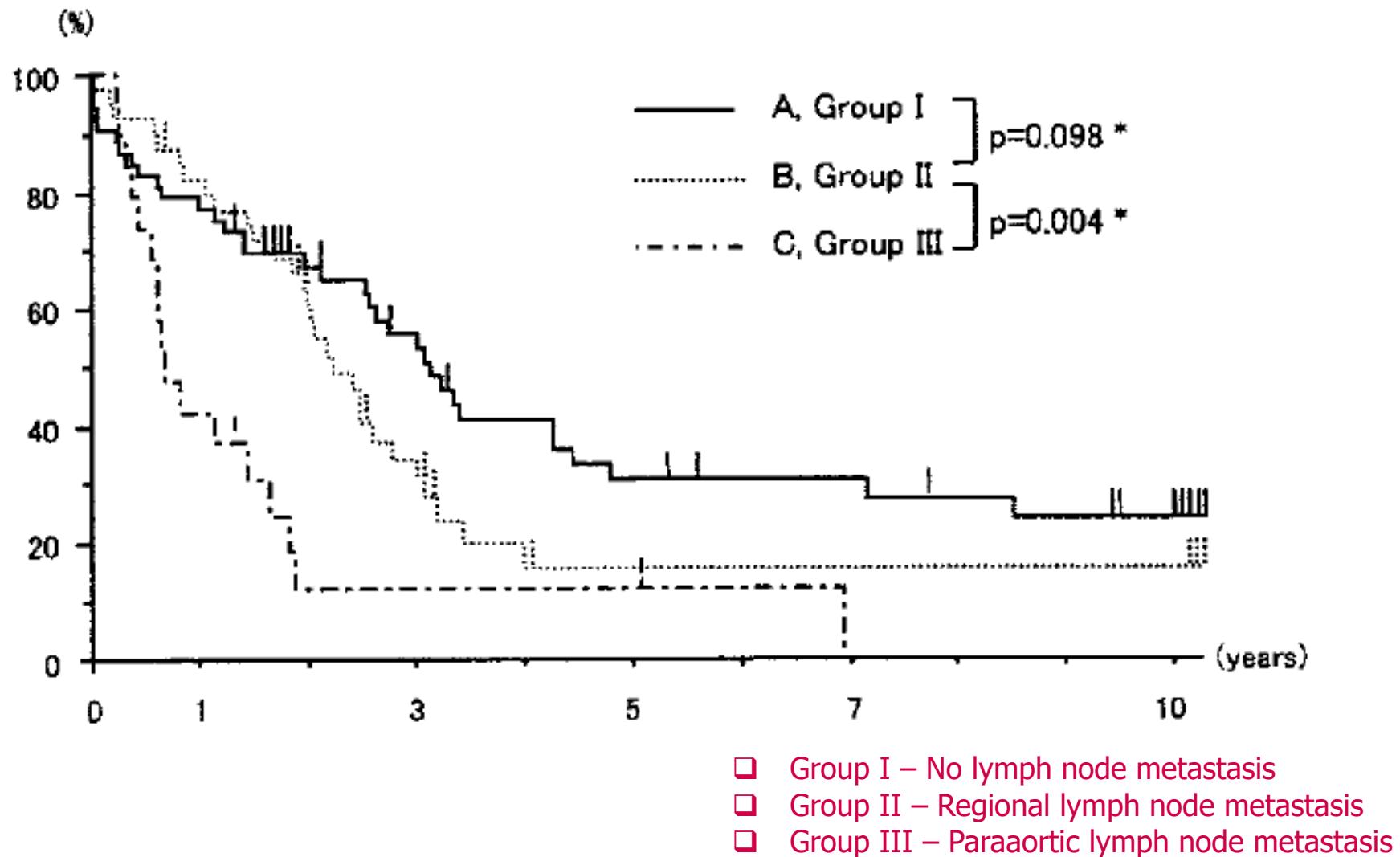
## Lymph Node Metastasis from Hilar Cholangiocarcinoma: Audit of 110 Patients Who Underwent Regional and Paraaortic Node Dissection

