



# To drain or not to drain

- Implications for liver surgery -

M. Schmeding

1st Maastricht EAHPBA Postgraduate HPB Course  
2/3 June 2016

**Nothing to disclose**

# Overview

- Preoperative biliary drainage: yes or no ? + how ?
- Postoperative biliary drainage
- Complications in liver surgery
- Which problem may be solved by drainage ?
- What type of drainage ?
- How long ?
- Guidelines / Literature / Limitations



„The more imperfect the technique of  
the surgeon the greater the  
necessity for drainage. No drainage  
at all is better than the ignorant  
employment of it“

William Halsted, 1898

- Preoperative routine biliary drainage: Negative impact on survival  
Barauskas et al. Dig Surg. 2016 May
- Severe jaundice reduces long-term survival after PPPD  
Sauvanet et al. J. Am. Coll. Surg. 2015 August
- Increased risk of surgical site infection for patients with stent  
Gavazzi et al. BMC Gastroent. 2016 March
- Preoperative metal vs. plastic stent: no difference  
Song et al. Gastrointest. Endosc. 2016 April
- Large multi-centre trial: Nasobiliary catheter > plastic stent, considerable dysfunction rates (18 vs. 35 %) Sasahira et al. World J Gastroenter. 2016 April
- Preoperative PTCD: increased postoperative major morbidity  
Kishi et al. Langenbecks Arch. 2016 April
- Future liver remnant volume > 50%: No drainage necessary !  
Wiggers et al. J. Am. Coll. Surg. 2016 April
- Preoperative cholangitis + FLR < 30% increase postoperative mortality.  
Ribero et al. J. Am. Coll. Surg. 2016 April

# **Preoperative biliary drainage**

**Expert consensus statement:**

**PTCD is best practise for preoperative drainage in hilar  
cholangiocarcinoma.**

Mansour JC1, Aloia TA2, Crane CH3, Heimbach JK4, Nagino M5,  
Vauthey JN2.

HPB (Oxford). 2015 Aug

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

Ahmer Hameed<sup>1,3</sup>, Tony Pang<sup>1,3</sup>, Judy Chiou<sup>2</sup>, Henry Pleass<sup>1,3</sup>, Vincent Lam<sup>1,3</sup>, Michael Hollands<sup>1,3</sup>, Emma Johnston<sup>1</sup>, Arthur Richardson<sup>1,3</sup> & Lawrence Yuen<sup>1,3</sup>

<sup>1</sup>Department of Surgery, Westmead Hospital, <sup>2</sup>Department of Medicine, Westmead Hospital, Sydney, and <sup>3</sup>Discipline of Surgery, University of Sydney, Australia

**Table 2** Drainage parameters by type of PBD

	HCCA by Bismuth classification, n <sup>a</sup>	Number of drainage catheter(s) required, mean (± SD) <sup>a</sup>	Period of drainage (days), median (range) <sup>a</sup>	Drainage of remnant (cf. bilateral), n (%), range <sup>a</sup>	Conversion rate(s) of PBD procedure(s), n (%) <sup>a</sup>	% Decrease in Br pre- and post-PBD, mean (± SD)
<b>EBD</b>	I – 48	1.2 ± 0.3	19 (12–105) <sup>e</sup>	431 (95; 65–100) <sup>f</sup>	113 (24) <sup>b</sup>	83 ± 6 <sup>d</sup>
	II – 87					
	III – 139					
	IV – 106					
<b>PTBD</b>	I – 9	1.5 ± 0.5	15 (11–77) <sup>e</sup>	129 (94; 73–100) <sup>f</sup>	2 (1) <sup>c</sup>	62 ± 23 <sup>d</sup>
	II – 41					
	III – 77					
	IV – 62					

**Table 3** Post-procedure complications and post-operative results by type of PBD<sup>a</sup>

	EBD, total (%)	PTBD, total (%)	Studies explicitly reported in, n
<b>Post-procedure complications</b>			
Cholangitis	153/557 (27)	51/380 (13)	6 (EBD); 7 (PTBD)
Pancreatitis	51/562 (9)	3/42 (7)	7 (EBD); 1 (PTBD)
Catheter dislocation/dislodgment	21/90 (23)	7/156 (4)	1 (EBD); 3 (PTBD)
Haemobilia/Bleeding	1/87 (1)	14/277 (5)	1 (EBD); 6 (PTBD)
Portal vein injury and/or thrombosis	–	15/248 (6)	3 (PTBD)
Retroperitoneal or duodenal perforation	4/257 (2)	–	3 (EBD)
Cancer seeding (tract)	–	10/248 (4) <sup>b</sup>	3 (PTBD)
Failure to proceed to surgery	27/164 (16)	9/72 (13)	1 (EBD); 2 (PTBD) <sup>e</sup>
<b>Others</b>			
Biliary perforation/intra-peritoneal bile leak or peritonitis	2	1	2 (EBD); 1 (PTBD)
External bile leak	–	6	1 (PTBD)
AV shunt formation	–	2	1 (PTBD)
<b>Post-operative results</b>			
<b>Mortality<sup>c</sup></b>	6/281 (2)	23/416 (6)	
<b>Morbidity<sup>c</sup></b>			
Hepatic failure	22/194 (11)	56/432 (13)	
Sepsis/abscess/cholangitis	17/120 (14)	44/262 (17)	
Bile leak	NR	21/166 (13)	
Anastomotic leak	NR	25/205 (12)	
<b>Survival, %<sup>d</sup></b>			
1-year, median (range)	91 (89–92)	73 (67–90)	2 (EBD); 6 (PTBD)
5-year, median (range)	46 (41–51)	30 (11–60)	2 (EBD); 5 (PTBD)

