Mahidol University
Faculty of Medicine Ramathibodi Hospital

HPB surgery complications

F Ativitch Asavachaisuvikom

Asst. Prof. Pongsatorn Tangtawee

HPB surgery unit, Faculty of Medicine, Ramathibodi hospital, Mahidol University

In this year...

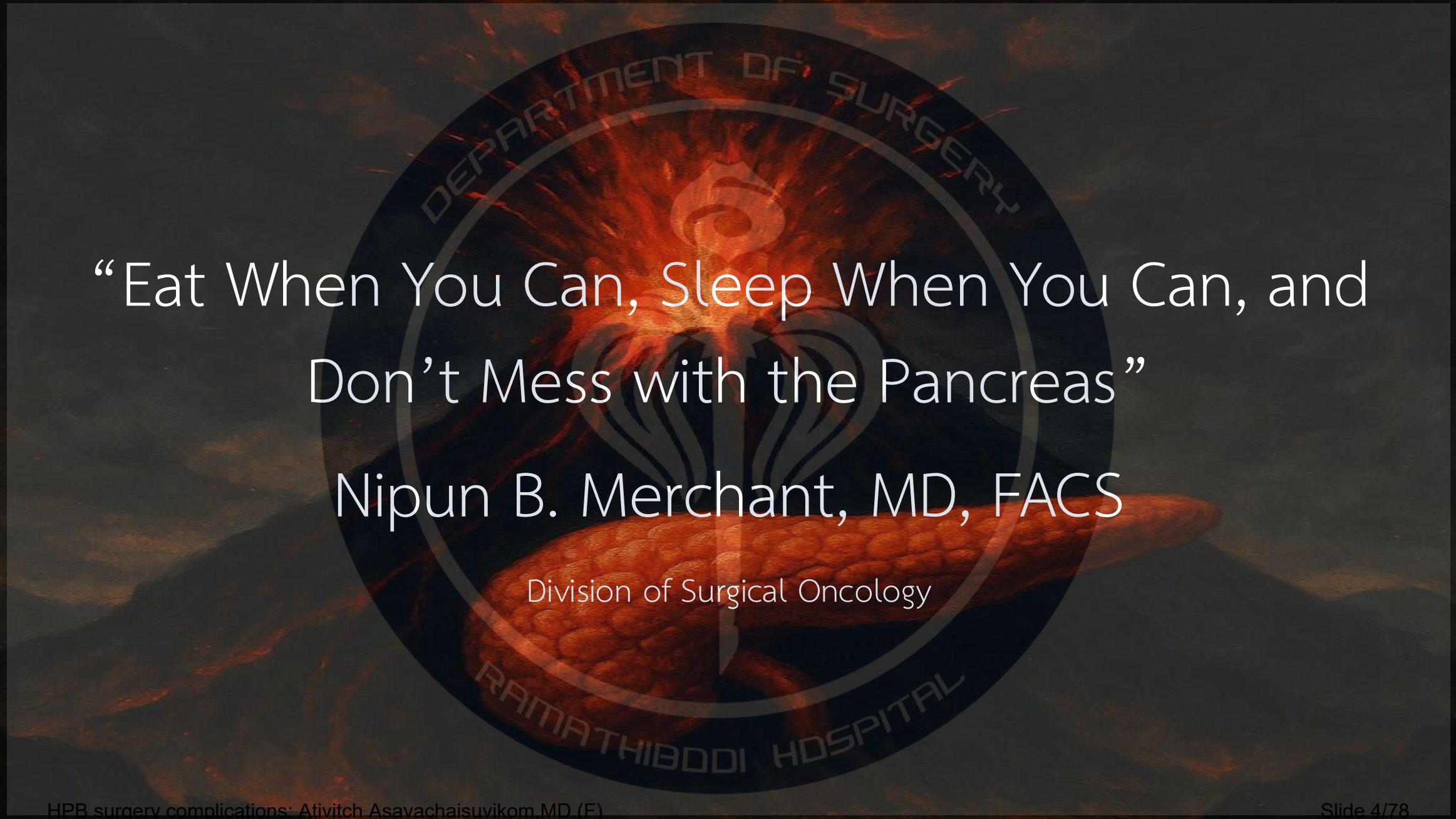

Mahidol University
Faculty of Medicine Ramathibodi Hospital
Post hepatectomy
liver failure
F Ativitch Asavachaisuvikom
HPB unit, Department of Surgery, Ramathibodi hospital


CBD injury
F Sukhum Kobdej
Advisor Dr Pongsatorn Tangtawee


Posthepatectomy Bile Leakage
F Sukhum Kobdej

Outline

- Postoperative pancreatectomy fistula(POPF)
- Postpancreatectomy hemorrhage(PPH)
- Delayed gastric emptying (DGE)
- Post-pancreatectomy acute pancreatitis(PPAP)
- Posthepatectomy hemorrhage



“Eat When You Can, Sleep When You Can, and Don’t Mess with the Pancreas”

Nipun B. Merchant, MD, FACS

Division of Surgical Oncology

Introduction

- Early series published in the late 1960s reported postoperative morbidity rates of 60% and mortality rates approaching 25%.
- Recent series from specialized surgical centers have reported mortality rates following PD to be less than 5%

Bassi C, Marchegiani G, Dervenis C et al., International Study Group on Pancreatic Surgery (ISGPS). The 2016 update of the International Study Group (ISGPS) definition and grading of postoperative pancreatic fistula: 11 Years After. Surgery. 2017 Mar;161(3):584-591

Postoperative pancreatic fistula(POPF)

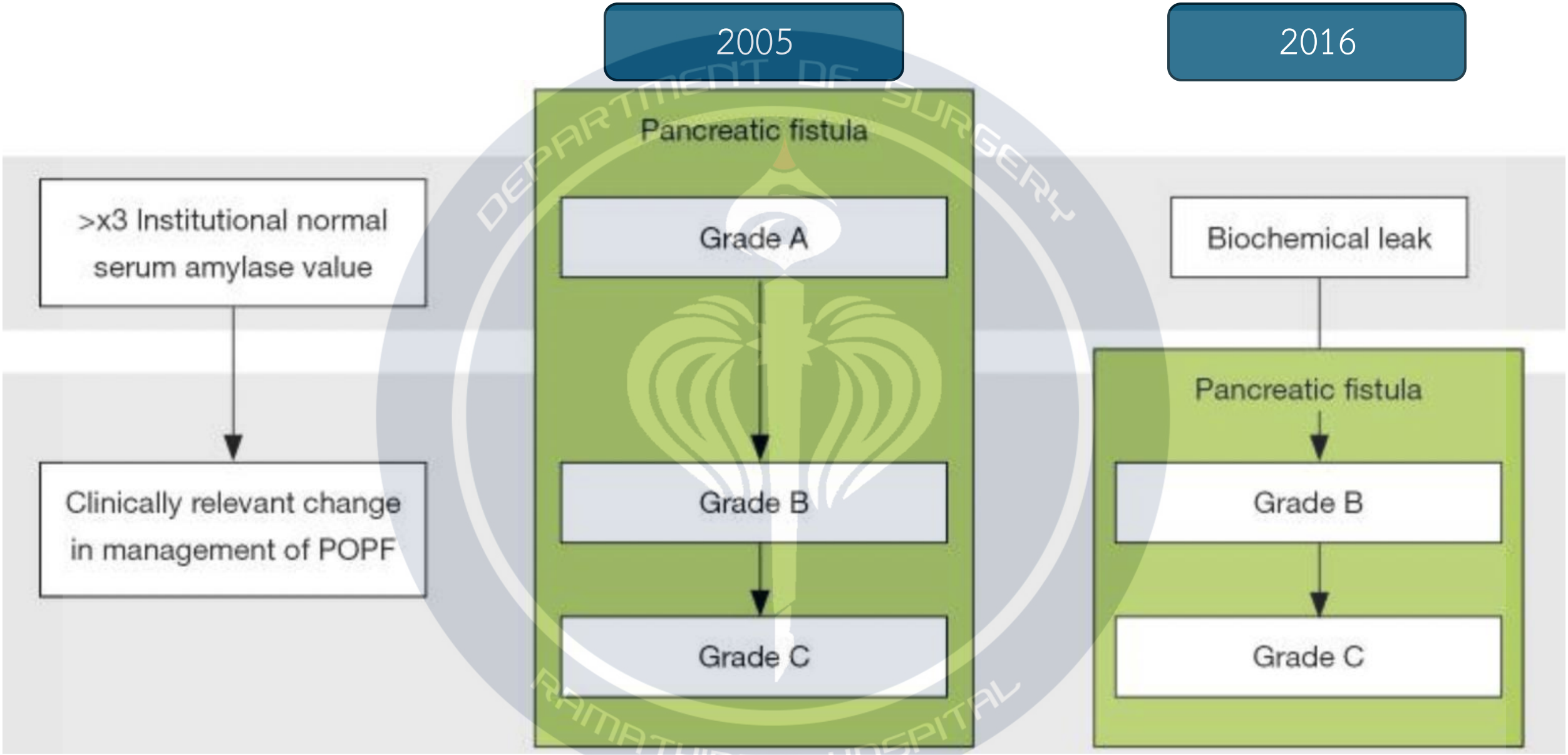
- Definition,

  "Pancreatic fistula remains an abnormal communication between the pancreatic ductal "system" and another epithelial surface containing pancreas-derived, enzyme-rich fluid"

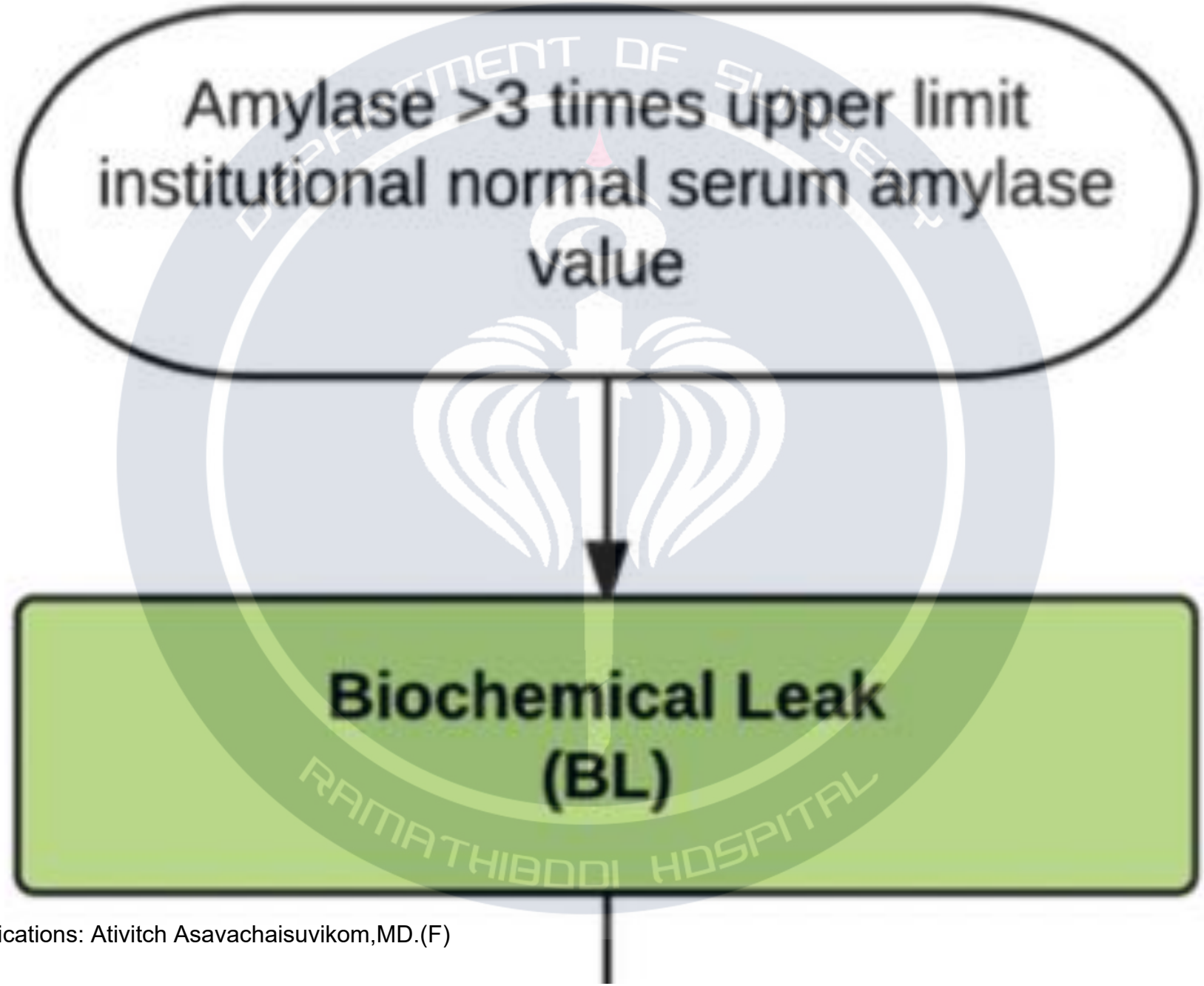
- For the diagnosis,

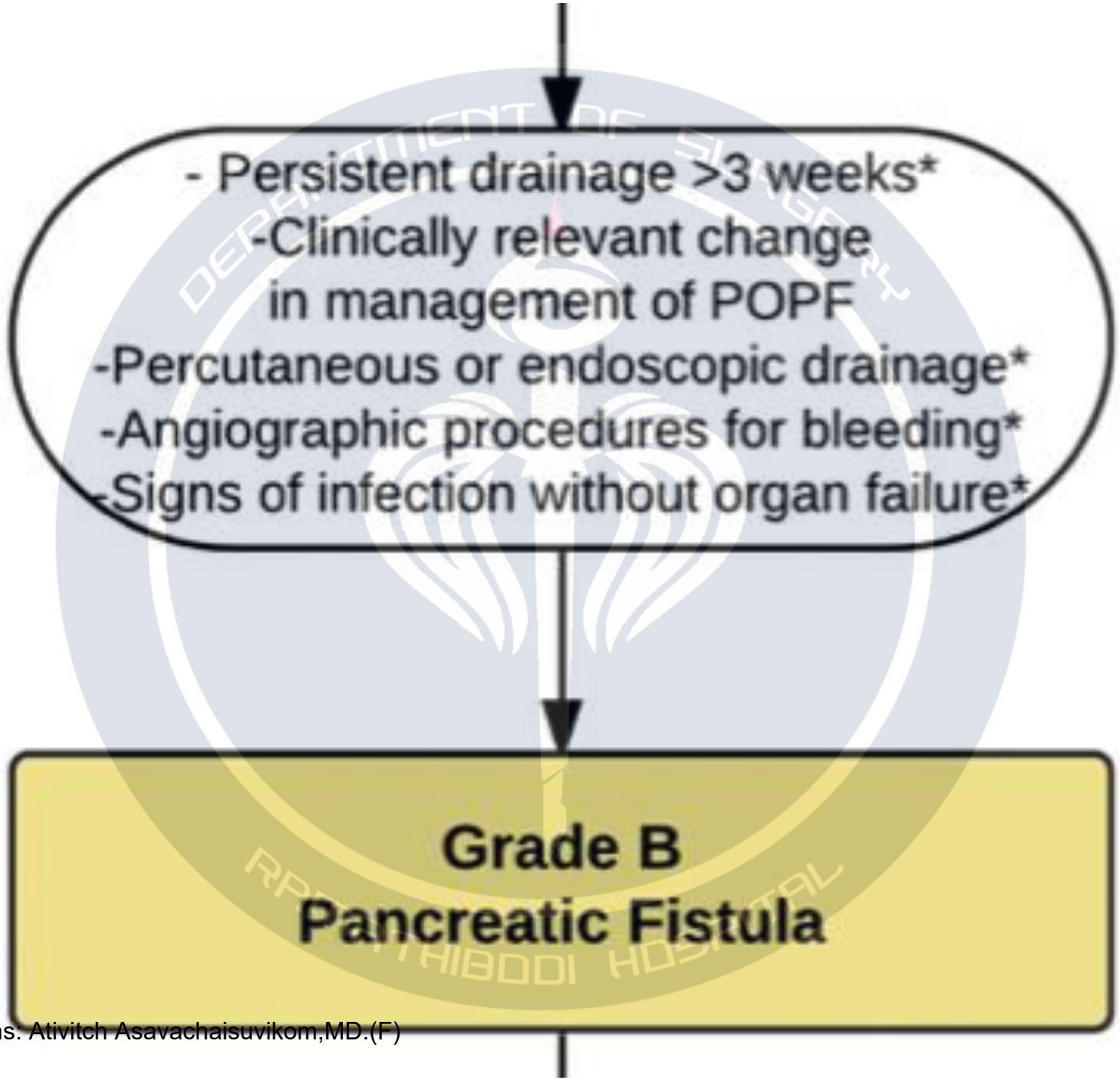
  "any measurable volume of drain fluid on/after POD 3 with amylase level >3 times UNL"