Table 2. DEFINITION OF REGIONAL LYMPH NODE GROUPS

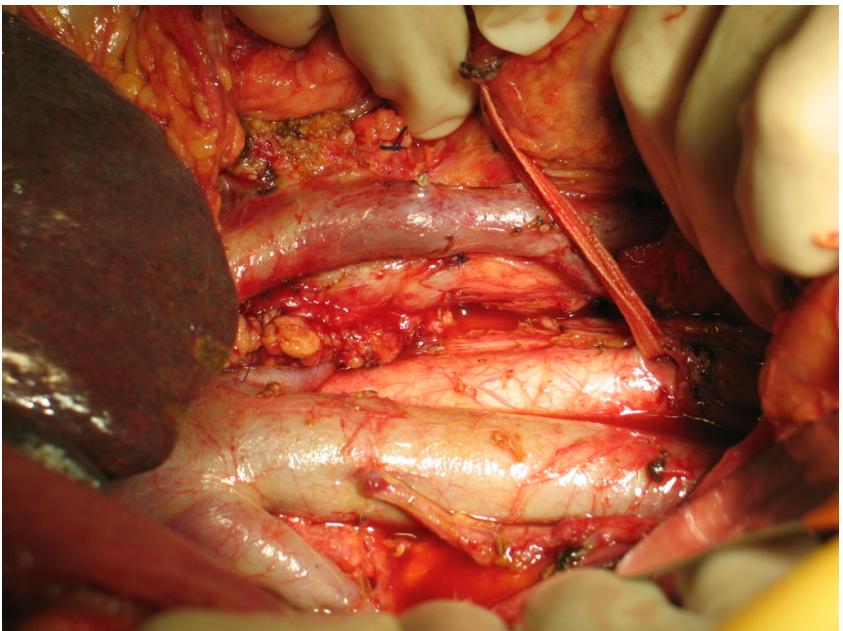
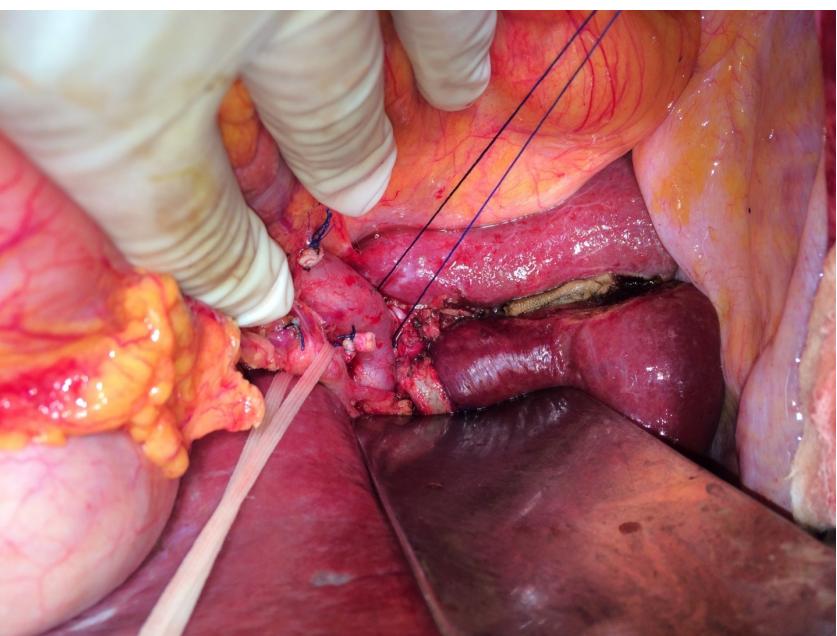
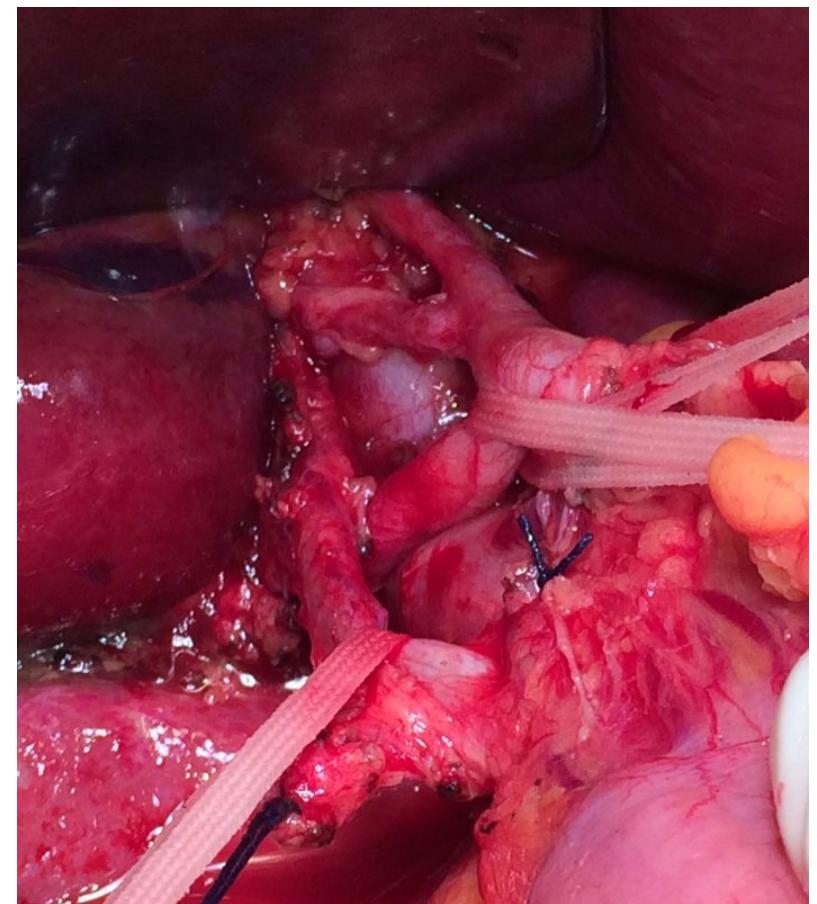
TNM classification	This Study
N1	N1
Hilar	Pericholedochal (No. 12h, 12c, 12b)
Cystic duct	
Pericholedochal	
N2	N2
Periportal	Periportal (No. 12 p, 12a)
Periduodenal	Common hepatic (No. 8a, 8p)
Peripancreatic	Posterior pancreaticoduodenal (No. 13a)
Celiac	Celiac (No. 9)
Superior mesenteric	Superior mesenteric (No. 14)