# Preoperative biliary drainage

Large multi-centre study on hilar malignancy patients:  
(Farges et al. Br. J. of Surg. 2013)

- 366 patients, preoperative biliary drainage in 180
- No influence on mortality overall
- Higher mortality in left-sided hepatectomy with drainage
- Lower mortality in right-sided hepatectomy with drainage

???



# Preoperative biliary drainage

## What's the clinical practise?

Factors of influence:

- General patient condition, age
- Extent of liver resection / FLRV
- Endoscopic expertise
- Serum-Bilirubin: Cut-off at 10mg/dl ???

# Complications in HPB surgery

## Indications for abdominal drainage ?

- Postoperative haemorrhage
- Biliary leakage
- Liver failure
- Cholangitis
- Vascular complications (thrombosis / aneurysm / fistula...)

# Postoperative Haemorrhage

## PRO Drain

- Early detection
- „Wait + see“ vs. surgical revision
- No large intraabdominal haematoma
- Reduced secondary infection rate
- Rinse-out consolidated haematoma

## CONTRA Drain

- Increased risk of infection
- False diagnosis of biliary leakage
- Loss or rupture of drain
- Pain
- Cosmetics

# Postoperative biliary leakage

## PRO Drain

- Early detection
- „Wait + see“ vs. surgical revision
- No large intraabdominal bilioma
- Reduced secondary infection rate
- „Rinse-out and consolidate“ strategy

## CONTRA Drain

- Late diagnosis of biliary leakage
- Increased risk of bilioma
- Loss or rupture of drain
- Increased risk of infection
- Pain
- Cosmetics

# Postoperative liver failure

## PRO Drain

- Rule-out major haemorrhage
- Rule-out major biliary leakage
- Avoid massive biliary peritonitis and consecutive liver insufficiency

## CONTRA Drain

- No external infection
- No loss of bile acids (regeneration)
- Loss or rupture of drain
- Pain
- Cosmetics

# Cholangitis

**PRO** Drain

???

**CONTRA** Drain

- No external infection
- No loss of bile acids (regeneration)
- Loss or rupture of drain
- Pain
- Cosmetics

# Vascular complications

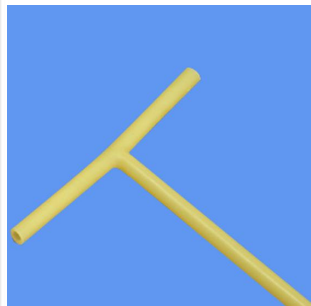
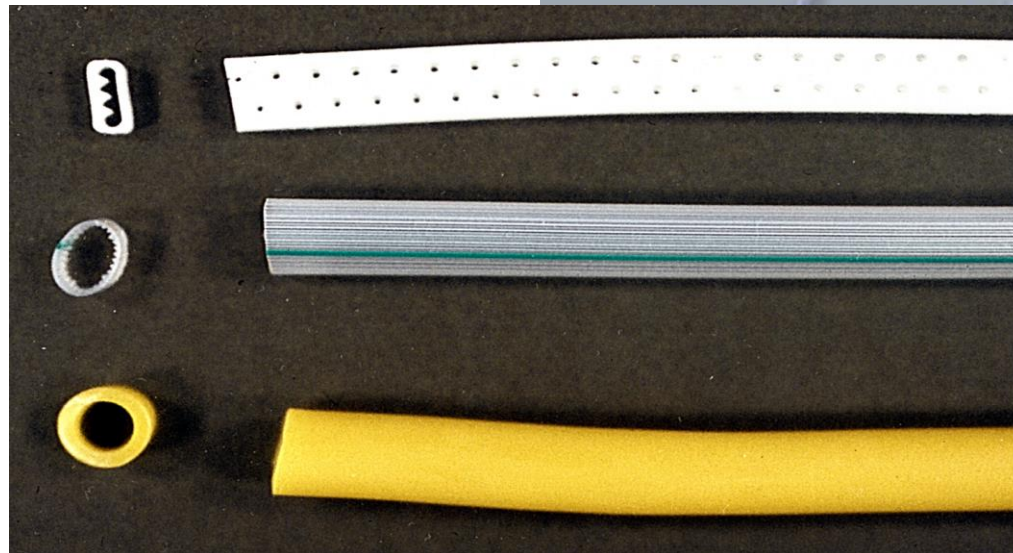
## PRO Drain

???