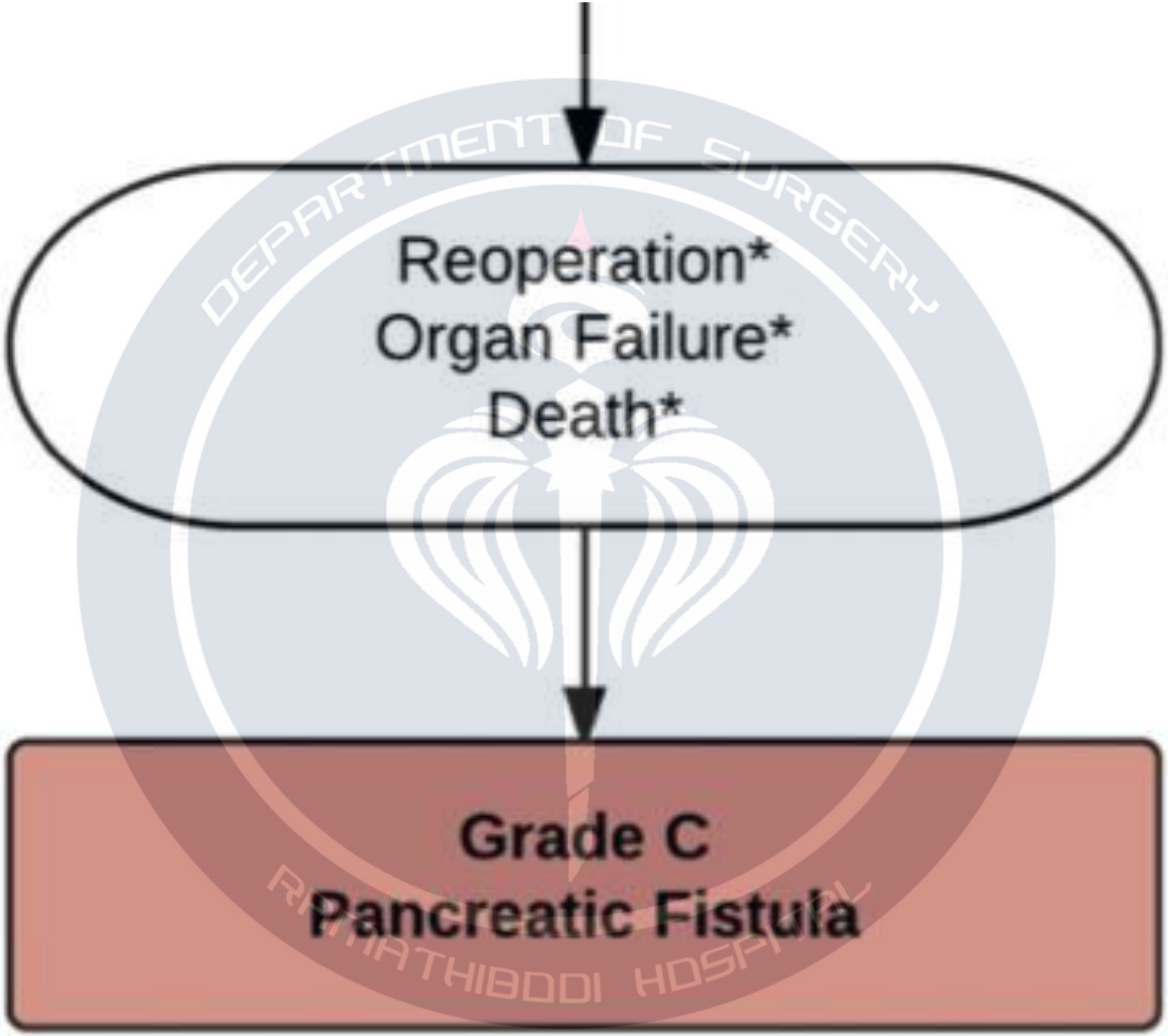
Bassi C, Marchegiani G, Dervenis C et al., International Study Group on Pancreatic Surgery (ISGPS). The 2016 update of the International Study Group (ISGPS) definition and grading of postoperative pancreatic fistula: 11 Years After. Surgery. 2017 Mar;161(3):584-591



Bassi C, Marchegiani G, Dervenis C et al., International Study Group on Pancreatic Surgery (ISGPS). The 2016 update of the International Study Group (ISGPS) definition and grading of postoperative pancreatic fistula: 11 Years After. Surgery. 2017 Mar;161(3):584-591


Amylase >3 times upper limit institutional normal serum amylase value
Biochemical Leak (BL)


- Persistent drainage >3 weeks*
-Clinically relevant change
in management of POPF
-Percutaneous or endoscopic drainage*
-Angiographic procedures for bleeding*
-Signs of infection without organ failure*
Grade B
Pancreatic Fistula



Bassi C, Marchegiani G, Dervenis C et al., International Study Group on Pancreatic Surgery (ISGPS). The 2016 update of the International Study Group (ISGPS) definition and grading of postoperative pancreatic fistula: 11 Years After. Surgery. 2017 Mar;161(3):584-591

Event	2005 ISGPF	2016 ISGPS
Percutaneous or endoscopic drainage	Grade C/Grade B (unclear)	Grade B
Angiographic procedures for POPF related bleeding	Grade C	Grade B
Organ Failure	Not included	Grade C
Sepsis	Grade C	Not included
All events and treatment on POPF classification must be POPF-related	No	Yes

Increase incidence of POPF grade B but more severe in grade C

(ICU stay, LOS, readmission rate, hospital costs, morbidity, 90-days mortality (P < 0.001))

Pulvirenti A, Marchegiani G, Pea A, et al. Clinical Implications of the 2016 International Study Group on Pancreatic Surgery Definition and Grading of Postoperative Pancreatic Fistula on 775 Consecutive Pancreatic Resections. Ann Surg 2017 J.

Postoperative pancreatic fistula(POPF)

- The most common complication occurring 10 - 34% in high volume center
- In Ramathibodi hospital, incidence 19.1% (grade B + C) after PD
- The updated classification, distal pancreatectomy is characterized by a lower than pancreaticoduodenectomy POPF rate, but by a higher BL incidence
- Possible to develope of complicated septic and/or hemorrhagic form

Can we predict POPF ?

Pulvirenti A, Marchegiani G, Pea A, et al. Clinical Implications of the 2016 International Study Group on Pancreatic Surgery Definition and Grading of Postoperative Pancreatic Fistula on 775 Consecutive Pancreatic Resections. Ann Surg 2017 J.

	Fistula risk score (Callery 2013)[1]	Modified Fistula Risk Score (m-FRS) (Kantor 2017)[2]	Alternative Fistula Risk Score (a-FRS) (Mungroop 2019)[3]	French POPF score (Tabchouri 2021)[4]
Preoperative	AdenoCA/chronic pancreatitis = 0 Others = 2	Sex: female 0; male 2 BMI (kg/m2): < 25 = 0; ≥25=1 Bilirubin (mg/dL): ≥2=0;<2=1	BMI (kg/m2): linear variable	Age: linear variable Preoperative radiotherapy or radiochemotherapy
Intraoperative	Pancreatic texture (hard = 0, soft/friable = 2) MPD size (>=5mm = 0, 4mm =1, 3mm=2,2mm= 3, <=1mm=4) Blood loss (<=400ml=0, 401-700ml=1, 701-1000ml=2, >1000ml=3)	Pancreas texture: Hard/intermediate =0: soft=2 Wirsung size (mm): ≥6=0; 3-6=3; <3=4	Pancreas texture: soft: no 0; yes 1 Wirsung size (mm) linear variable	Pancreas texture: soft: no 0; yes 1 Wirsung size (mm) linear variable
POPF risk	0 = 0% 1-2 = Low(6%) 3-6 = Moderate(22%) 7-10 = High(88%)	0-2 = 0% 3-6 = Low(<10%) 7-8 = Moderate(10-20%) 9-10 = High(>20%)	Low 0—5% Moderate (> 5—20%) High (> 20%)	Negligible (1%) if < 0.25 Low (2%) if 0.25—0.5 Moderate (8%) if 0.5—0.75 High (30%) if > 0.75

[1]Callery MP, Pratt WB, Kent TS, Chaikof EL, Vollmer CM. A prospectively validated clinical risk score accurately predicts pancreatic fistula after pancreatoduodenectomy. J Am Coll Surg 2013;216:1—14.

[2]Kantor O, Talamonti MS, Pitt HA, et al. Using the NSQIP Pancreatic Demonstration Project to Derive a Modified Fistula Risk Score for Preoperative Risk Stratification in Patients Undergoing Pancreaticoduodenectomy. J Am Coll Surg. 2017 May;224(5):816-825.

[3]Mungroop TH, van Rijssen LB, van Klaveren D, et al. Alternative Fistula Risk Score for pancreatoduodenectomy (a- FRS): design and international external validation. Ann Surg 2019;269:937—43.

[4]Tabchouri N, Bouquot M, Hermand H, et al. A novel pan- creatic fistula risk score including preoperative radiation therapy in pancreatic cancer patients. J Gastrointest Surg 2021;25:991—1000.

OPEN

A Simple Classification of Pancreatic Duct Size and Texture Predicts Postoperative Pancreatic Fistula

A classification of the International Study Group of Pancreatic Surgery

Fabian Schuh, MD, André L. Mihaljevic, MD, MSc,*† Pascal Probst, MD,* Maxwell T. Trudeau, MD,‡ Philip C. Müller, MD,§ Giovanni Marchegiani, MD,‖ Marc G. Besselink, MD, PhD,¶ Faik Uzunoglu, MD,# Jakob R. Izbicki, MD,# Massimo Falconi, MD,** Carlos Fernandez-del Castillo, MD, PhD,†† Mustapha Adham, MD,‡‡ Kaspar Z'graggen, MD,§ Helmut Friess, MD,§§ Jens Werner, MD,‖‖ Jürgen Weitz, MD,¶¶ Oliver Strobel, MD,* Thilo Hackert, MD,* Dejan Radenkovic, MD,## Dezso˝ Kelemen, MD,*** Christopher Wolfgang, MD,††† Y. I. Miao, MD,‡‡‡ Shailesh V. Shrikhande, MD, PhD,§§§ Keith D. Lillemoe, MD,‖‖‖ Christos Dervenis, MD,¶¶¶ Claudio Bassi, MD,‖ John P. Neoptolemos, MD,* Markus K. Diener, MD,*† Charles M. Vollmer, Jr., MD,‡ and Markus W. Büchler, MD*✉*

Type A: not-soft pancreatic texture AND main pancreatic duct size > 3mm

Type B: not-soft pancreatic texture AND main pancreatic duct size <= 3mm

Type C: soft pancreatic texture AND main pancreatic duct size > 3mm

Type D: soft pancreatic texture AND main pancreatic duct size <= 3mm

Schuh F, Mihaljevic AL, Probst P et al.. A Simple Classification of Pancreatic Duct Size and Texture Predicts Postoperative Pancreatic Fistula: A classification of the International Study Group of Pancreatic Surgery. Ann Surg. 2023 Mar 1;277(3):e597-e608

OPEN

A Simple Classification of Pancreatic Duct Size and Texture Predicts Postoperative Pancreatic Fistula

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Fabian Schuh, MD, André L. Mihaljevic, MD, MSc,*† Pascal Probst, MD,* Maxwell T. Trudeau, MD,‡ Philip C. Müller, MD,§ Giovanni Marchegiani, MD,‖ Marc G. Besselink, MD, PhD,¶ Faik Uzunoglu, MD,# Jakob R. Izbicki, MD,# Massimo Falconi, MD,** Carlos Fernandez-del Castillo, MD, PhD,†† Mustapha Adham, MD,‡‡ Kaspar Z'graggen, MD,§ Helmut Friess, MD,§§ Jens Werner, MD,‖‖ Jürgen Weitz, MD,¶¶ Oliver Strobel, MD,* Thilo Hackert, MD,* Dejan Radenkovic, MD,## Dezso˝ Kelemen, MD,*** Christopher Wolfgang, MD,††† Y. I. Miao, MD,‡‡‡ Shailesh V. Shrikhande, MD, PhD,§§§ Keith D. Lillemoe, MD,‖‖‖ Christos Dervenis, MD,¶¶¶ Claudio Bassi, MD,‖ John P. Neoptolemos, MD,* Markus K. Diener, MD,*† Charles M. Vollmer, Jr., MD,‡ and Markus W. Büchler, MD*✉*

A systematic review, 108 studies, 14471 patients

Soft pancreatic texture was significantly associated with the development of CR-POPF

(OR 4.24, 95% CI 3.67-4.89, P < 0.01)