Numbers in parentheses indicate lymph node group according to the classification by the Japanese Society of Biliary Surgery.

# LYMPHADENECTOMY

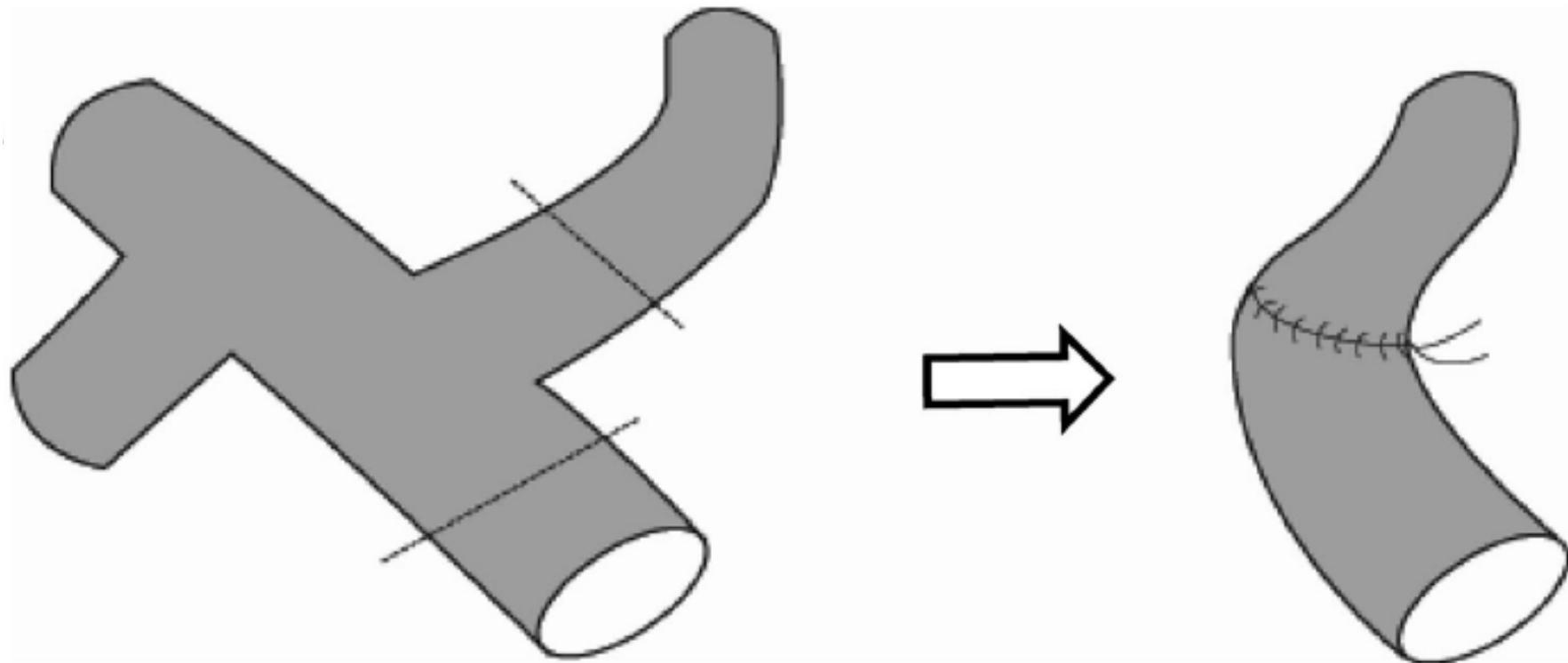


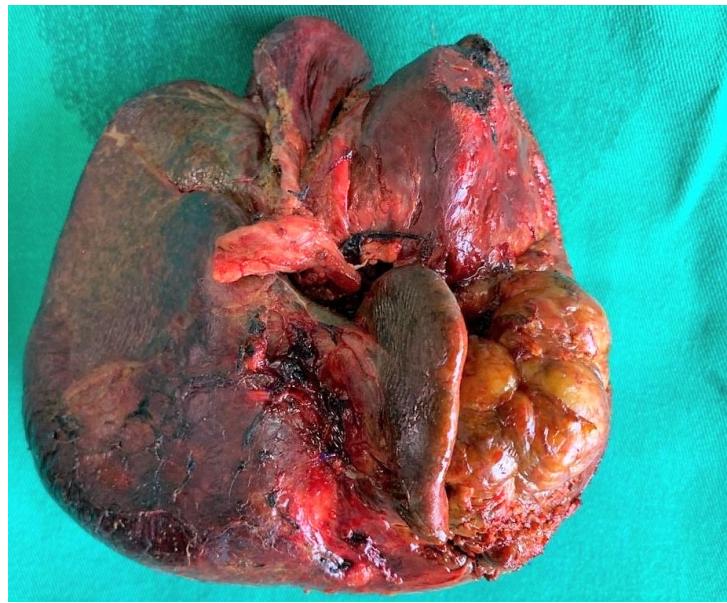
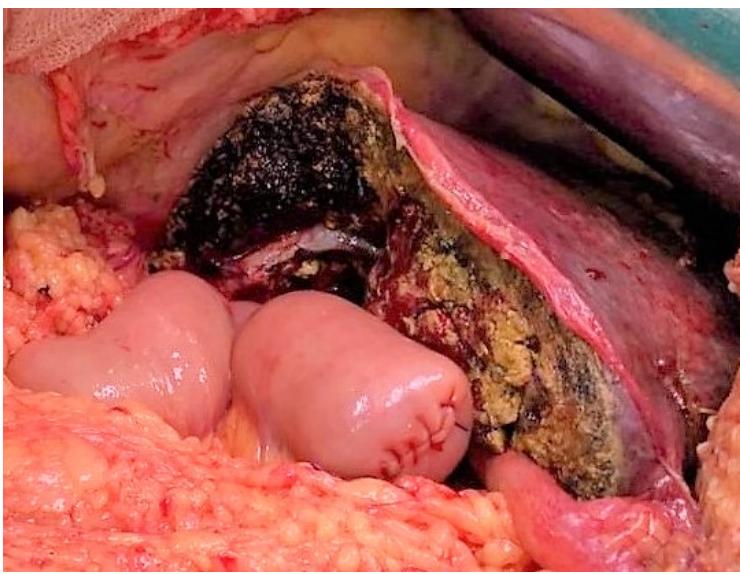