## CONTRA Drain

- No risk of drainage-induced vascular lesion
- No external infection
- No loss of bile acids (regeneration)
- Loss or rupture of drain
- Pain
- Cosmetics

# Types of drainage: abdominal





# Routine abdominal drainage for uncomplicated liver resection (Review)

Gurusamy KS, Samraj K, Davidson BR

*Cochrane Database Syst Rev. 2007*

No significant difference „no drainage“ vs. „drainage“

(mortality, intraabdominal fluid collection with secondary drainage, abscess, wound infection, hospital stay)



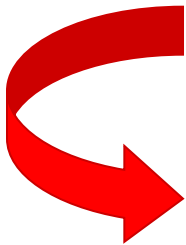
No use of prophylactic drainage in uncomplicated liver surgery !

# Abdominal Drainage After Hepatic Resection Is Contraindicated in Patients With Chronic Liver Diseases

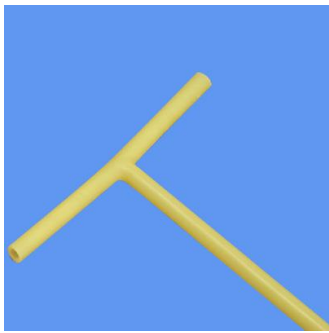
*Chi-Leung Liu, MS, FRCS (Edin), FACS,\* Sheung-Tat Fan, MS, MD, PhD, FRCS (Glasg & Edin), FACS,\*  
Chung-Mau Lo, MS, FRACS, FRCS (Edin), FACS,\* Yik Wong, MB, ChB, FRCR (UK),†*

*Liu et al. Ann Surg 2004*


- 104 patients with cirrhosis or hepatitis (52 vs. 52)
- Significantly more abscesses, postoperative haemorrhage, biliary leakage in the group with drainage
- Significantly longer hospital stay with drainage
- Drainage as independent risk factor for morbidity, stronger than resection volume and blood loss !



No use of prophylactic drainage in patients with chronic liver disease !

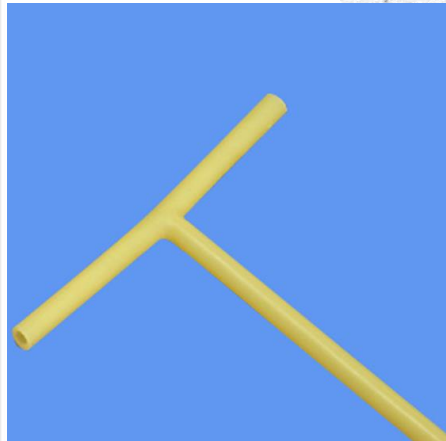
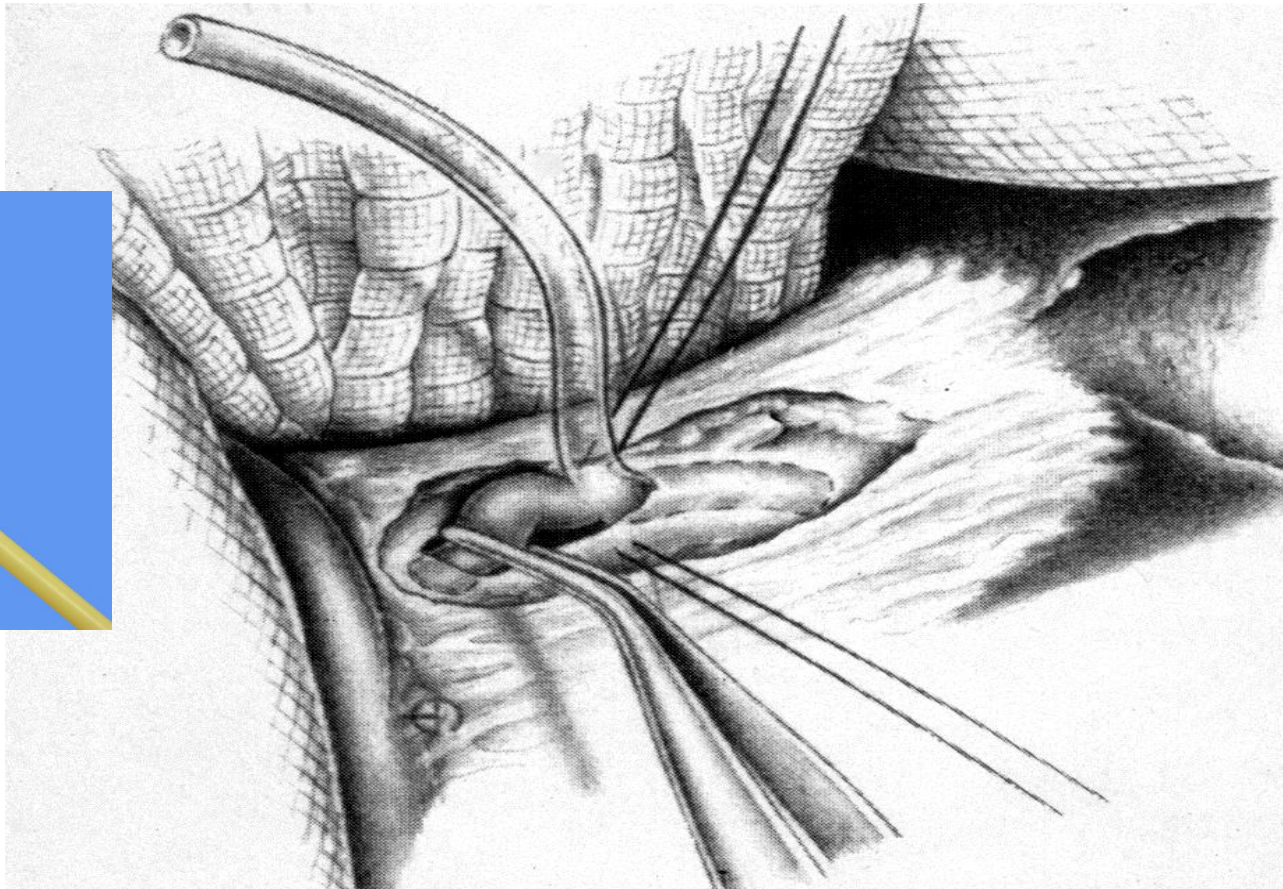