MPD diameter <= 3 mm significantly increased CR-POPF risk (OR 3.66, 95% CI 2.62–5.12, P < 0.01)

Schuh F, Mihaljevic AL, Probst P et al.. A Simple Classification of Pancreatic Duct Size and Texture Predicts Postoperative Pancreatic Fistula: A classification of the International Study Group of Pancreatic Surgery. Ann Surg. 2023 Mar 1;277(3):e597-e608

OPEN

A Simple Classification of Pancreatic Duct Size and Texture Predicts Postoperative Pancreatic Fistula

A classification of the International Study Group of Pancreatic Surgery

Fabian Schuh, MD, André L. Mihaljevic, MD, MSc,*† Pascal Probst, MD,* Maxwell T. Trudeau, MD,‡ Philip C. Müller, MD,§ Giovanni Marchegiani, MD,‖ Marc G. Besselink, MD, PhD,¶ Faik Uzunoglu, MD,# Jakob R. Izbicki, MD,# Massimo Falconi, MD,** Carlos Fernandez-del Castillo, MD, PhD,†† Mustapha Adham, MD,‡‡ Kaspar Z'graggen, MD,§ Helmut Friess, MD,§§ Jens Werner, MD,‖‖ Jürgen Weitz, MD,¶¶ Oliver Strobel, MD,* Thilo Hackert, MD,* Dejan Radenkovic, MD,## Dezso˝ Kelemen, MD,*** Christopher Wolfgang, MD,††† Y. I. Miao, MD,‡‡‡ Shailesh V. Shrikhande, MD, PhD,§§§ Keith D. Lillemoe, MD,‖‖‖ Christos Dervenis, MD,¶¶¶ Claudio Bassi, MD,‖ John P. Neoptolemos, MD,* Markus K. Diener, MD,*† Charles M. Vollmer, Jr., MD,‡ and Markus W. Büchler, MD*✉*

		No. of Patients Without CR-POPF	No. of Patients *With CR-POPF*	*Rates*	*P*
A	Not-soft pancreatic texture and MPD > 3 mm	1533	56	3.5%	0.002
B	Not-soft pancreatic texture and MPD ≤ 3 mm	854	56	6.2%	<0.001
C	Soft pancreatic texture and MPD >3 mm	847	169	16.6%	<0.001
D	Soft pancreatic texture and MPD ≤3 mm	1547	471	23.2%	
		4781	752	15.7%	Overall $P < 0.001$

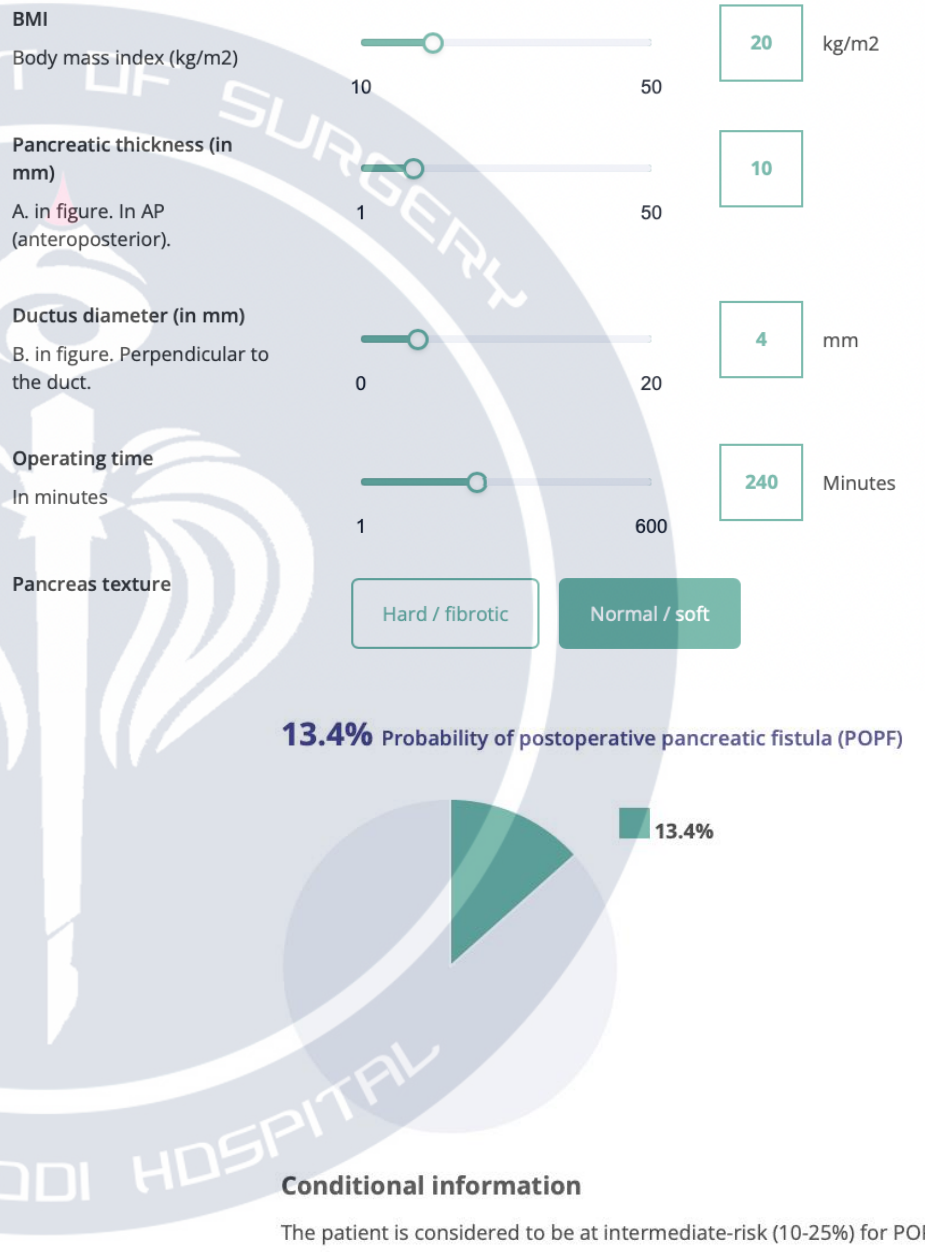
Schuh F, Mihaljevic AL, Probst P et al.. A Simple Classification of Pancreatic Duct Size and Texture Predicts Postoperative Pancreatic Fistula: A classification of the International Study Group of Pancreatic Surgery. Ann Surg. 2023 Mar 1;277(3):e597-e608

Distal Pancreatectomy Fistula Risk Score (D-FRS)

Development and International Validation

De Pastena, Matteo MD, PhD[*,†]; van Bodegraven, Eduard A. MD[†]; Mungroop, Timothy H. MD[†]; Vissers, Frederique L. MD[†]; Jones, Leia R. BSc[†,‡]; Marchegiani, Giovanni MD, PhD[*]; Balduzzi, Alberto MD[*]; Klompmaker, Sjors MD, MSc, PhD[†,§]; Paiella, Salvatore MD, PhD[*]; Tavakoli Rad, Shazad[†]; Groot Koerkamp, Bas MD, PhD[‖]; van Eijck, Casper MD, PhD[‖]; Busch, Olivier R. MD, PhD[†]; de Hingh, Ignace MD, PhD[¶]; Luyer, Misha MD, PhD[¶]; Barnhill, Caleb MD[#]; Seykora, Thomas MD[**]; Maxwell T, Trudeau[**]; de Rooij, Thijs MSc[†]; Tuveri, Massimiliano MD[*]; Malleo, Giuseppe MD, PhD[*]; Esposito, Alessandro MD[*]; Landoni, Luca MD[*]; Casetti, Luca MD, PhD[*]; Alseidi, Adnan MD, PhD[#,††]; Salvia, Roberto MD, PhD[*]; Steyerberg, Ewout W.[‡‡]; Abu Hilal, Mohammad MD, MSc, PhD[‡,§§]; Vollmer, Charles M. MD[**]; Besselink, Marc G. MD, MSc, PhD[†]; Bassi, Claudio MD, FRCS, FACS, FEBS, FASA (Hon.)[*]

Dutch pancreatic cancer group
https://www.evidencio.com/models/show/2587



De Pastena Matteo, van Bodegraven Eduard A, et al., Distal Pancreatectomy Fistula Risk Score (D-FRS): Development and International Validation. Annals of Surgery 277(5):p e1099-e1105, May 2023.

Postoperative pancreatic fistula(POPF)

ELSEVIER

Journal of Gastrointestinal Surgery

Volume 28, Issue 9, September 2024, Pages 1406-1411

Origin

In
or
co
of
Improvement Program data

Abdullah Khalid [a], Neda Amini [a], Shamsher A. Pasha [b], Lyudmyla Demyan [a], Elliot Newman [c], Daniel A. King [d], Danielle DePeralta [d], Sepideh Gholami [d], Gary B. Deutsch [d], Marcovalerio Melis [c], Matthew J. Weiss [d]

5694 patients with POPF grade(B/C)

How to prevent it ?

Increase 30-day readmission and mortality

Abdullah Khalid, Neda Amini, Shamsher A, et al., Impact of postoperative pancreatic fistula on outcomes in pancreatoduodenectomy: a comprehensive analysis of American College of Surgeons National Surgical Quality Improvement Program data, Journal of Gastrointestinal Surgery, Volume 28, Issue 9, 2024

Prevention

- Technical
  - Pancreaticojejunostomy vs Pancreaticogastrostomy
  - Modified Blumgart PJ vs Pancreaticogastrostomy
  - PJ with external stent vs PG with external stent
  - P-duct stent
  - Omental roll up
- Medication
  - Somatostatin analogue

DEPARTMENT OF SURGERY
RAMATHIBODI HOSPITAL

Cochrane Library

Cochrane Database of Systematic Reviews

Pancreaticojejunostomy versus pancreaticogastrostomy reconstruction for the prevention of postoperative pancreatic fistula following pancreaticoduodenectomy (Review)

Cheng Y, Briarava M, Lai M, Wang X, Tu B, Cheng N, Gong J, Yuan Y, Pilati P, Mocellin S

- 10 RCTs that enrolled a total of 1629 participants.
- Effects of pancreaticogastrostomy compared to pancreaticojejunostomy on postoperative pancreatic fistula

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	No of partici-pants (studies)	Quality of the evidence (GRADE)
	Risk with PG	Risk with PJ			
Postoperative pancreatic fistula (Grade A, B or C) Follow up: 30 days	**214 per 1000**	**254 per 1000**	**RR 1.19** (0.88 to 1.62)	1513 (9 studies)	⊕⊕⊖⊖ **Low** a,b,c

No statistical difference

Cheng Y, Briarava M, Lai M, et al.Pancreaticojejunostomy versus pancreaticogastrostomy reconstruction for the prevention of postoperative pancreatic fistula following pancreaticoduodenectomy. Cochrane Database Syst Rev. 2017 Sep 12;9(9):CD012257

http://dx.doi.org/10.1016/j.hpb.2015.09.007 HPB

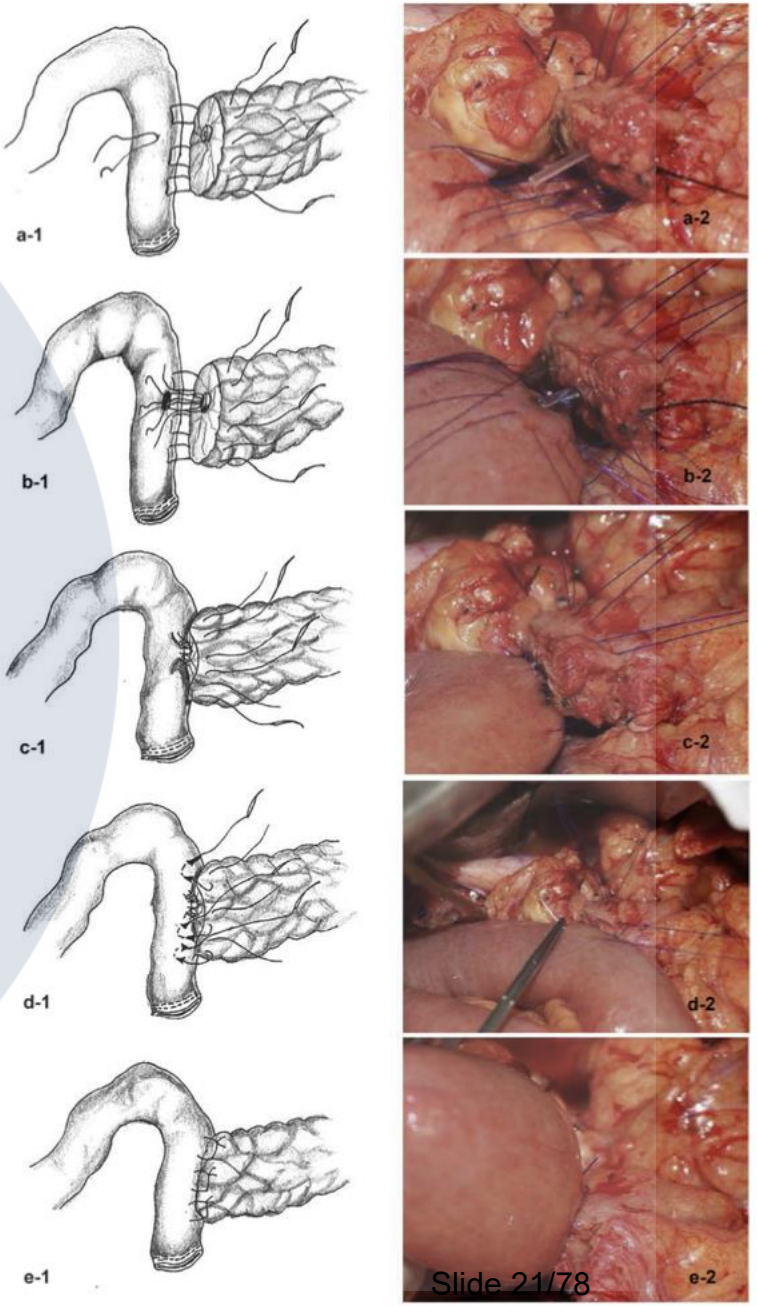
ORIGINAL ARTICLE

Comparison of Modified Blumgart pancreaticojejunostomy and pancreaticogastrostomy after pancreaticoduodenectomy

Shin-E. Wang, Shih-Chin Chen, Bor-Uei Shyr & Yi-Ming Shyr

Department of Surgery, Taipei Veterans General Hospital, National Yang Ming University, Taipei, Taiwan, ROC

- 206 patients undergoing PD, Prospectively data collection
- Blumgart PJ was associated with shorter postoperative hospital stay (median (range) 25 (10–99) vs. 27 (10–97) days, P = 0.022).
- Surgical mortality in Blumgart PJ vs PG(0 vs 4.9%, P = 0.030).
- The CR-POPF by Blumgrt PJ is significantly lower than that by PG for overall patients (7% vs. 20%, P = 0.007), especially for those in intermediate fistula risk zone (6% vs. 21%, P = 0.048) and high fistula risk zone (14% vs. 47%, P = 0.038)



Wang SE, Chen SC, Shyr BU, Shyr YM. Comparison of Modified Blumgart pancreaticojejunostomy and pancreaticogastrostomy after pancreaticoduodenectomy. HPB (Oxford). 2016 Mar;18(3):229-35.