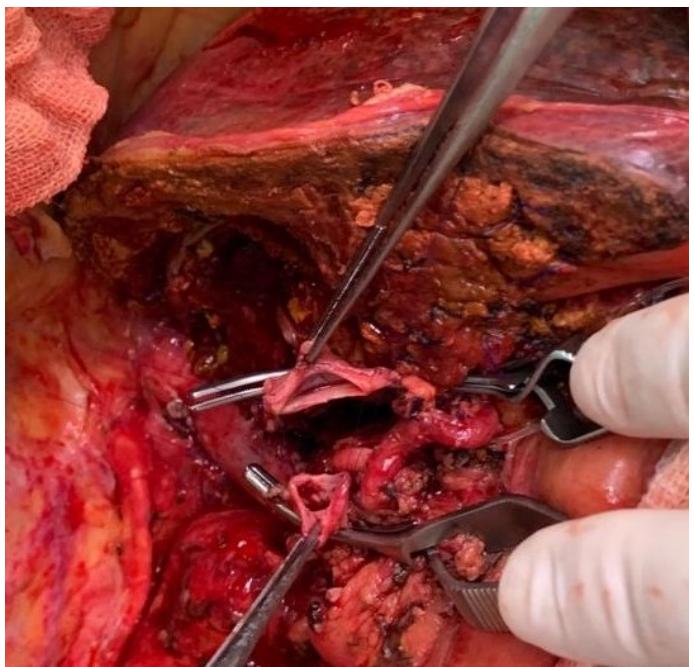
- Hilar (12h)
- Pericholedochal (12b and 12c)
- Peripancreatic (13a)
- Periportal (12p)
- Common hepatic artery (8a and 8p)
- Periaortic
  - 2-3 nodes for nodal staging
  - Node dissection has no impact on survival



