Strategies to decrease bleeding and biliary fistula during and after liver resection

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Disclosure statement

- No financial relationships to disclose !

Liver

- Responsible for synthesis of coagulation and fibrinolyic factors
- Major blood vessels

- Synthesis of bile

- Per/post operative blood loss and biliary fistula are major causes of morbidity of liver surgery

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Facts: Blood loss

- Per & postoperative hemorrhage

  transfusion rate 5-20% / return to OR
  increased risk: in major resections
  in steatotic / chemo livers
  in cirrhotic livers
  in redo hepatectomies

Facts: biliary fistula

- Postoperative biliary fistula 1-15%
  - increased if resistance to bile flow
  - increased in non anatomical resection
  - increased in large resection plane

Preoperatively

- Good surgical planning and experience
- Good knowledge of liver anatomy
- Evaluation of the risks of postoperative liver dysfunction
- Patient preparation

Peroperatively

- Limitation of the blood loss
  - low venous pressure
  - hilar clamping (total/hemi)
- Laparotomy/laparoscopy
- Liver tissue section devices
  - CUSA/US/radiofrequency
- Control of the vessels and bile ducts
  - ligation/clips/endoGIA
- Coagulation devices
  - irrigated bipolar coagulation/argon beam

End of resection

- Manual compression of the resection plane with gauze (up to 15 min!)
- Therapeutic: Surgicel / Gelfoam / Tachosil
- Preventive: ?
  fibrin sealent ?
- Drain?

Liver surgery in Jehovah witnesses

- EPO
- Iron

- Liver transplantation:
  - spleen embolisation

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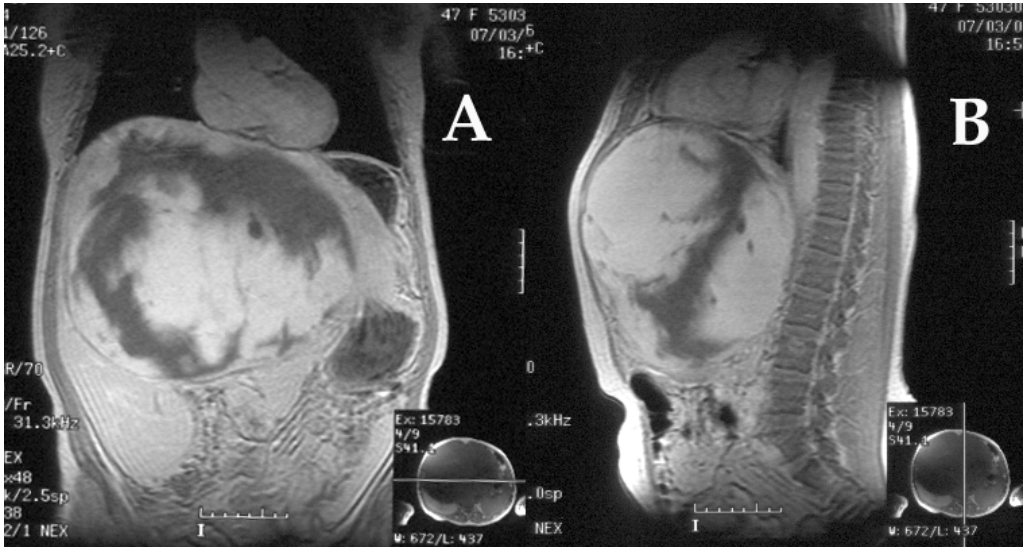