JAMA Surgery | Original Investigation

Pancreaticojejunostomy With Externalized Stent vs Pancreaticogastrostomy With Externalized Stent for Patients With High-Risk Pancreatic Anastomosis

A Single-Center, Phase 3, Randomized Clinical Trial

Stefano Andrianello, MD; Giovanni Marchegiani, MD, PhD; Giuseppe Malleo, MD, PhD; Gaia Masini, MD; Alberto Balduzzi, MD; Salvatore Paiella, MD, PhD; Alessandro Esposito, MD; Luca Landoni, MD; Luca Casetti, MD, PhD; Massimiliano Tuveri, MD; Roberto Salvia, MD, PhD; Claudio Bassi, MD

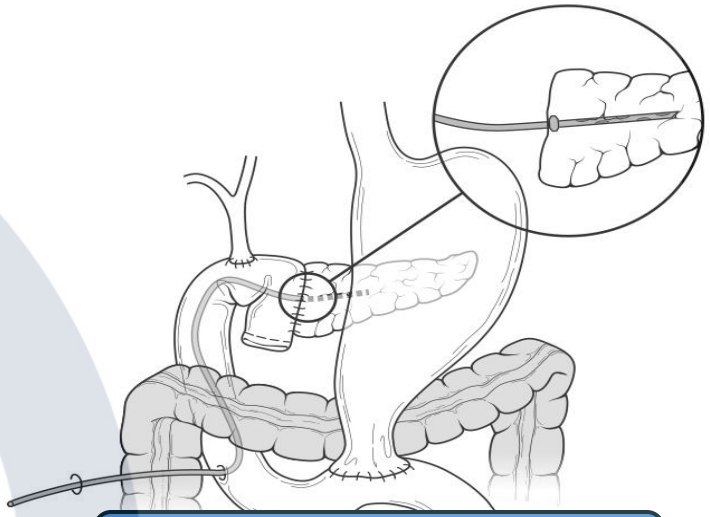
Table 2. Primary Outcome of Postoperative Pancreatic Fistula

Characteristic	PJ (n = 36)	PG (n = 36)	Risk Ratio (95% CI)	*P* Value
POPF, No. (%)	14 (38.9)	18 (50.0)	0.778 (0.461-1.313)	.48
BL, No. (%)	5 (13.9)	2 (5.6)	2.535 (0.518-12.058)	.43
Grade B, No. (%)	14 (38.9)	14 (38.9)	NA	.11
Grade C, No. (%)	0	4 (11.1)		

Table 3. Postoperative Complications

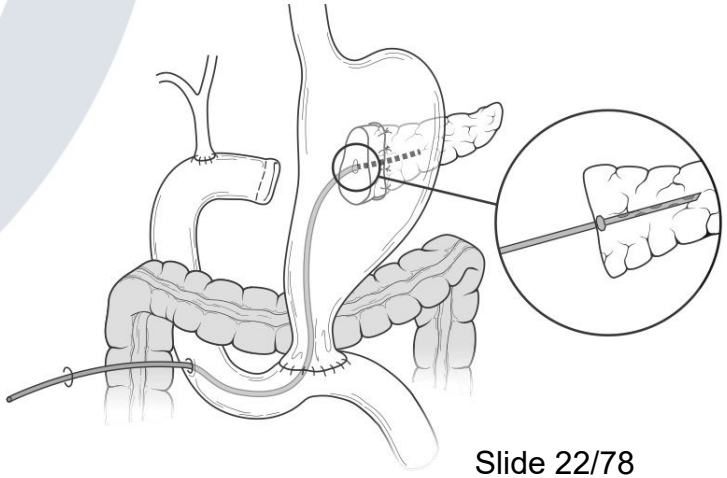
	No. (%)			
Characteristic	PJ (n = 36)	PG (n = 36)	Risk Ratio (95% CI)	*P* Value
Clavien-Dindo score ≥III	8 (22.2)	17 (47.2)	0.471 (0.233-0.949)	.047

A Pancreaticojejunostomy



Cattel-Warren duct-to-mucosa technique

B Pancreaticogastrostomy



Andrianello S, Marchegiani G, Malleo G, et al. Pancreaticojejunostomy With Externalized Stent vs Pancreaticogastrostomy With Externalized Stent for Patients With High-Risk Pancreatic Anastomosis: A Single-Center, Phase 3, Randomized Clinical Trial. *JAMA Surg.* 2020;155(4):313–321.

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.elsevier.com/locate/ijsu

Review

Does pancreatic duct stent placement lead to decreased postoperative pancreatic fistula rates after pancreaticoduodenectomy? A meta-analysis

Chenchen Guo [a,*], Bin Xie [b], Diandian Guo [c]

[a] Department of General Surgery, The First Affiliated Hospital of University of Science and Technology of China, Hefei, Anhui, 230001, China
[b] Anhui Normal University, Wuhu, Anhui, 241000, China
[c] School of Medicine, Southeast University, Nanjing, 210009, China

Source	Anastomosis technique	Internal/ external stents	Type of stent	POPF assessment scale	Prophylactic octreotide
Cai 2022	Bing's anastomosis	Internal stent	–	ISGPF definition	–
Singh 2021	end-to-side, duct-to-mucosa, PJ anastomosis	internal stent	a 5 cm #5 French polyvinyl chloride infant feeding tube	ISGPF definition	Octreotide (100 mcg)
Qureshi 2018	end-to-side, mucosa-to-mucosa, PJ anastomosis	external stent	–	ISGPF definition	–
Motoi 2012	end-to-side, duct-to-mucosa, PJ anastomosis	external stent	a 5-Fr polyvinyl catheter	ISGPF definition	Not
Pessaux 2011	end-to-side, duct-to-mucosa, PG anastomosis or end-to-side, duct-to-mucosa, PJ anastomosis	external stent	a Fr 3 to 6 polyvinyl catheter with multiple side-holes	ISGPF definition	Octreotide (100μg, 3 times a day)
Poon 2007	end-to-side, duct-to-mucosa, PJ anastomosis	external stent	a Fr 3–8 polyvinyl catheter with multiple side-holes	>10 ml/day (3 times serum level) more than 3 days after surgery	Not
Winter 2006	end-to-side, duct-to-mucosa, PJ anastomosis or end-to-end, invagination, PJ anastomosis	Internal stent	A 3.5 to 8 French plastic pediatric feeding tube, length of 6 cm	ISGPF definition and JHH definition	Not

Subgroup analysis of the effect of pancreatic duct stents on POPF.

Subgroup analyses		Studies, n	Patients, n	Pooled RR (95% CI)	I^2 (%)	p-value	p- value
All studies		7	847	0.85 (0.57–1.26)	51	0.41	–
Ways of drainage	internal	3	374	1.25 (0.87–1.80)	0	0.22	0.005
	external	4	473	0.61 (0.43–0.86)	29	0.005	
prophylactic octreotide	Yes	2	208				
	Not	3	447				
surgical approaches	open	6	757				
	laparoscopic	1	90				

POPF, postoperative pancreatic fistula; RR, relative risk; CI, confidence interval; N

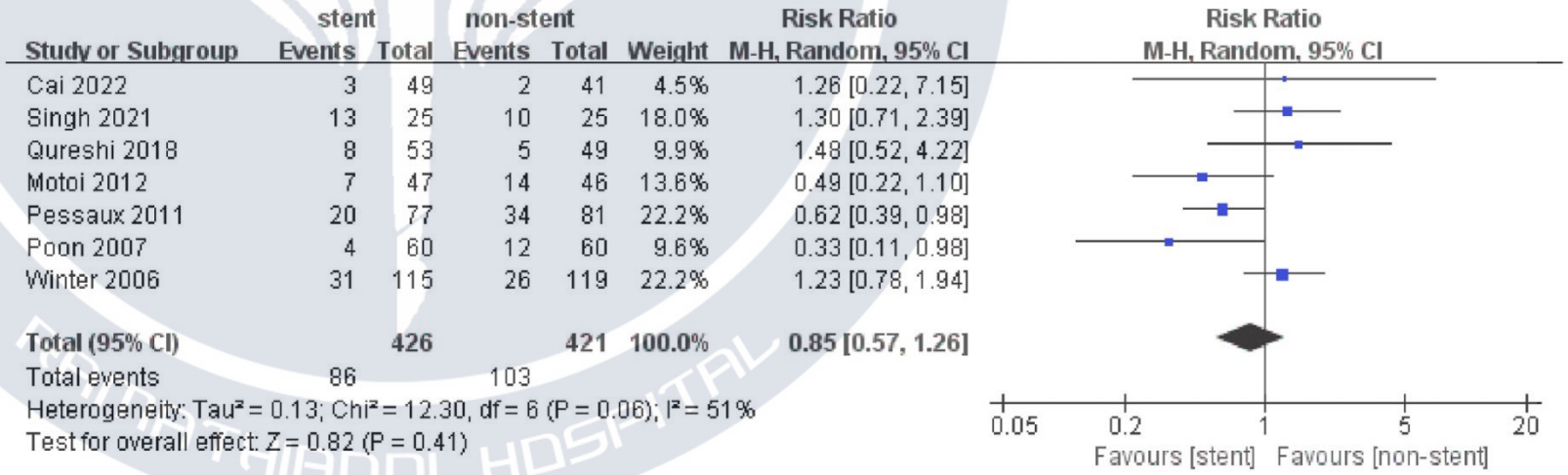


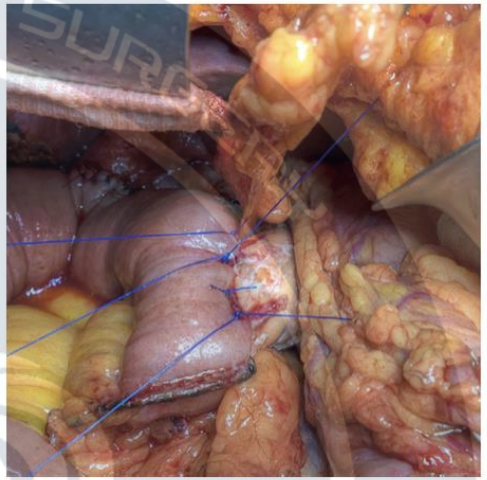
Fig. 3. Forest plot of the comparisons of outcomes between the stent group and the non-stent group: pancreatic fistula.

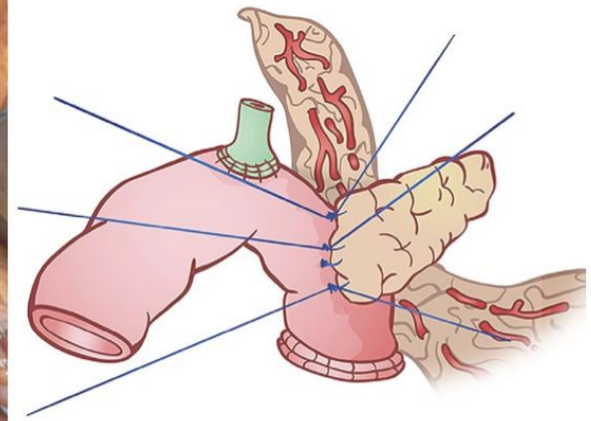
Chenchen Guo, Bin Xie, Diandian Guo, Does pancreatic duct stent placement lead to decreased postoperative pancreatic fistula rates after pancreaticoduodenectomy? A meta-analysis, International Journal of Surgery, Volume 103, 2022

ORIGINAL ARTICLE

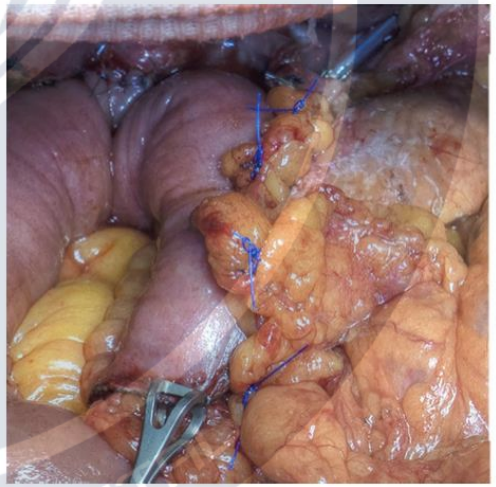
Prospective randomized controlled trial of omental roll-up technique on pancreatojejunostomy anastomosis for reducing perioperative complication in patients undergoing pancreatoduodenectomy

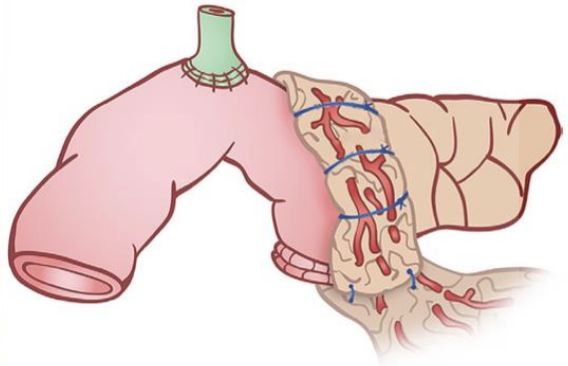
Pongsatorn Tangtawee | Somkit Mingphruedhi | Narongsak Rungsakulkij | Wikran Suragul | Watoo Vassanasiri | Paramin Muangkaew





- Prospectively RCT, N = 24 patients
- The incidence of POPF was not different between the omental roll-up group (n = 5, 14.7%) and non-omental roll-up group (n = 7, 20.6%) (P = 0.525).
- No differences were found in postoperative hemorrhage after pancreatectomy, delayed gastric emptying, and chyle leakage between the groups.





Tangtawee P, Mingphruedhi S, Rungsakulkij N, Suragul W, Vassanasiri W, Muangkaew P. Prospective randomized controlled trial of omental roll-up technique on pancreatojejunostomy anastomosis for reducing perioperative complication in patients undergoing pancreatoduodenectomy. J Hepatobiliary Pancreat Sci. 2021 May;28(5):450-456.