## Biliary drainage: Background

- After biliary tract lesion and surgical procedure: Pressure release in the biliary system desired:  T-tube / biliary drain („Roder“ / „Neuhaus“ /...)
- Radiologic control of biliary tract possible
- Problems:
  - Waiting time until tube removal 4-6 weeks in order to avoid biliary leakage of bile duct
  - morbidity of the procedure itself (bile duct injury)
- Improved data for DHC revision without T-tube
- Improved endoscopic management

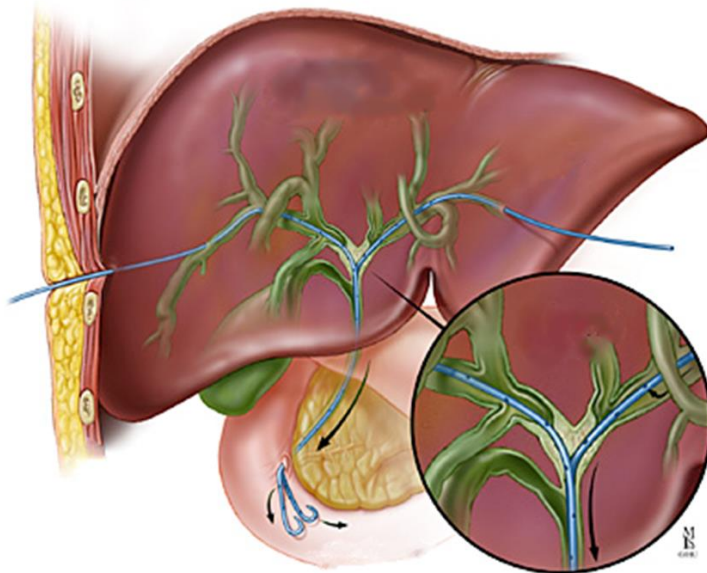
# Types of drainage: biliary

## T-tube

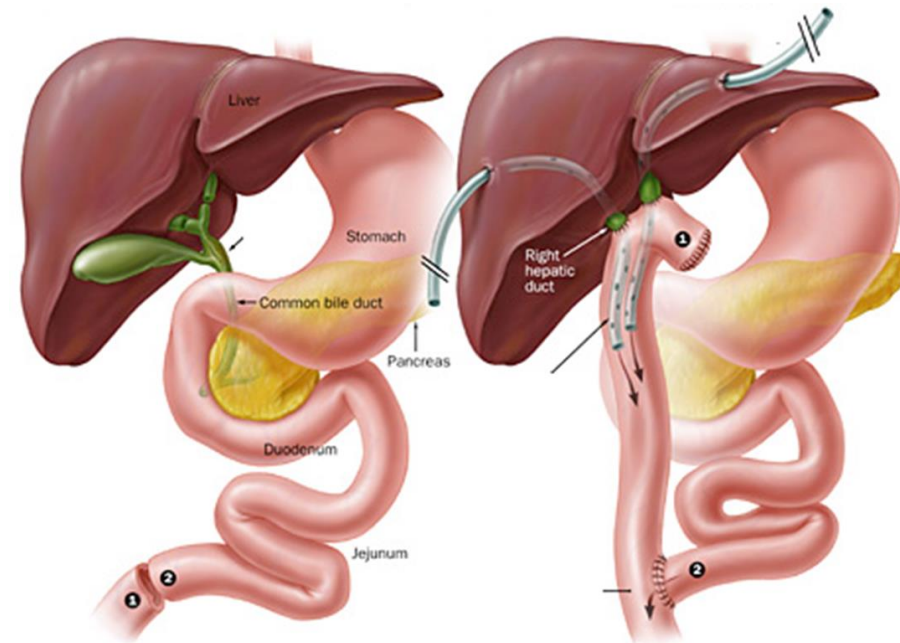


# Types of drainage: biliary

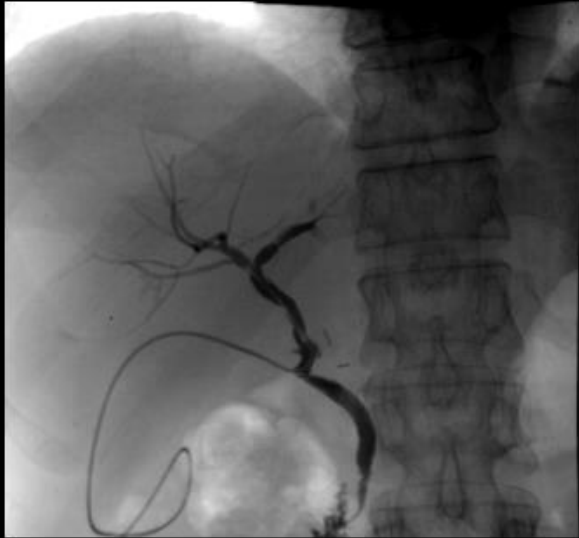
PTCD



transhepatic drain



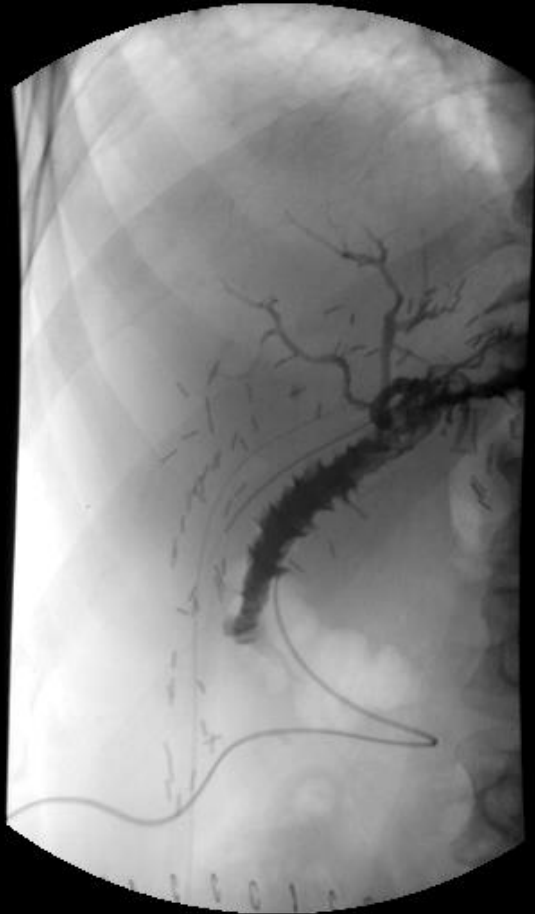




after LT



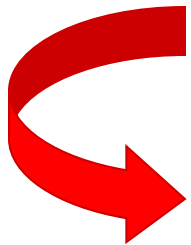
after right hepatic resection  
(papillary stenosis)



Roder-Drainage in BDA after extended resection  
left (segm. 1-4 + 5/8)                      right (segm.4-8 +1)

## Postoperative biliary drainage

- Serum bile acid levels positively influence liver regeneration after major hepatectomy (Otao et al. Br. J. Of Surg. 2012 Nov)
- Bile acid flux is required for normal liver regeneration (Naugler WE PLOS One 2014)