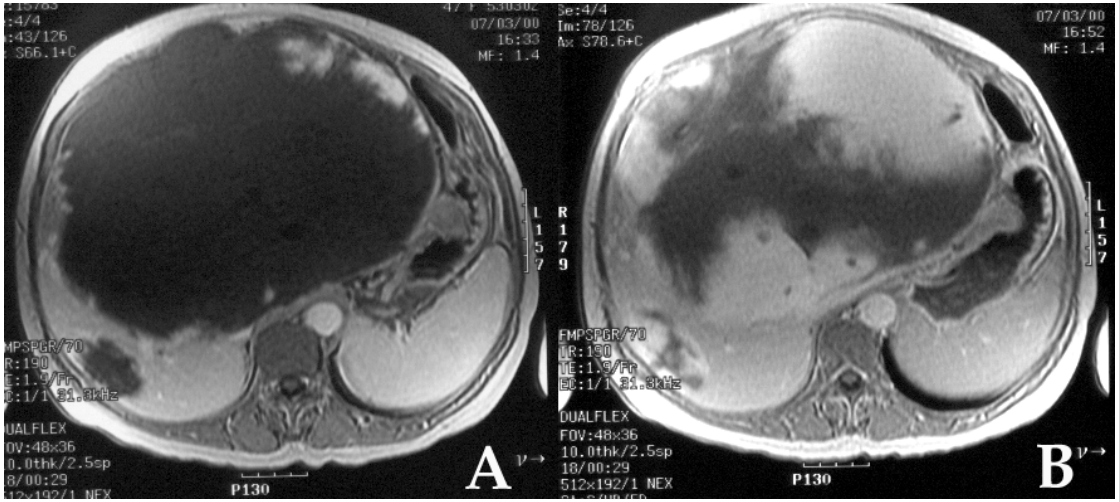

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Enucleation of a Giant Hepatic Hemangioma in a Jehovah's Witness

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Liver transplantation in a Jehovah's witness

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Liver transplantation in Jehovah's witnesses

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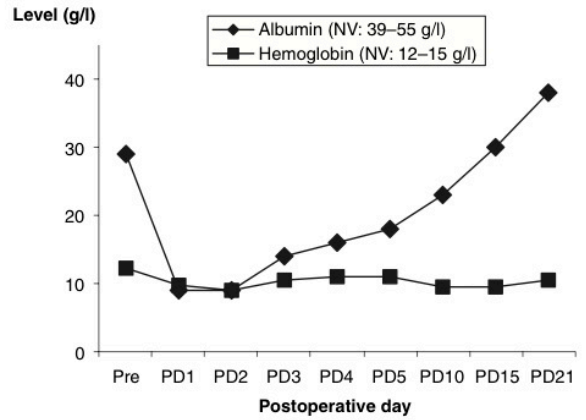

Figure 2 Evolution of albumin and haemoglobin levels in patient 3 (NV, normal values; PD, postoperative day).

Peroperatively

- Limitation of the blood loss
  - low venous pressure
  - hilar clamping (total/hemi)
- Laparotomy/laparoscopy
- Liver tissue section device
  - CUSA/US/radiofrequency
- Control of the vessels and bile ducts
  - ligation/clips/endoGIA
- Coagulation device
  - irrigated bipolar coagulation/argon beam

Risk Factors and Management of Bile Leakage after Hepatic Resection

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DOI: 10.1007/s00268-003-6907-x