Observational Study

Medicine

OPEN

Prophylactic octreotide for postoperative pancreatic fistula in patients with pancreatoduodenectomy

Risk-stratified analysis

So Jeong Yoon, MD, Okjoo Lee, MD, Ji Hye Jung, MD, Sang Hyun Shin, MD, PhD, Jin Seok Heo, MD, PhD, In Woong Han, MD, PhD*

Contents lists available at ScienceDirect

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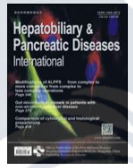

Original Article/Pancreas

Efficacy of octreotide in the prevention of complications after pancreaticoduodenectomy in patients with soft pancreas and non-dilated pancreatic duct: A prospective randomized trial

Ayman El Nakeeb*, Ahmed ElGawalby, Mahmoud A. Ali, Ahmed Shehta, Hosam Hamed, Mohamed El Refea, Ahmed Moneer, Ahmed Abd El Rafee

Gastroenterology Surgical Center, Mansoura University, Mansoura 35516, Egypt

RANDOMIZED CONTROLLED TRIAL

Somatostatin Versus Octreotide for Prevention of Postoperative Pancreatic Fistula: The PREFIPS Randomized Clinical Trial

A FRENCH 007—

Sébastien Gaujoux, MD, PhD,†✉ Jean-*
Guillaume Piessen, MD, PhD,‖¶ Sté*
*Frantz Foissac, PhD,*** *Louise E*
Emmanuel Buc, MD, PhD,§§‖‖ Musta*
*David Fuks, MD, PhD,*******†† *Sophie*
Fabrice Muscari, MD, PhD,‖‖‖¶¶¶ *Laure*
*Jean-Christophe Vaillant, MD, PhD,*** *Lilian Schwarz, MD, PhD,*†††‡‡‡‡
Antonio Sa Cunha, MD, PhD,§§§‖‖‖‖‖ *Milena Muzzolini, MD,*** *Bertrand Dousset, MD,*** *Alain Sauvanet, MD,*¶¶¶¶¶¶¶¶¶¶*

Available online at www.sciencedirect.com

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ORIGINAL ARTICLE

Randomized controlled study of the effect of octreotide on pancreatic exocrine secretion and pancreatic fistula after pancreatoduodenectomy

Dong Do You [a], Kwang Yeol Paik [b,*], Il Young Park [c], Young Kyung Yoo [d]

World J Surg
https://doi.org/10.1007/s00268-019-04956-6

SCIENTIFIC REVIEW

The Use of Prophylactic Somatostatin Therapy Following Pancreaticoduodenectomy: A Meta-analysis of Randomised Controlled Trials

A. Adiamah[1] · Z. Arif[1] · F. Berti[1] · S. Singh[1] · N. Laskar[1] · D. Gomez[1]

Not effectively for decreasing incidence of POPF

Adiamah A, Arif Z, Berti F, Singh S, Laskar N, Gomez D. The Use of Prophylactic Somatostatin Therapy Following Pancreaticoduodenectomy: A Meta-analysis of Randomised Controlled Trials. World J Surg. 2019 Jul;43(7):1788-1801.

Ayman El Nakeeb, Ahmed ElGawalby, Mahmoud A. Ali, et als., Efficacy of octreotide in the prevention of complications after pancreaticoduodenectomy in patients with soft pancreas and non-dilated pancreatic duct: A prospective randomized trial, Hepatobiliary & Pancreatic Diseases International, Volume 17, Issue 1, 2018, Pages 59-63,

Contents lists available at ScienceDirect

Pancreatology

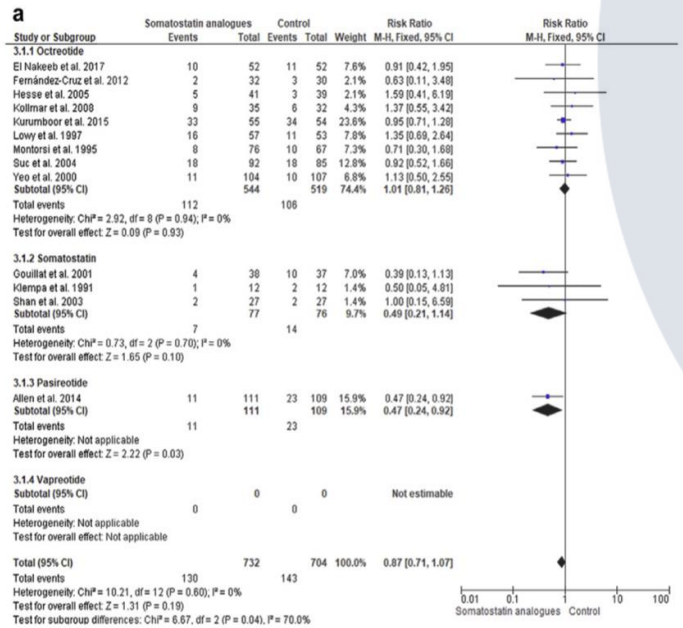
journal homepage: www.elsevier.com/locate/pan

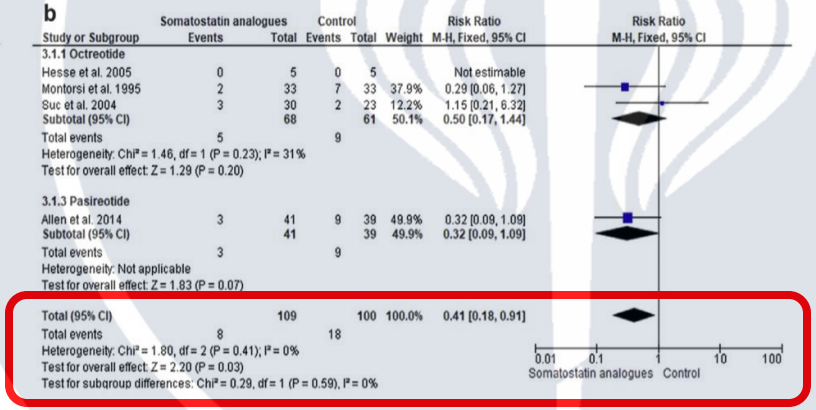
Original Article

Do somatostatin-analogues have the same impact on postoperative morbidity and pancreatic fistula in patients after pancreaticoduodenectomy and distal pancreatectomy? – A systematic review with meta-analysis of randomized-controlled trials

Stephan Schorn [a, *], Thomas Vogel [a], Ihsan Ekin Demir [a, b], Elke Demir [a], Okan Safak [a], Helmut Friess [a], Güralp Onur Ceyhan [b]

[a] Technical University of Munich, School of Medicine, Klinikum Rechts der Isar, Department of Surgery, Germany
[b] Department of General Surgery, HPB-Unit, School of Medicine, Acibadem Mehmet Ali Aydinlar University, Istanbul, Turkey





Characteristics of the included studies.

Study	Somatostatin-analogue	Definition of POPF	Blinding	Surgery
Allen et al., 2014	Perioperative pasireotide 900 μg 2× day for 7 days	ISGPF	Double blinded	PD + DP
Büchler et al., 1991	Perioperative octreotide 100 μg 3× day for 7 days	Amylase and lipase >3 times serum concentration, >3 days postop, >10 ml/h	Double blinded	PD + DP
El Nakeeb et al., 2017	Perioperative octreotide 100 μg 3× day until time of resumption of oral fluids intake	ISGPF	na	PD
Fernández-Cruz et al., 2012	Perioperative octreotide 100 μg 3× day for 10 days	ISGPF	Na	PD
Friess et al., 1995	Perioperative octreotide 100 μg 3× day for 7 days	Amylase and lipase >3 times serum level, >3 days postop, >10 ml/h	Double blinded	PD + DP
Gouillat et al., 2001	Perioperative somatostatin 250 μg/h for 7 days	>100 ml/day exceeding 5 times normal serum amylase after POD 3, persisting after POD 12 or in association with clinically relevant symptoms requiring surgery, drainage or intensive care	Double blinded	PD
Hesse et al., 2005	Perioperative octreotide 100 μg 3× day for 7 days	>100 ml/day exceeding 5 times normal serum amylase after POD 3, persisting after POD 12 or in association with clinically relevant symptoms requiring surgery, drainage or intensive care	Open	PD + DP
Katsourakis et al., 2013	Perioperative somatostatin 250 μg/h for 6 days	ISGPF	Na	PD + DP
Klempa et al., 1991	Perioperative somatostatin 250 μg/h for 7 days	–	Na	PD
Kollmar et al., 2008	Perioperative octreotide 100 μg 3× day for 7 days	ISGPF	Double blinded	PD
Kurumboor et al., 2015	Perioperative octreotide 100 μg 3× day for 6 days	ISGPF	Open	PD
Lowy et al., 1997	Perioperative octreotide 150 μg 3× day for 6 days	drainage of amylase-rich fluid (>2.5 times the upper limit of normal for serum amylase) and clinical signs or the need of reintervention	Na	PD
Montorsi et al., 1995	Perioperative octreotide 100 μg 3× day for 7 days	>10 ml/day fluids exceeding 3 times normal serum amylase after POD 3	Double blinded	PD + DP
Pederzoli et al., 1994	Perioperative octreotide 100 μg 3× day for 7 days	>10 ml/day for >4 days after POD 4, amylase >3 times normal	Double blinded	PD + DP
Sarr et al., 2003	Perioperative vapreotide 600 μg 2× day for 7 days	>30 ml/day 5, amylase or lipase >5 times normal	Double blinded	PD + DP
Shan et al., 2005	Perioperative somatostatin 250 μg/h for 7 days	>10 ml/day fluids exceeding amylase >3 times serum level for >7 days	Na	PD
Suc et al., 2004	Perioperative octreotide 100 μg 3× day for 10 days	Fluids exceeding >4 times normal serum level or any radiological signs of POFP	Single blinded	PD + DP
Yeo et al., 2000	Perioperative octreotide 250 μg 3× day for 7 days	>50 ml/day fluids exceeding >3 times normal serum value on or after day 10 or radiological sings of POPF	Double blinded	PD

Schorn S, Vogel T, Demir IE, et al.. Do somatostatin-analogues have the same impact on postoperative morbidity and pancreatic fistula in patients after pancreaticoduodenectomy and distal pancreatectomy? – A systematic review with meta-analysis of randomized-controlled trials. Pancreatology. 2020 Dec;20(8):1770-1778. doi: 10.1016/j.pan.2020.10.043. Epub 2020 Oct 22. PMID: 33121847.

HPB
Volume 26, Issue 10, October 2024, Pages 1229-1236

Original Article

Prophylactic somatostatin analogs for postoperative pancreatic fistulas: a cross-sectional survey of AHPBA surgeons

Sardar Shahmir B. Chauhan [1], Benjamin Vierra [1], James O. Park [1 3], Venu G. Pillarisetty [1 3], Giana H. Davidson [1 2], Jonathan G. Sham [1 2 3]

Results

One hundred and two surgeons responded in spring 2023. 48.0% of respondents reported using prophylactic SSAs during their surgical training, however, only 29.4% do so in their current practice, most commonly when performing Whipple procedures. Octreotide was the most frequently used SSA (34.3%), followed by octreotide LAR (12.7%) and pasireotide (11.8%). Reasons for not prescribing included a lack of high-quality data (62.7%), perception of limited efficacy (34.3%) and high cost (30.4%).

Currently trend

29.4% used in current practice

Reasons for not prescribing

- Lack of high quality data(62.7%)
- Limited efficacy(34.4%)
- High cost(30.4%)

Sardar Shahmir B. Chauhan, Benjamin Vierra et al., Prophylactic somatostatin analogs for postoperative pancreatic fistulas: a cross-sectional survey of AHPBA surgeons, HPB, Volume 26, Issue 10, 2024

Management

The aim of this management is to

- control the patient's fluid
- electrolyte
- nutritional status

B. Malgras, S. Dokmak, B. Aussilhou, et al. Management of postoperative pancreatic fistula after pancreaticoduodenectomy, Journal of Visceral Surgery, Volume 160, Issue 1, 2023, Pages 39-51, ISSN 1878-7886

Management

Monitoring

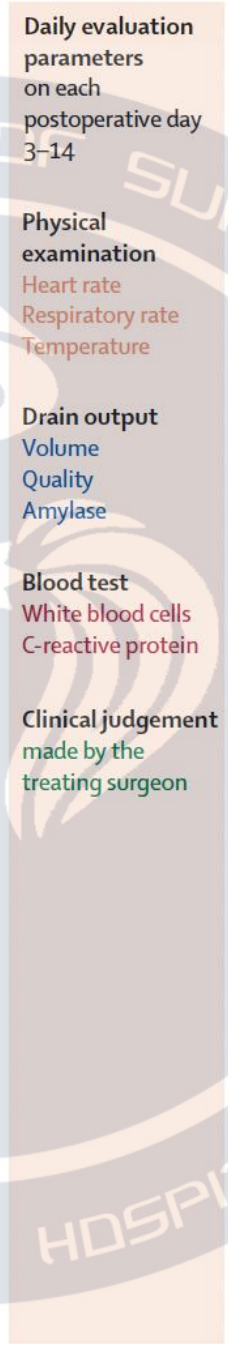
- Clinical (vital constants, abdominal pain, feeding, transit, appearance and quantity of drained fluids, skin condition at the drain orifice if POPF is prolonged or high-flow, biological result(haemoglobin, leukocytosis, CRP, creatinine))
- Fluid and electrolyte rebalancing
- Routine CT scan?