## PORTAL VEIN INVOLVEMENT

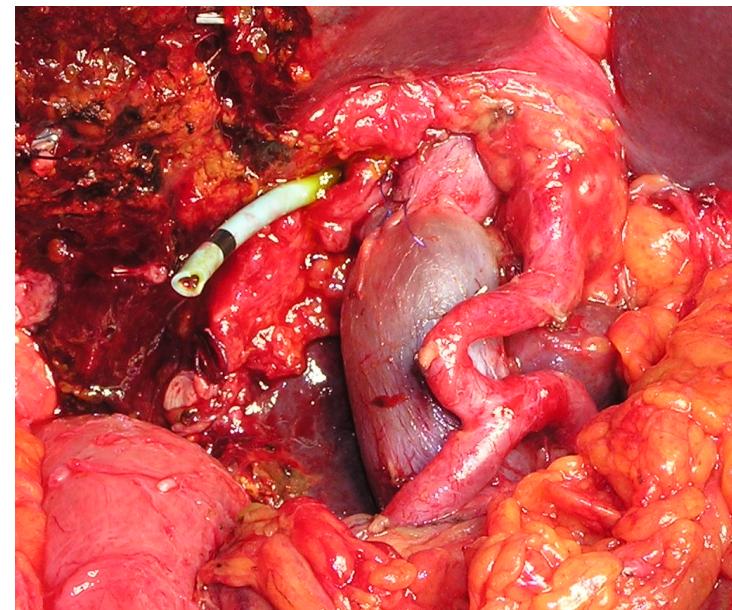
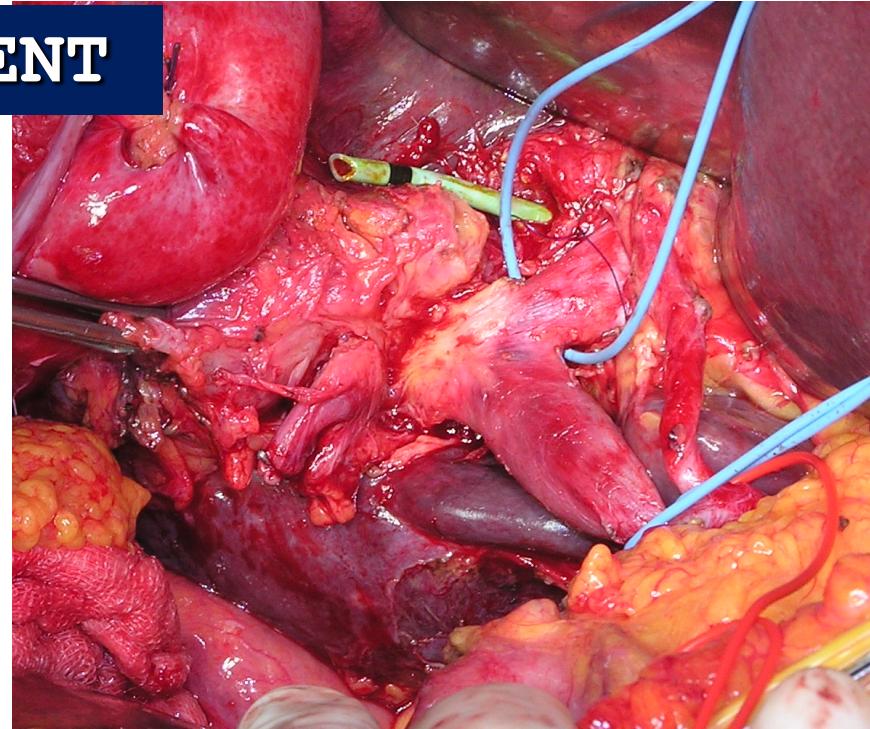
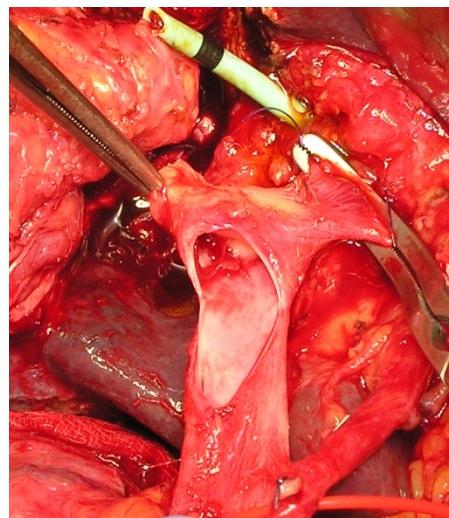
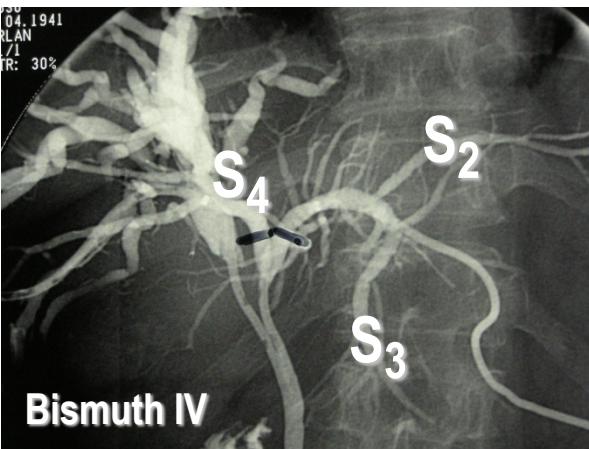
- Right hepatectomy and portal vein resection