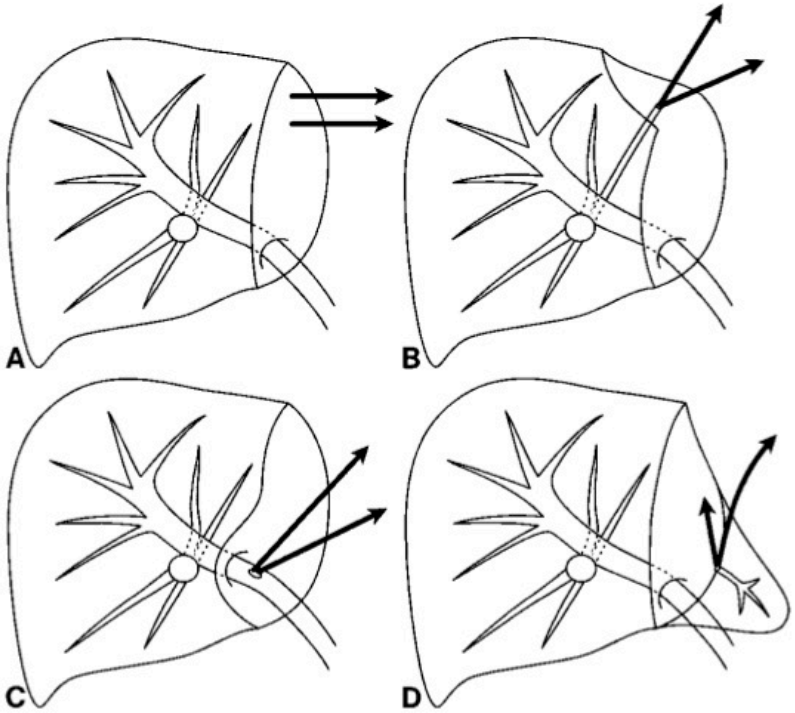

Fig. 1. Patients with postoperative bile leakage were classified into the following four groups: type A, minor leakage, with only a small amount of bile leakage; type B, major leakage due to insufficient closure of the bile duct stump; type C, major leakage due to injury of the bile duct; type D, major leakage due to division of the bile duct.

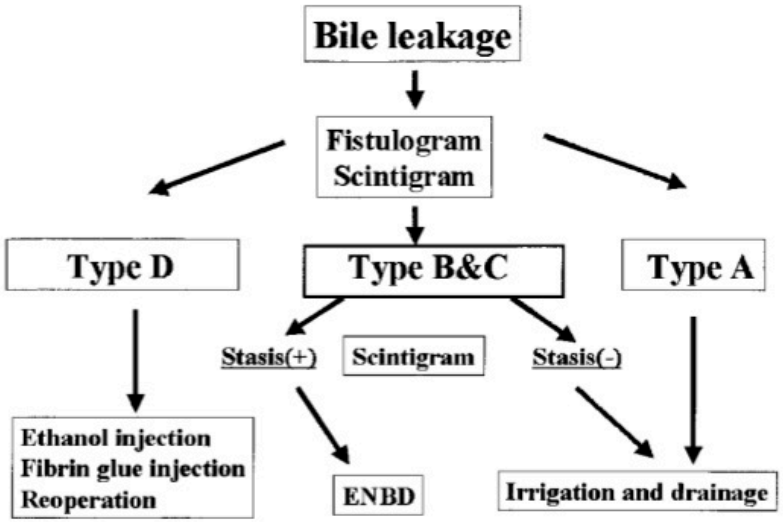

Fig. 2. Type A was controllable by drainage and irrigation alone. Types B and C had complications with major bile leakage. Almost all of these problems tended to be intractable, especially when biliary stasis was present. Endoscopic nasobiliary tube drainage (ENBD) was necessary for biliary drainage when biliary stasis is revealed on biliary scintigraphy. For type D patients ethanol or fibrin glue injection into the damaged bile duct of the segregated segment and reoperation are ideal.

Management of excluded segmental bile duct leakage following liver resection

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HPB 2009, 11, 364–369

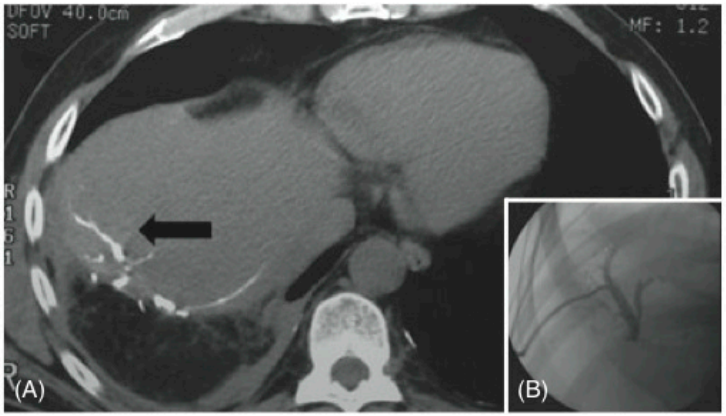

Figure 2 (A) Plain computed tomography performed after percutaneous cholangiography shows a communicating biliary fistula adjacent to the resected surface of the liver (black arrow). (B) Percutaneous cholangiography demonstrating no communication between a dilated intrahepatic bile duct and the principal bile duct