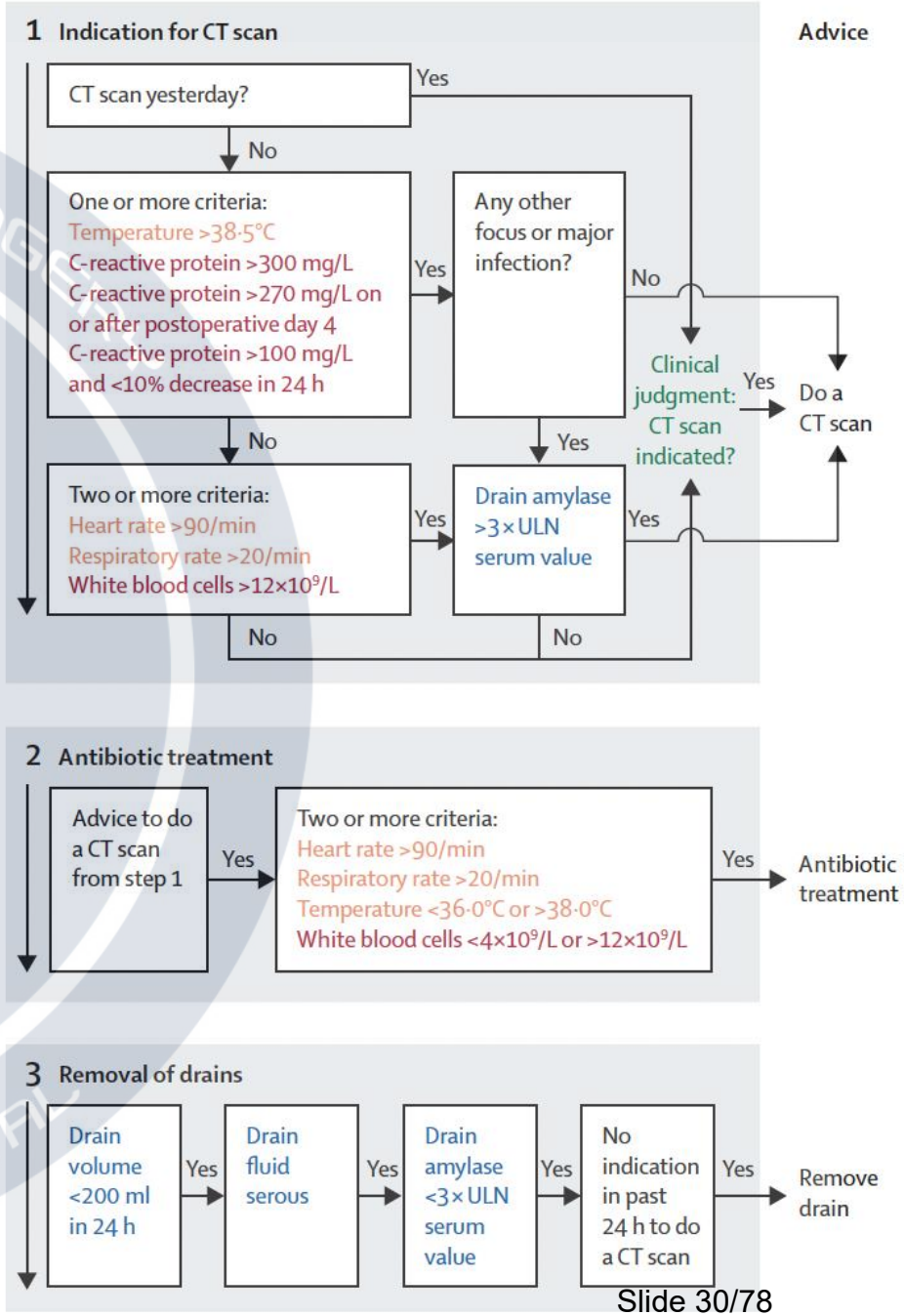
B. Malgras, S. Dokmak, B. Aussilhou, et al. Management of postoperative pancreatic fistula after pancreaticoduodenectomy, Journal of Visceral Surgery, Volume 160, Issue 1, 2023, Pages 39-51, ISSN 1878-7886

Algorithm-based care versus usual care for the early recognition and management of complications after pancreatic resection in the Netherlands: an open-label, nationwide, stepped-wedge cluster-randomised trial

F Jasmijn Smits, Anne Claire Henry*, Marc G Besselink, Olivier R Busch, Casper H van Eijck, Mark Arntz, Thomas L Bollen, Otto M van Delden, Daniel van den Heuvel, Christiaan van der Leij, Krijn P van Lienden, Adriaan Moelker, Bert A Bonsing, Inne H Borel Rinkes, Koop Bosscha, Ronald M van Dam, Wouter J M Derksen, Marcel den Dulk, Sebastiaan Festen, Bas Groot Koerkamp, Robbert J de Haas, Jeroen Hagendoorn, Erwin van der Harst, Ignace H de Hingh, Geert Kazemier, Marion van der Kolk, Mike Liem, Daan J Lips, Misha D Luyer, Vincent E de Meijer, J Sven Mieog, Vincent B Nieuwenhuijs, Gijs A Patijn, Wouter W te Riele, Daphne Roos, Jennifer M Schreinemakers, Martijn W J Stommel, Fennie Wit, Babs A Zonderhuis, Lois A Daamen, C Henri van Werkhoven, I Quintus Molenaar†, Hjalmar C van Santvoort†, for the Dutch Pancreatic Cancer Group*

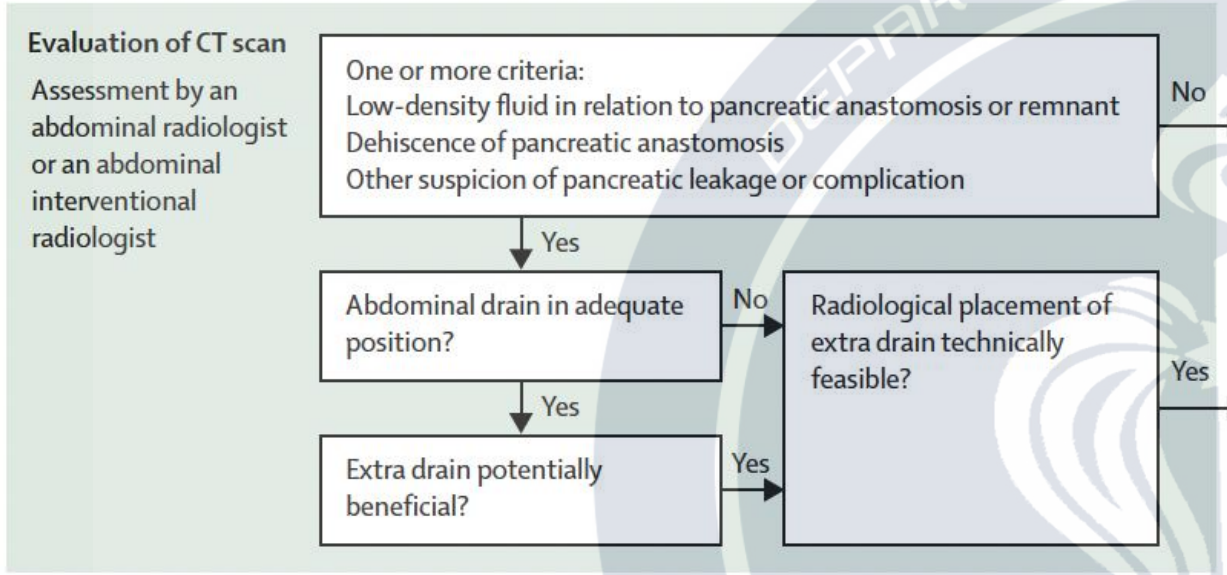
- Jan 2018 to Nov 2019, all 1805 patients who had pancreatic resection in multi high volume center in Netherland
- 1748 patients (885 receiving usual care and 863 receiving algorithm-center care)





DEPARTMENT OF SURGERY RAMATHIBODI HOSPITAL

Smits FJ, Henry AC, Besselink MG, Busch OR et al., Dutch Pancreatic Cancer Group. Algorithm-based care versus usual care for the early recognition and management of complications after pancreatic resection in the Netherlands: an open-label, nationwide, stepped-wedge cluster-randomised trial. Lancet. 2022 May



	Intervention (n=863)	Control (n=885)	Adjusted risk ratio (95% CI)*	p value
Clinical events†				
Postoperative pancreatic fistula	239/863 (28%)	187/885 (21%)	1·23 (0·97–1·56)	0·084
Postoperative bile leak‡	66/643 (10%)	57/671 (8%)	0·90 (0·60–1·33)	0·59
Gastroenterostomy leak‡	8/643 (1%)	11/671 (2%)	0·88 (0·30–2·62)	0·82
Chyle leak	61/863 (7%)	69/885 (8%)	0·95 (0·59–1·54)	0·84
Delayed gastric emptying			1·17 (0·76–1·80)	0·48

	Intervention (n=863)	Control (n=885)	Adjusted risk ratio (95% CI)	p value
Primary composite outcome of at least one of bleeding that required invasive intervention, organ failure, or 90-day mortality	73 (8%)	124 (14%)	0·48 (0·38–0·61)	<0·0001
Secondary outcomes for the individual components of the primary outcome				
Bleeding that required intervention	47 (5%)	51 (6%)	0·65 (0·42–0·99)	0·046
New-onset organ failure	39 (5%)	92 (10%)	0·35 (0·20–0·60)	0·0001
Circulatory failure	28 (3%)	70 (8%)	0·32 (0·23–0·46)	<0·0001
Respiratory failure	22 (3%)	55 (6%)	0·35 (0·24–0·50)	<0·0001
Renal failure	12 (1%)	29 (3%)	0·37 (0·16–0·85)	0·019
90-day mortality	23 (3%)	44 (5%)	0·42	0·029

Not difference

Less incidence of bleeding that required invasive intervention and new onset organ failure

Smits FJ, Henry AC, Besselink MG, Busch OR et al., Dutch Pancreatic Cancer Group. Algorithm-based care versus usual care for the early recognition and management of complications after pancreatic resection in the Netherlands: an open-label, nationwide, stepped-wedge cluster-randomised trial. Lancet. 2022 May

Management

Nutrition

- NPO vs Enteral feeding vs TPN

ISGPS 2016

BL : oral

grade B or C : may related with complication, suggest enteral nutrition or fasting with TPN

- Caloric goals : cover at least 80% of energy requirements (calculated by the 25 — 30 kcal/kg/day formula) to facilitate closure of the POPF and reduce the risk of complications

- Continued oral feeding is easier with PJ than with PG, because with the latter the flow of food can increase the flow rate of drainage from the POPF

Bassi C, Marchegiani G, Dervenis C et al., International Study Group on Pancreatic Surgery (ISGPS). The 2016 update of the International Study Group (ISGPS) definition and grading of postoperative pancreatic fistula: 11 Years After. Surgery. 2017 Mar;161(3):584-591

McClave SA, Taylor BE, Martindale RG, et al. Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutri- tion (A.S.P.E.N.). J Parenter Enteral Nutr 2016;40:159—211.

Management

Ann Surg Oncol (2015) 22:3905–3912
DOI 10.1245/s10434-015-4496-1

Annals of
SURGICAL ONCOLOGY
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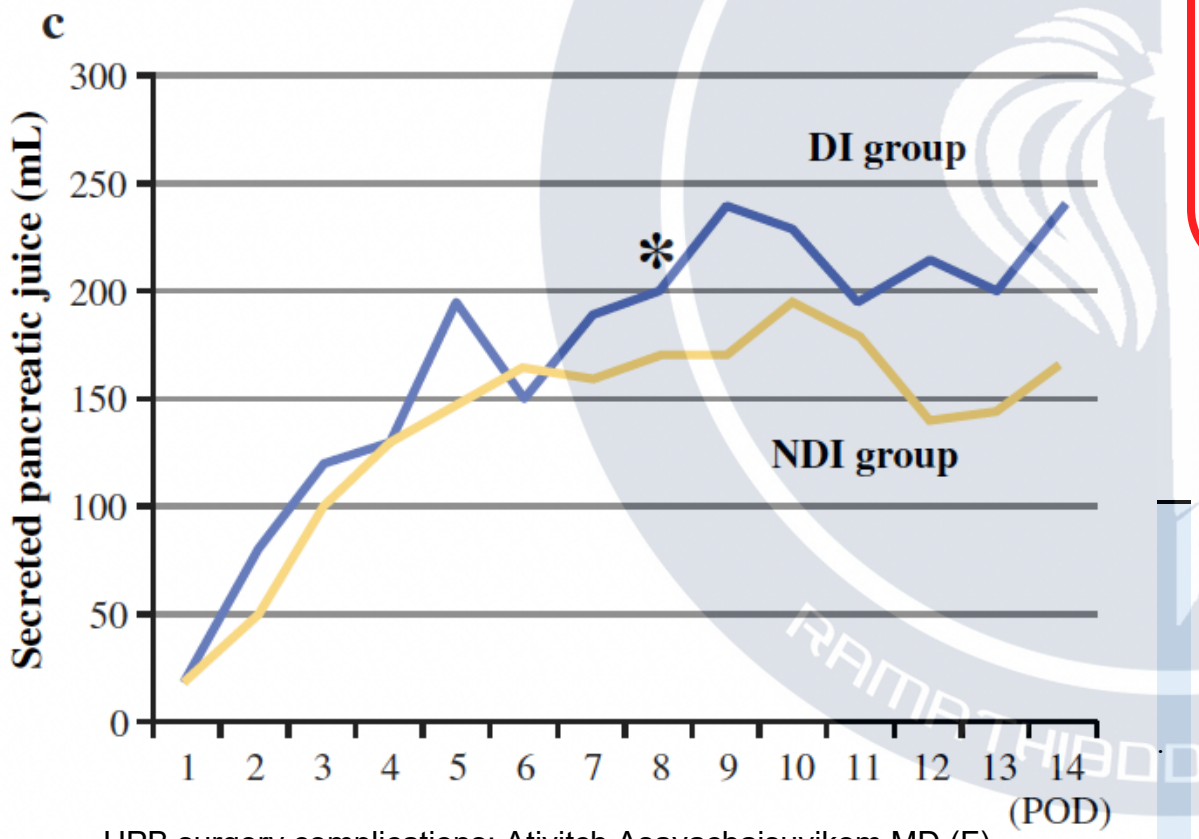


TABLE 2 Postoperative complications

	DI group ($n = 30$)	NDI group ($n = 29$)	p value
POPF			.3284
Grade A	10	10	
Grade B	20	17	
Grade C	0	2	
Clinically relevant POPF (grade B/C)	20	19	.9257
POPF-related hemorrhage	0	2	.1434
Length of drain placement (days)[a]	27 (7–80)	26 (7–70)	.8858
Delayed gastric emptying			.3574
Grade A	1	0	
Grade B	1	3	
Grade C	0	0	
Intra-abdominal abscess	1	2	.5334
Biliary leakage	0	0	1.0000
Ileus	1	0	.3214
Bacteremia	0	2	.1434
Wound infection	1	1	.9805
Peptic ulcer	1	0	.3214
Cholangitis	1	0	.3214
Others	4	2	.4135
Postoperative fasting period (days)[a]	5 (5–25)	23 (7–70)	<.0001
Drainage output volume (mL)[a]			
POD 1	170 (52–385)	213 (51–600)	.7587
POD 3	32.5 (2–1670)	44 (2–187)	.6347
POD 5	10 (2–845)	21 (2–221)	.2661
POD 7	10.5 (2–865)	15 (0–225)	.6891
Postoperative hospital stay (days)[a]	29.5 (16–88)	29 (17–78)	.4661
Reoperation	0	0	1.0000
Readmission	2	2	.9720
Mortality	0	0	1.0000

DI dietary intake, *NDI* no dietary intake, *POPF* postoperative pancreatic fistula, *POD* postoperative day

[a] Values are median (range)

Fujii T, Nakao A, Murotani K, et al. Influence of food intake on the healing process of postoperative pancreatic fistula after pancreatoduodenectomy: a multi-institutional randomized controlled trial. Ann Surg Oncol 2015;22:3905—12.