- No biliary drainage recommended for uncomplicated BDA (Suzuki et al. Hepatogastroent. 2014 June)
- Postoperative biliary drainage: No impact on biliary leakage (Olthof et al. HPB 2016)



No postoperative biliary drainage !!



# External biliary drainage following major liver resection for perihilar cholangiocarcinoma: impact on development of liver failure and biliary leakage

Pim B. Olthof, Robert J.S. Coelen, Jimme K. Wiggers, Marc G.H. Besselink, Olivier R.C. Busch & Thomas M. van Gulik

Department of Surgery, Academic Medical Center – University of Amsterdam, Amsterdam, The Netherlands

**Table 2** Postoperative complications and mortality in the drain and no-drain group

	Postoperative external bile drain ( <i>n</i> = 89) <i>n</i> (%)	No postoperative external bile drain ( <i>n</i> = 36)	<i>P</i> -value
Hospital stay, days, median (range)	15 (6–95)	12 (5–28)	0.002
Any complication, Clavien-Dindo Grade III+	47 (53%)	20	0.844
Biliary leakage	28 (32%)	13	0.616
Hemorrhage	9 (10%)	3	1.000
Infectious complications	42 (47%)	14	0.433
PHLF	26 (29%)	2	0.004
Relaparotomy	18 (20)	3	0.122
90-day mortality	17 (19%)	5	0.608

Biliary leakage, hemorrhage and PHLF defined according to the ISGLS criteria (grade B and C).