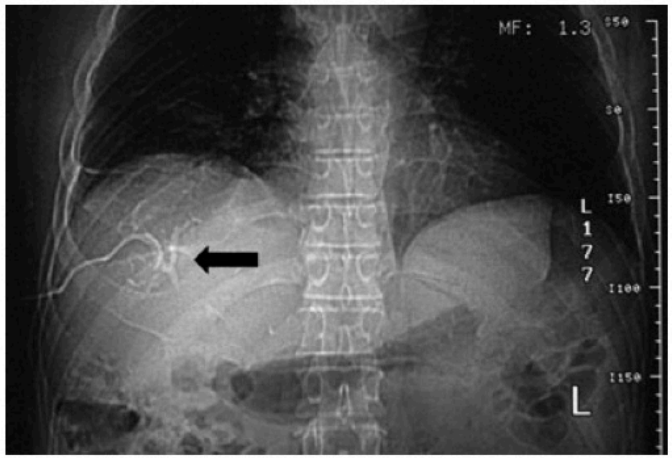

Figure 3 Demonstration of the right anterior branch of the biliary system by fistulography. A distal injury to the bile duct was responsible for the non-communicant biliary fistula. The bile duct which was ligated proximally during the initial hepatectomy was mistakenly preserved as part of the anterior segment of the right liver

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End of resection

- Manual compression of the resection plane with gauze (up to 15 min!)
- Therapeutic Surgicel/Gelfoam/Tachosil
- Preventive
  fibrin sealent ?
- Cholangiography contrast/methylene blue/air
- Drain?

Fibrin Sealant for Prevention of Resection Surface-Related Complications After Liver Resection

A Randomized Controlled Trial

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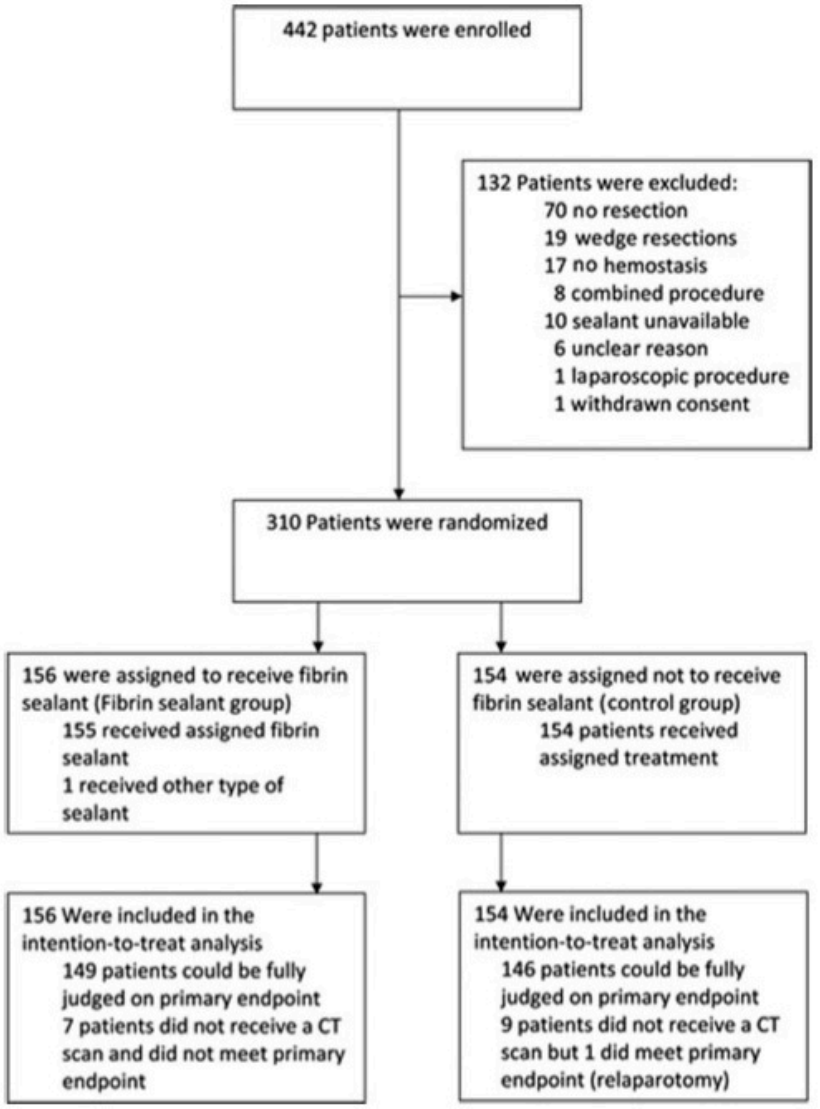