Management

Randomized clinical trial

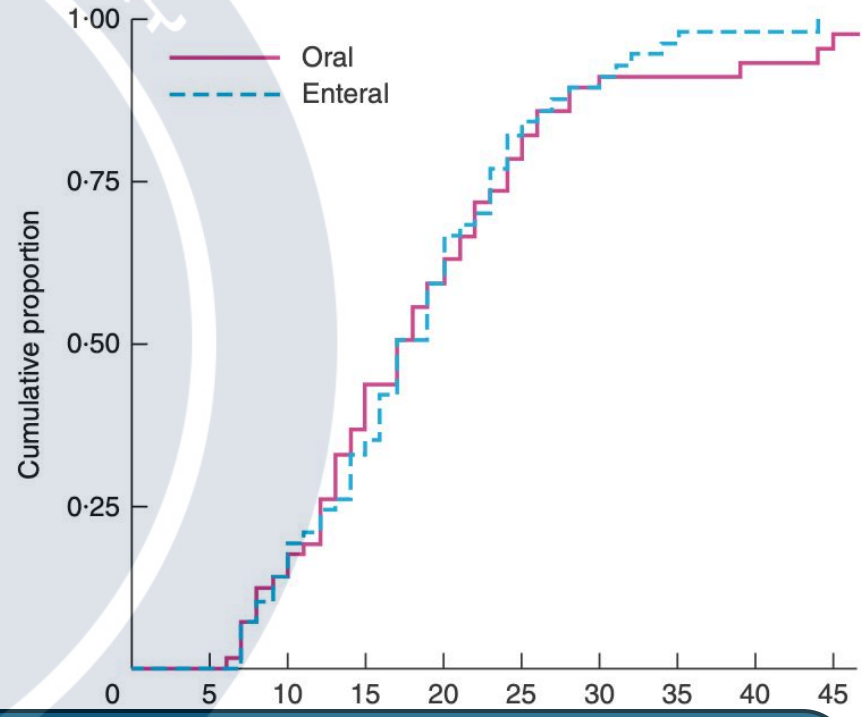
Randomized trial of oral *versus* enteral feeding for patients with postoperative pancreatoduodenectomy

J.-M. Wu[1], T.-C. Kuo[1], H.-A. Chen[6], C.-H. Wu[1], S.-R. Lai[2], C.-Y. Yang[1], S.-Y. Hsu[3], T.-W. Ho[4], W.-C. Liao[5,7] and Y.-W. Tien[1]

Departments of [1]Surgery, [2]Nutrition, [3]Nursing, [4]Bioinformatics and [5]Internal Medicine, National Taiwan University Hospital and National Taiwan University College of Medicine, [6]Department of Surgery, Shuang Ho Hospital, Taipei Medical University College of Medicine, and [7]Internal Medicine, College of Medicine, National Taiwan University, Taipei, Taiwan

Correspondence to: Dr Y.-W. Tien, Department of Surgery, National Taiwan University Hospital, National Taiwan University College of Medicine, 7 Chung-Shan South Road, Taipei 100, Taiwan (e-mail: ywtien5106@ntu.edu.tw)

	Enteral feeding ($n = 57$)	Oral feeding ($n = 57$)	*P* for superiority‡	*P* for non-inferiority#
Efficacy outcome				
Fistula closure within 30 days	51 (89; 79, 96)	50 (88; 76, 95)	–	0·020 (ITT) 0·011 (PP)
Time to fistula closure (days)*	17 (16–20; 16, 20)	17 (15–20; 15, 20)	0·617§	
Grade of fistula			0·582	
A	32 (56)	28 (49)		
B				
C				
Duration				
Cost afte				
Safety o				
Fever/				
Fluid c				
Pneun				
Postp				
Diarrh				
Readmission			0·718	



Oral feeding in patients with POPF after pancreatoduodenectomy did not increase the duration or grade of POPF, and was associated with reduced duration of stay and hospital costs

Wu JM, Kuo TC, Chen HA, et al. Randomized trial of oral versus enteral feeding for patients with postoperative pancreatic fistula after pancreatoduodenectomy. Br J Surg. 2019 Feb;106(3):190-198.

Management

Medication

- Somatostatin analogue

No clear recommendations

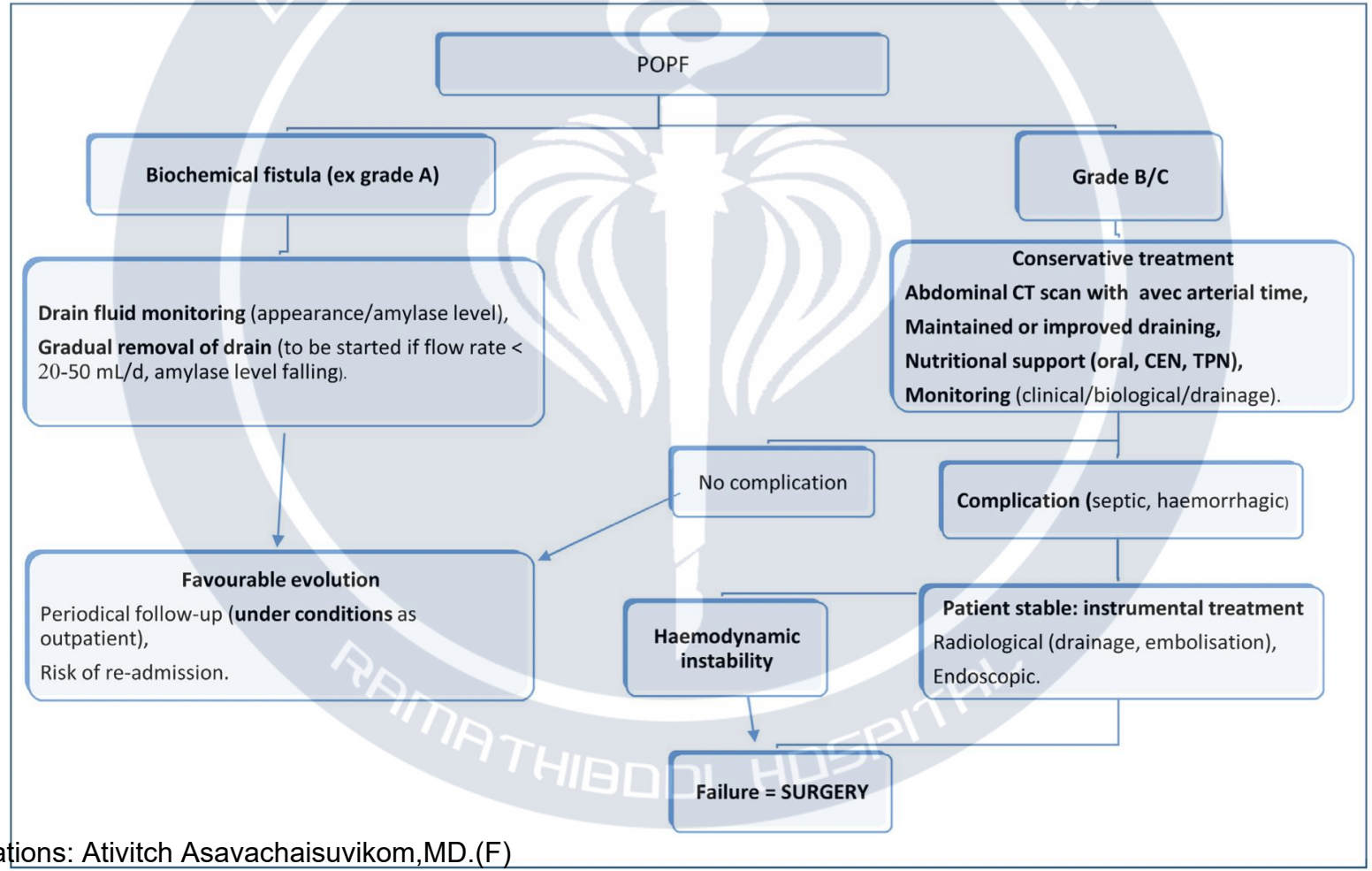
Intervention

- Pancreatic duct stent
  - Retrospective study ; ERCP with p-duct stent was not seen benefit in distal pancreatectomy

Schorn S, Vogel T, Demir IE, et al.. Do somatostatin-analogues have the same impact on postoperative morbidity and pancreatic fistula in patients after pancreaticoduodenectomy and distal pancreatectomy? - A systematic review with meta-analysis of randomized-controlled trials. Pancreatology. 2020 Dec;20(8):1770-1778. doi: 10.1016/j.pan.2020.10.043. Epub 2020 Oct 22. PMID: 33121847.

Linder, S., Holmberg, M., Agopian-Dahlenmark, L. et al. Endoscopic main duct stenting in refractory postoperative pancreatic fistula after distal pancreatectomy – a friend or a foe?. BMC Surg 24, 33 (2024). https://doi.org/10.1186/s12893-023-02233-x

Management



B. Malgras, S. Dokmak, B. Aussilhou, et al. Management of postoperative pancreatic fistula after pancreaticoduodenectomy, Journal of Visceral Surgery, Volume 160, Issue 1, 2023, Pages 39-51, ISSN 1878-7886

https://doi.org/10.1016/j.hpb.2024.11.006 HPB

ORIGINAL ARTICLE

Reoperation for pancreatic fistula: a systematic review of completion pancreatectomy vs. pancreas-preserving-procedures and outcomes

Alessio Marchetti[1,2,*], Gaetano Corvino[1,*], Giampaolo Perri[3], Giovani Marchegiani[3] & Raffaele De Luca[4]

[1]Department of Pancreatic Surgery, Verona University Hospital, Piazzale Ludovico Antonio Scuro 10, 37134, Verona, VR, Italy, [2]Department of Surgery, The NYU Grossman School of Medicine and NYU Langone Health, 550 First Avenue, New York, NY, 10016, USA, [3]Hepato Pancreato Biliary (HPB) and Liver Transplant Surgery, Department of Surgical, Oncological and Gastroenterological Sciences (DiSCOG), University of Padua, Via Giustiniani 2, 35128, Padova, and [4]Department of Surgical Oncology, I.R.C.C.S Istituto Tumori "Giovanni Paolo II", Viale Orazio Flacco 65, 70124, Bari, Italy

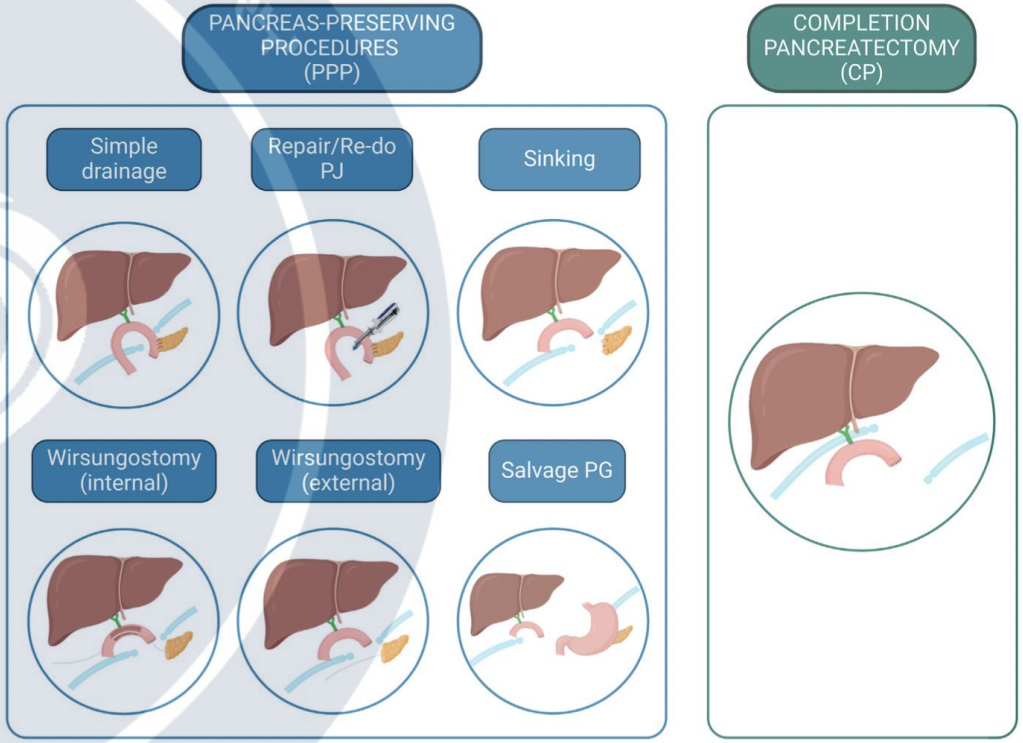
Abstract

Background: Consensus on the nomenclature and indications for reoperation for post-operative pancreatic fistula (POPF) after pancreatoduodenectomy (PD) is lacking. This study explores the available literature to classify the different types of reoperations and report outcomes.

Methods: A systematic literature search was performed, including articles from 2010 to 2024 reporting reoperations for POPF after PD. The primary outcome was 30- or 90-day-mortality. Secondary outcomes included reoperation date, additional relaparotomy, ICU-admission, hospital stay, rate of pancreatic-exocrine-insufficiency, diabetes and long-term survivors.

Results: Twenty-five studies were reviewed with 766 patients reoperated for POPF after PD, 283 (37 %) undergoing completion pancreatectomy (CP) and 483 (63 %) pancreas-preserving-procedures (PPPs). Among PPPs, drainage (30 %), wirsungostomy (14 %), pancreatic anastomosis repair (6 %), "sinking" of pancreatic stump (6 %) and re-do pancreatic anastomosis (4 %) were identified. The main indications for reoperation were post-pancreatectomy hemorrhage, necrotizing acute pancreatitis, sepsis and peritonitis. PPPs were preferred with severe hemodynamic instability. Mortality rates after CP and PPPs ranged from 20 to 56 % and 0–67 %, respectively. Early reoperation was associated with reduced ICU-recovery after "sinking" ($p = 0.049$).