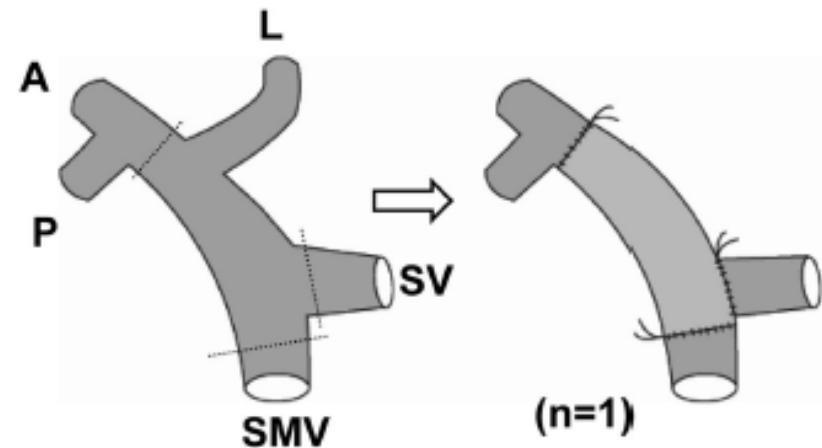
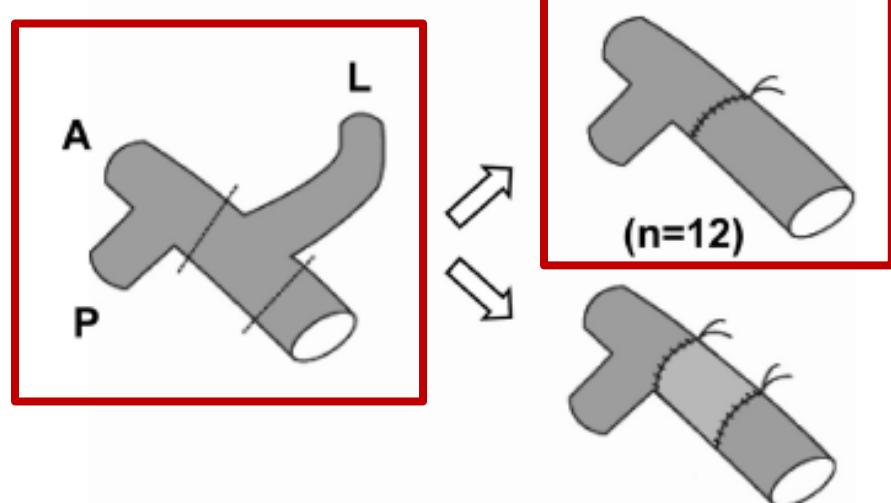
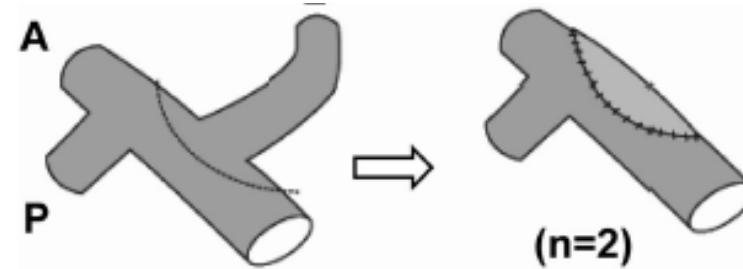
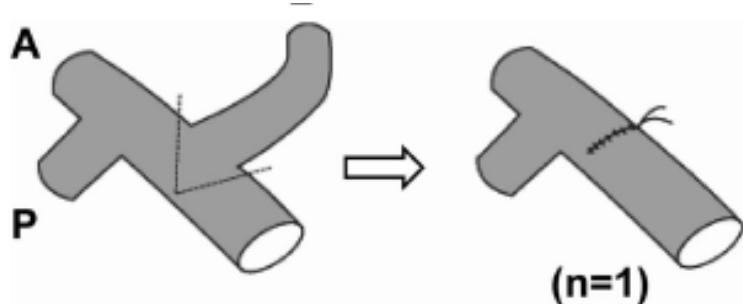
# PORTAL VEIN INVOLVEMENT