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TABLE 2. Characteristics of Postoperative Resection Surface-Related Complications, According to Study Group

Variable	Fibrin Sealant (n = 156)	Control (n = 154)	*P*
Composite endpoint bile leakage, abscess *or* bleeding at resection surface, n (%)	38 (24)	37 (24)	1.00
Bile leakage*	22 (14)	21 (14)	1.00
Grade 1§	8	15	—
Grade 3	12	6	—
Grade 4	1	0	—
Grade 5	1	0	—
Abscess†	10 (6)	12 (8)	0.67
Grade 3	9	10	—
Grade 4	0	1	—
Grade 5	1	1	—
Bleeding‡	18 (11)	11 (7)	0.24
Grade 2	15	10	—
Grade 3	3	1	—
Any reintervention for resection surface related complications, n (%)	19 (12)	15 (10)	0.59
Surgical reintervention	4 (3)	1 (1)	0.37
Radiological reintervention	13 (8)	13 (8)	1.00
Endoscopic reintervention	9 (6)	4 (3)	0.26
Protocol postoperative CT scan, n (%)			
Fluid collection at resection surface >100 mL	41 (28)	38 (26)	0.90
Composite endpoint bile leakage, abscess, bleeding *or* reintervention *or fluid* collection at resection surface >100 mL on CT scan, n (%)	65 (44)	58 (40)	0.56

TABLE 4. Characteristics of Postoperative General Complications, According to the Study Group

Variable	Fibrin Sealant (n = 156)	Control (n = 154)	*P*
Overall postoperative complications according to Clavien-Dindo—highest grade per patient, n (%)*	—	—	0.14
No complications	74 (47)	65 (42)	—
Grade 1	8 (5)	16 (10)	—
Grade 2	40 (26)	49 (32)	—
Grade 3	22 (14)	17 (11)	—
Grade 4	6 (4)	6 (4)	—
Grade 5	6 (4)	1 (1)	—
Specific general complications, n (%)			
Postoperative transfusion	26 (17)	22 (14)	0.64
Pleural effusion (>250 mL on CT volumetry)	30 (20)	40 (28)	0.17
Pneumonia	12 (8)	8 (5)	0.49
Urinary tract infection	10 (6)	12 (8)	0.67
Wound infection	13 (8)	10 (7)	0.67
Ascites infection	3 (2)	5 (3)	0.50
Liver insufficiency	9 (6)	4 (3)	0.26
Renal insufficiency	4 (3)	5 (3)	0.75
Pulmonary embolism	0 (0)	5 (3)	0.03
Deep venous thrombosis	0 (0)	1 (1)	0.50
Portal vein thrombosis	1 (1)	1 (1)	1.00
Cerebrovascular accident	1 (1)	1 (1)	1.00
Myocardial infarction	0 (0)	1 (1)	0.50
Mortality, n (%)			
In-hospital mortality	5 (3.2)	1 (0.6)	0.21
30-d mortality	6 (3.8)	1 (0.6)	0.12
Intraoperative mortality	0	0	—