**Table 3** Univariate and multivariable analysis for risk factors of post-hepatectomy liver failure (ISGLS Grade B or C)

	Univariable analysis		Multivariable analysis	
	OR (95% CI)	<i>P</i> -value	OR (95% CI)	<i>P</i> -value
Age	1.01 (0.97–1.06)	0.561	1.03 (0.98–1.09)	0.224
Male gender	1.48 (0.59–3.69)	0.406	1.70 (0.54–5.34)	0.362
Jaundice at presentation	1.89 (0.59–6.02)	0.281	1.27 (0.31–5.22)	0.736
Preoperative bilirubin (μmol/L)	1.02 (0.99–1.05)	0.233	1.00 (0.96–1.04)	0.956
Postoperative external bile drain	7.02 (1.57–31.36)	0.011	10.07 (1.84–55.1)	0.008
Preoperative cholangitis	2.86 (1.21–6.81)	0.017	3.65 (1.16–11.48)	0.027
FLR volume (%)	3.92 (1.62–9.49)	0.002	0.01 (0.001–0.15–11.90)	0.009

# Bile duct revision

## SYSTEMATIC REVIEW AND META-ANALYSIS

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### Is the End of the T-Tube Drainage Era in Laparoscopic Choledochotomy for Common Bile Duct Stones Is Coming?

#### *A Systematic Review and Meta-Analysis*

*Zi Yin, MD,\* Kang Xu, MD, PhD,\* Jian Sun, MD,\* Jianlong Zhang, MD,\* Zhiyu Xiao, MD,\* Jie Wang, MD, PhD,\*  
Haitao Niu, MD,† Qiang Zhao, MD,‡ Shangxiong Lin, MD,§ and Yajie Li, MD\**

- 956 Pat. from 12 studies with laparoscopic bile duct revision for choledocholithiasis
- Significantly reduced biliary complication rate without T-tube
- Without T-tube surgical procedure time reduced by 19 min.; hospital stay reduced by 3 days.

# Bile duct revision

- Current meta-analysis: Primary suture of DHC without T-tube is safe and more effective than with T-tube  
(*Wu et al. Langenbecks Arch Surg* 2012)
- 295 Patients
- No differences concerning postoperative biliary leakage or „biliary complication“
- Reduced perioperative morbidity, shorter surgical procedure, less operative revisions, shorter hospital stay without T-tube

## T-tube drainage versus primary closure after laparoscopic common bile duct exploration (Review)

Gurusamy KS, Koti R, Davidson BR

2013



- 3 randomised studies / 295 patients
- No differences in morbidity
- No advantages for use of T-tube detectable
- Significantly longer surgical procedure and hospital stay with T-tube, back to work 8 days later than without T-tube
- Quality of life not investigated

# T-Drain vs. Endoscopic Stent

- Randomised study: T- tube vs. stent after laparoscopic DHC revision  
(Mangla et al. *Surg Laparosc Endosc Percutan Tech.* 2012)
- Small sample: 31 vs. 29 patients with laparoscopic choledochotomy for bile duct stones.
- Patients with stent: significantly shorter hospital stay and earlier back to „normal activity“.
- Morbidity equal

# T- tube for liver transplantation

## Biliary Reconstruction Using a Side-to-Side Choledochocholedochostomy With or Without T-Tube in Deceased Donor Liver Transplantation

### *A Prospective Randomized Trial*

*Sascha Weiss, MD, Sven-Ch Schmidt, MD, Frank Ulrich, MD, Andreas Pascher, MD, PhD,  
Guido Schumacher, MD, PhD, Martin Stockmann, MD, PhD, Gero Puhl, MD, PhD,  
Olaf Guckelberger, MD, PhD, Ulf P. Neumann, MD, PhD, Johann Pratschke, MD, PhD,  
and Peter Neuhaus, MD, PhD*

- 194 patients
- Significantly reduced overall complication rate for patients with T- tube, improved overall survival
- No differences concerning biliary leakage / BD stenosis
- No difference concerning cholangitis and necessity for endoscopic treatment
- Higher overall morbidity for patients without T- tube