- Right hepatectomy
- Portal vein resection



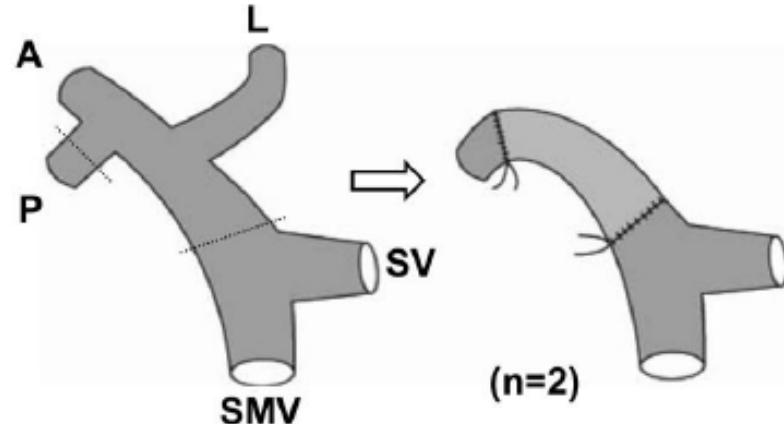
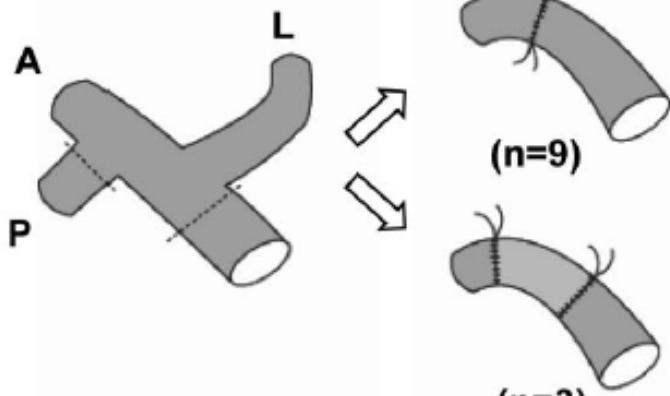
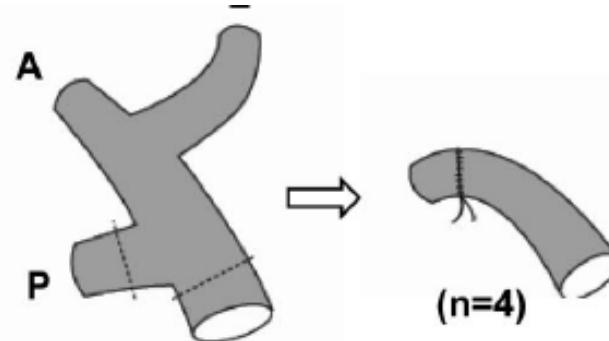
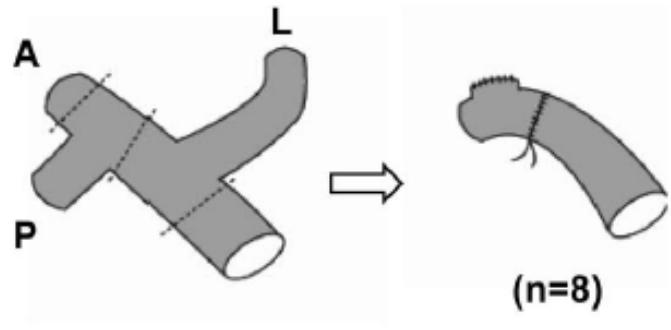
# PORTAL VEIN INVOLVEMENT

## □ Left hepatectomy and portal vein resection



# PORTAL VEIN INVOLVEMENT

## □ Left trisectionectomy and portal vein resection



# HILAR CHOLANGIOPANCREATOLOGY

- Liver transplant
- ALPPS
- Chemotherapy



# Lençóis Maranhenses



Thanks !



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INTERNATIONAL SOCIETY OF  
LIVER SURGEONS



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