*Grading complications according to Clavien-Dindo classificatio[22,23]

TABLE 3. Drain Fluid Analysis, According to the Study Group

Variable	Fibrin Sealant (n = 106)	Control (n = 106)	*P*
Mean drain volume at day 1 to 3, median (interquartile range), mL/day	105 (50–275)	138 (38–274)	0.96
Hemoglobin at day 1, median (interquartile range), mmol/L*	0.4 (0.2–0.5)	0.4 (0.2–1.1)	0.10
Bilirubin at day 1, median (interquartile range), μmol/L	15 (12–22))	24 (14–53)	0.01
Duration drainage, median (interquartile range), d	5 (3–9)	6 (3–8)	0.58

*To convert values for hemoglobin to g/dL, multiply by 1.650. To convert values for bilirubin to mg/dL, divide by 88.4.

ity of patients undergoing liver resection.[19,21] In the United States, more than 14,000 liver resections for colorectal liver metastases are performed annually.[25–27] On the basis of the average costs per application of fibrin sealant of $400 and the assumption that, similar to Japan and The Netherlands, fibrin sealants are used in 80% of the cases, the estimated annual costs for fibrin sealants in liver surgery in the United States are $4.5 million. Abrogation of the routine use of

Fibrinolytic Proteins in Human Bile Accelerate Lysis of Plasma Clots and Induce Breakdown of Fibrin Sealants

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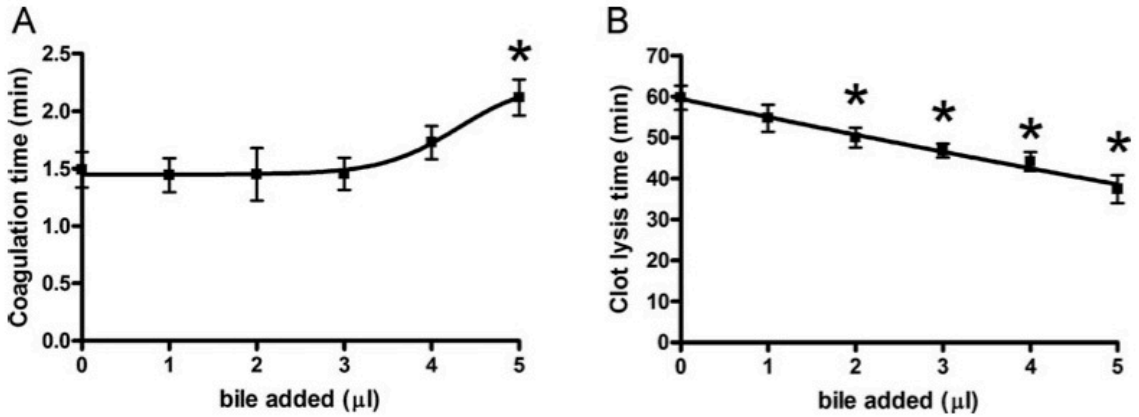

FIGURE 1. Bile has anticoagulant and profibrinolytic properties in a plasma environment. Human bile was added in increasing volumes to pooled normal plasma (50 μL), and a mixture of tissue factor, phospholipid vesicles, calcium chloride, and tPA. The total reaction volume was kept constant at 100 μL. Clot formation and subsequent lysis were followed in time by repeated turbidity measurements at 405 nm. Clotting times (panel A) and clot lysis times (panel B) were calculated from the turbidity curves and plotted against the bile volume added. Indicated are means ± standard deviations of 4 independent experiments using a single batch of human bile obtained from gallbladders from patients undergoing cholecystectomy. Bile isolated from the gallbladder of 2 additional patients yielded comparable results as did intrahepatic bile isolated from the hepatic duct of 3 patients during a pylorus-preserving pancreaticoduodenectomy (not shown). *indicates $P < 0.01$ compared to 0 μL of bile added.

Thanks!

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