Ann Surg 2009

## ORIGINAL ARTICLE

### Removable intraductal stenting in duct-to-duct biliary reconstruction in liver transplantation

Hadrien Tranchart,<sup>1,2</sup> Stéphane Zalinski,<sup>1,2</sup> Ailton Sepulveda,<sup>1,2</sup> Mircea Chirica,<sup>1,2</sup> Frederic Prat,<sup>3,4</sup> Olivier Soubrane<sup>1,4</sup> and Olivier Scatton<sup>1,2</sup>

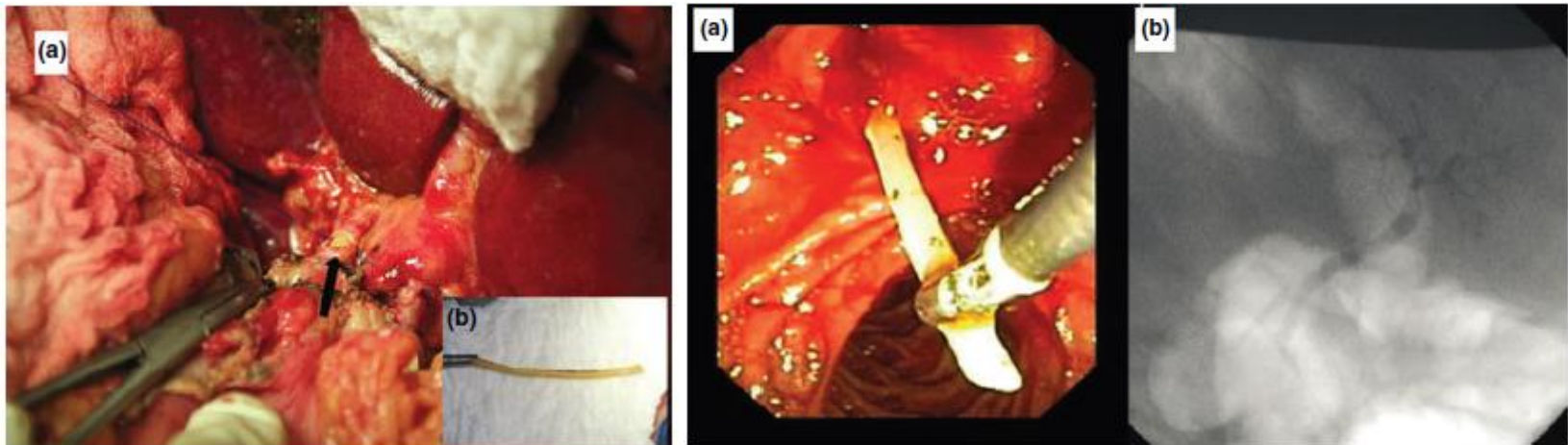
1 Department of Hepatobiliary Surgery and Liver Transplantation, Saint-Antoine Hospital, Assistance Publique – Hôpitaux de Paris, Paris Cedex, France

2 Université Pierre et Marie Curie, Paris, France

3 Department of Gastroenterology and Endoscopy, Cochin Hospital, Paris, France

4 Université Paris Descartes, Paris, France

2011



- End-to-end anastomosis with BD < 5mm diameter
- Endoscopic stent-removal 4-8 months after LT
- Low complication rate / small sample(20 pat.)

# T-tube or No T-tube in Cadaveric Orthotopic Liver Transplantation: The Eternal Dilemma

## *Results of a Prospective and Randomized Clinical Trial*

*Rafael López-Andújar, MD, PhD,\* Eva Montalvá Orón, MD, PhD,\* Andrés Frangi Carregnato, MD,\*  
Fabio Vergara Suárez, MD,\* Angel Moya Herraiz, MD, PhD,\* Fernando San Juan Rodríguez, MD,\*  
Juan José Vila Carbó, MD, PhD,\* Eugenia Pareja Ibars, MD, PhD,\* Javier Escrig Sos, MD, PhD,†  
Angel Rubín Suárez, MD,‡ Martín Prieto Castillo, MD, PhD,‡ José Mir Pallardó, MD, PhD,\*  
and Manuel De Juan Burgueño, MD, PhD\**

Ann Surg 2013

- 95 vs. 92 patients, prospectively randomised
- Overall complication rate: 22 %
- Less severe complications with T- tube than without
- Complications with T- tube earlier detectable
- Significantly less BD strictures with T- tube
- No differences concerning biliary leakage
- No differences in organ- and patient- survival



# T-Tube or No T-Tube in the Reconstruction of the Biliary Tract During Orthotopic Liver Transplantation: Systematic Review and Meta-Analysis

Carina Riediger,<sup>1\*</sup> Michael W. Müller,<sup>1\*</sup> Christoph W. Michalski,<sup>1</sup> Norbert Hüser,<sup>1</sup> Tibor Schuster,<sup>2</sup> Jörg Kleeff,<sup>1</sup> and Helmut Friess<sup>1</sup>

<sup>1</sup>Department of Surgery and <sup>2</sup>Institute of Medical Statistics and Epidemiology, Technische Universität München, Munich, Germany

Liver Transpl. 2010

- 15 retrospective studies + 6 prospective studies (5 randomised) included in this meta-analysis
- Conclusion: no clear picture; strategy very centre-dependent
- Overall less BD strictures when T-tube used
- Concerning the T- tube associated morbidity very heterogeneous picture

## Orthotopic Liver Transplantation: T-Tube or Not T-Tube? Systematic Review and Meta-Analysis of Results

*Georgios C. Sotiropoulos,<sup>1,4</sup> George Sgourakis,<sup>1,2</sup> Arnold Radtke,<sup>1</sup> Ernesto P. Molmenti,<sup>3</sup>  
Konstantinos Goumas,<sup>2</sup> Sofia Mylona,<sup>2</sup> Ioannis Fouzas,<sup>2</sup> Constantine Karaliotas,<sup>2</sup> and Hauke Lang<sup>1</sup>*

- 1027 patients from 9 studies
- No differences concerning biliary leakage / surgical revision / endoscopic stent-implantation / re-transplantation
- Less cholangitis without T- tube
- Less anastomotic strictures with T- tube
- Tendency towards less „global biliary complications“ without T- tube



The authors recommend „no T- tube“.

# Anastomotic stability

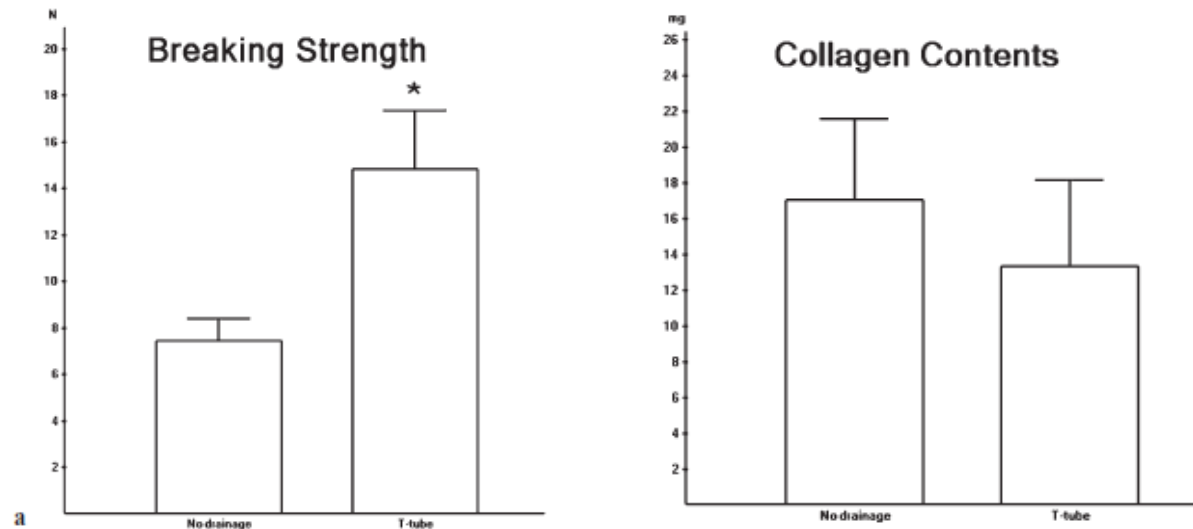
## T-tube drainage stimulates the healing of choledocho-choledochostomies. An experimental study in pigs



© Springer 2008

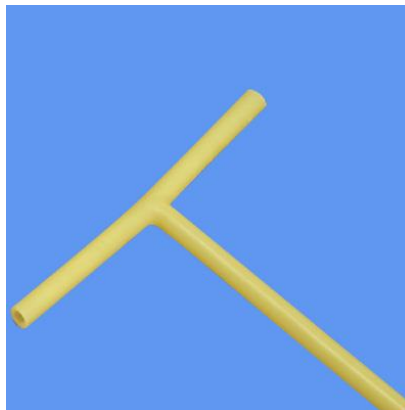
HENRIK BLEGVAD LAURSEN<sup>1</sup>, ANNE-SOFIE KANNERUP<sup>1</sup>, HANS OXLUND<sup>2</sup>, YOSHIKAZU YASUDA<sup>3</sup>, PETER FUNCH-JENSEN<sup>1</sup>, MOGENS ROKKJAER<sup>1</sup>, and FRANK VIBORG MORTENSEN<sup>1</sup>

- Experimental study with 20 pigs
- End-to-end choledocho-choledochostomy
- POD 6: resection of anastomosis + histological evaluation
- Significantly higher stability of the T- tube supported suture / identical collagen content



## T- tube: Quo vadis ?

- No routine employment of T- tube for BD revision
- No sufficient data concerning the setting of liver resection
- LT: no clear advantage / disadvantage : decision very centre-specific



## To drain or not to drain ???



# ESCAM

(European Surgical Center Aachen-Maastricht)



**UNIKLINIK**  
**RWTHAACHEN**