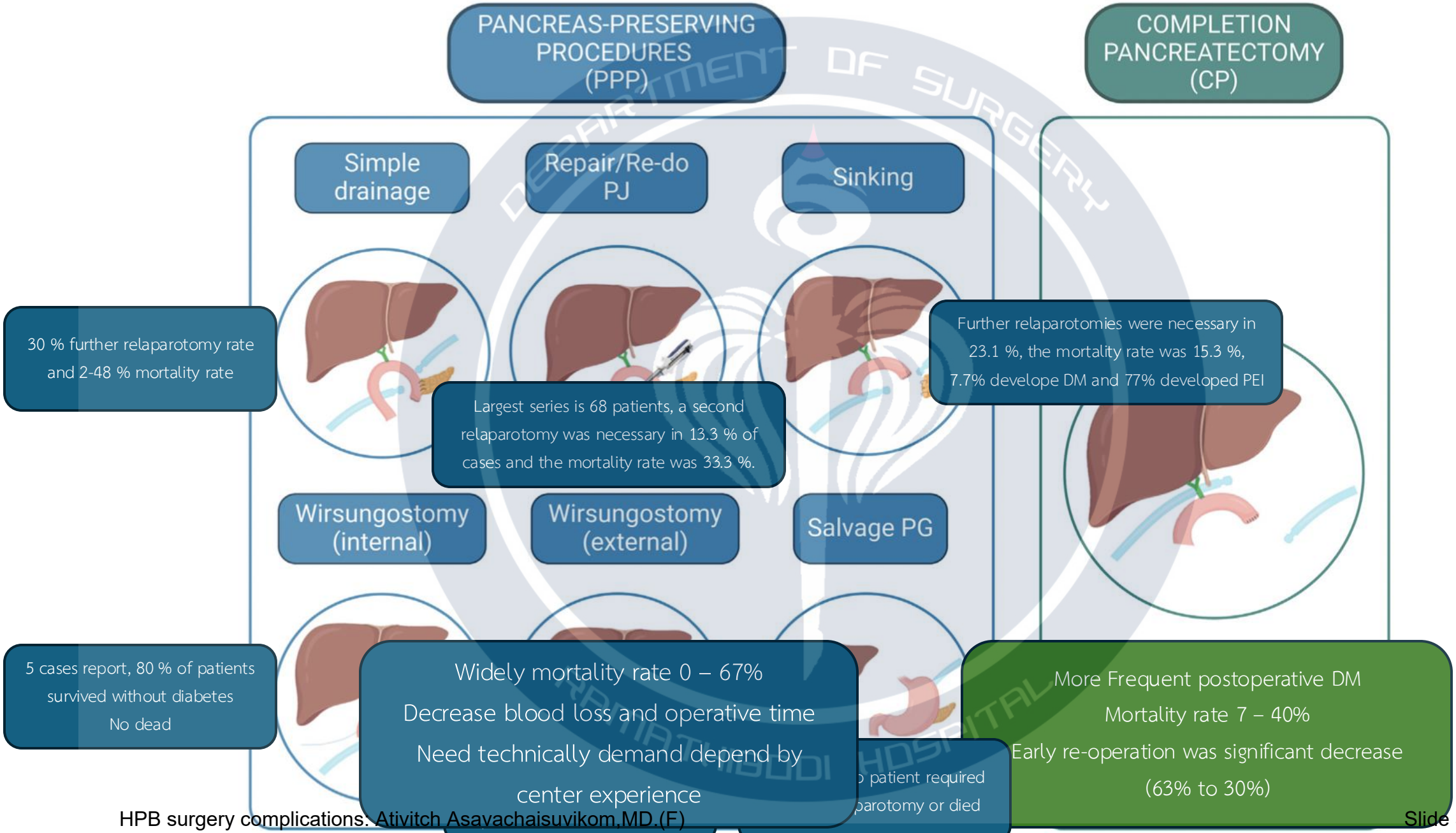
Conclusion: Reoperation for POPF after PD is rarely needed. When it is, early timing seems critical for better outcomes, and PPPs seems to be the best bail out option in patients with severe hemodynamic instability.



Severe hemodynamic instability was the most common indication

Main indications were Sepsis (22.3%), PPH (17.3%)

Alessio Marchetti, Gaetano Corvino, Giampaolo Perri, Reoperation for pancreatic fistula: a systematic review of completion pancreatectomy vs. pancreas-preserving-procedures and outcomes, HPB, Volume 27, Issue 2, 2025



Alessio Marchetti, Gaetano Corvino, Giampaolo Perri, Reoperation for pancreatic fistula: a systematic review of completion pancreatectomy vs. pancreas-preserving-procedures and outcomes, HPB, Volume 27, Issue 2, 2025

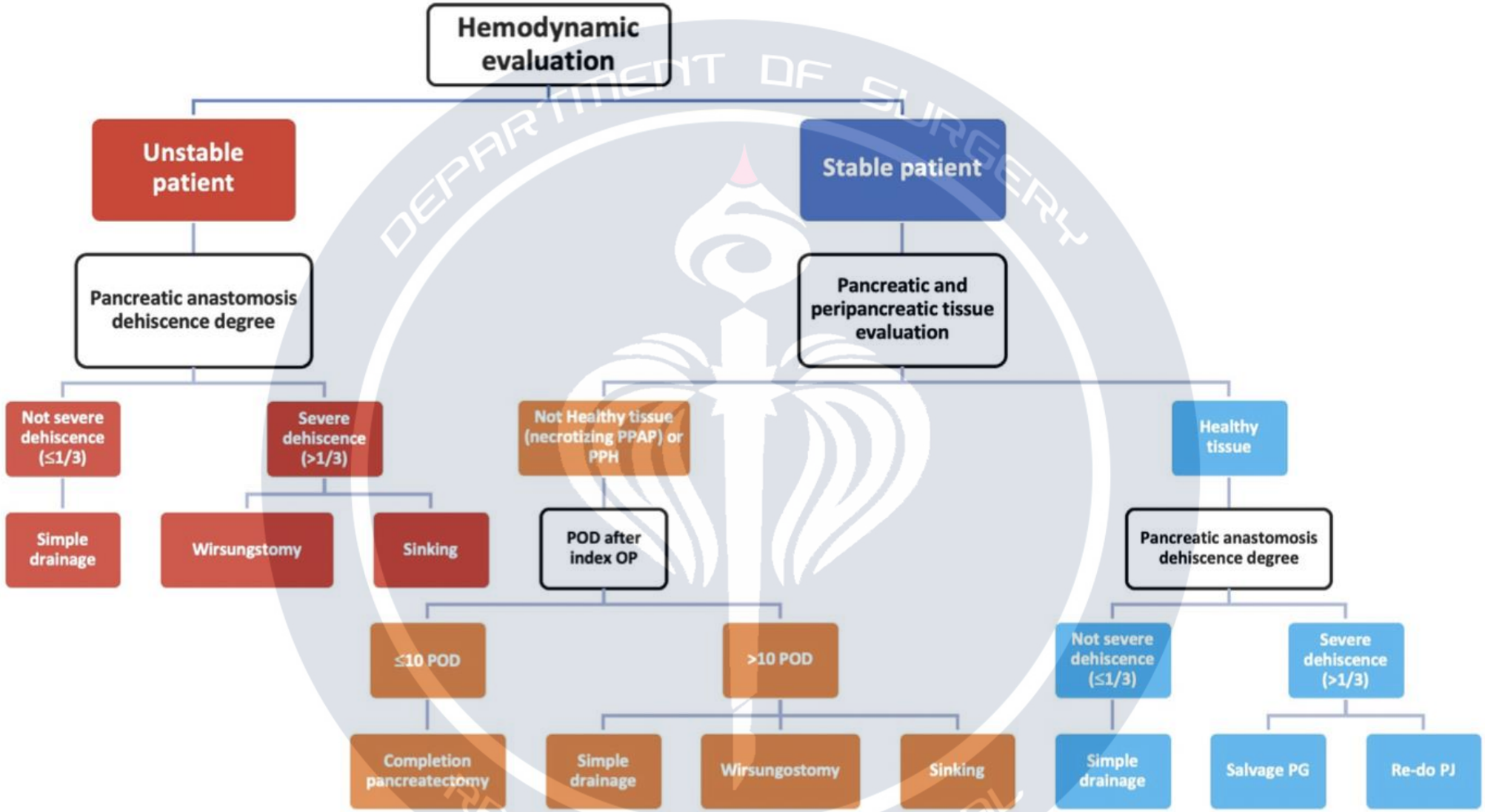


Figure 2 **Decision making flow-chart for reoperation in patients with POPF after PD** Abbreviations: POPF, post operative pancreatic fistula; PD, pancreato-duodenectomy; PPAP, post pancreatectomy acute pancreatitis; PPH, post pancreatectomy hemorrhage; POD, post operative day; PJ, pancreatico-jejunostomy; PG, pancreatico-gastrostomy

Alessio Marchetti, Gaetano Corvino, Giampaolo Perri, Reoperation for pancreatic fistula: a systematic review of completion pancreatectomy vs. pancreas-preserving-procedures and outcomes, HPB, Volume 27, Issue 2, 2025

Take home message for POPF

- Definition : Drain amylase > 3 times ULN on/after POD3
- Grading : ISGPS 2016
  - Grade B : persistent drainage > 3 weeks, PCD, endoscopic management, angiographic procedure, signs of infection
  - Grade C : Reoperation, Organ failure, Death
- No proven strategies for decrease incidence of grade B+C POPF
- Management :
  - Conservative
  - Surgery : may be performed in patients with hemodynamic instability or sepsis

Postpancreatectomy hemorrhage(PPH)

- Definition,

  "Postoperative hemorrhage after pancreatic resection including intraabdominal hemorrhage and gastrointestinal hemorrhage"

- Incidence 0.8 - 16.1 %
- Mortality–related PPH rate 0% - 30.8 %
- Ramathibodi hospital, incidence 9.3%

Wente MN, Veit JA, Bassi C, et al. Postpancreatectomy hemorrhage (PPH): an International Study Group of Pancreatic Surgery (ISGPS) definition. Surgery. 2007 Jul;142(1):20-5.
Jilesen AP, Tol JA, Busch OR, van Delden OM, van Gulik TM, Nieveen van Dijkum EJ, et al. Emergency management in patients with late hemorrhage after pancreatoduodenectomy for a periampullary tumor. World J Surg 2014;38(9):2438e47.
Feng J, Chen YL, Dong JH, Chen MY, Cai SW, Huang ZQ. Post-pan- creaticoduodenectomy hemorrhage: risk factors, managements and out- comes. Hepatobiliary Pancreat Dis Int 2014;13(5):513e22.

Postpancreatectomy hemorrhage

- Defined by 3 parameters;
  - Onset
  - Location
  - Severity

Wente MN, Veit JA, Bassi C, et al. Postpancreatectomy hemorrhage (PPH): an International Study Group of Pancreatic Surgery (ISGPS) definition. Surgery. 2007 Jul;142(1):205.

Postpancreatectomy hemorrhage

- Defined by 3 parameters;
  - Onset : Early(within 24 hours) vs Late(more than 24 hours)
  - Location
  - Severity

Wente MN, Veit JA, Bassi C, et al. Postpancreatectomy hemorrhage (PPH): an International Study Group of Pancreatic Surgery (ISGPS) definition. Surgery. 2007 Jul;142(1):205.

Postpancreatectomy hemorrhage

Early onset (within 24 hours)

- Technical failure
  - Inadequate hemostatic at time of surgery
  - A slipped ligature
  - Bleeding from anastomosis
- Underling coagulopathy
  - Diffuse hemorrhage from retroperitoneum
  - Jaundice

Late onset (more than 24 hours)

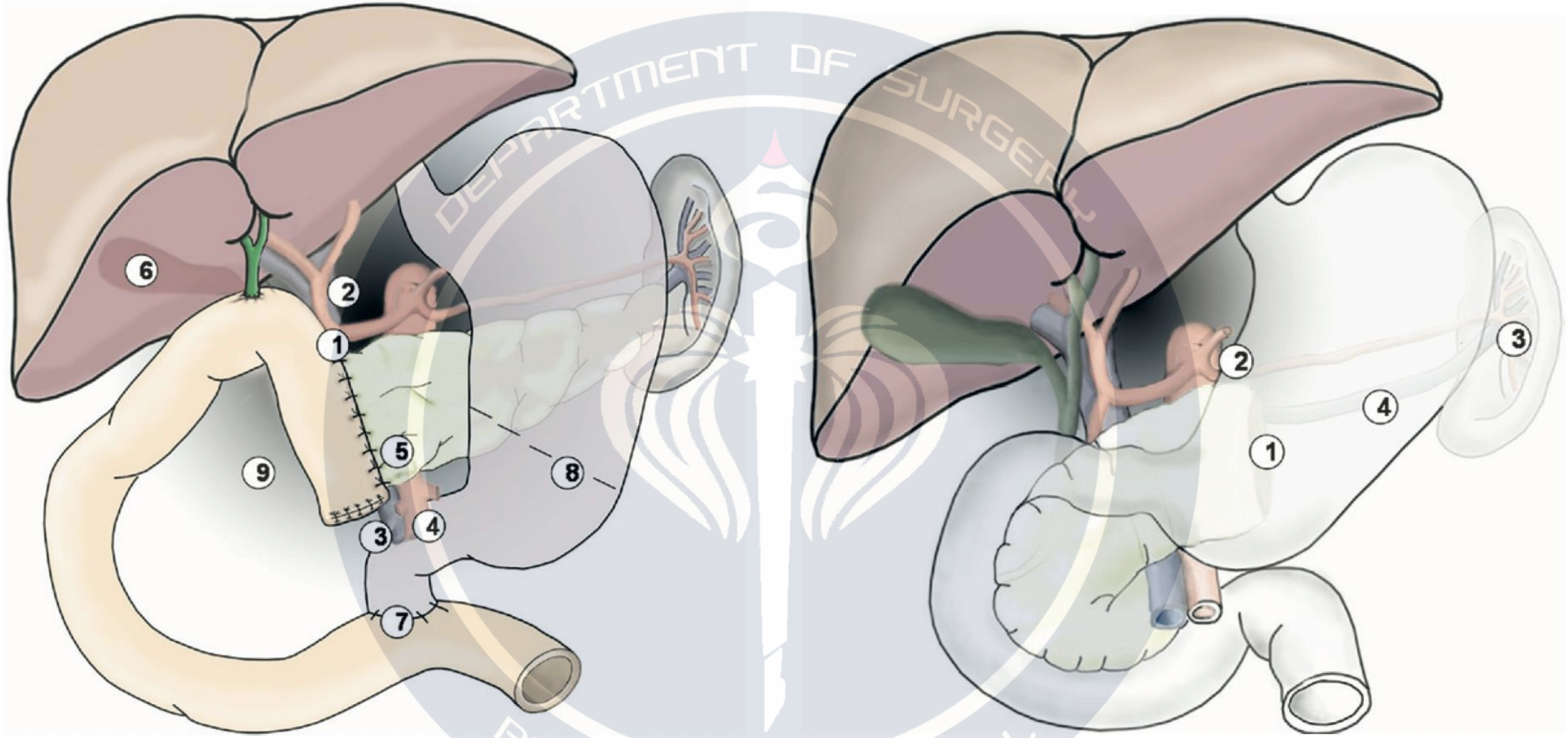
- Mortality rates ranged from 15% to 58%
- Complex pathogenesis
  - surgical trauma (including vascular skeletonization during lymphadenectomy)
  - vascular erosion secondary to anastomotic leakage
  - intra-abdominal abscess
  - pseudoaneurysm formation
  - intraluminal ulcerations

Wente MN, Veit JA, Bassi C, et al. Postpancreatectomy hemorrhage (PPH): an International Study Group of Pancreatic Surgery (ISGPS) definition. Surgery. 2007 Jul;142(1):205.

Postpancreatectomy hemorrhage

- Defined by 3 parameters;
  - Onset : Early(within 24 hours) vs Late(more than 24 hours)
  - Location : Right vs Left pancreatic resection, Intraluminal vs Extraluminal
  - Severity

Wente MN, Veit JA, Bassi C, et al. Postpancreatectomy hemorrhage (PPH): an International Study Group of Pancreatic Surgery (ISGPS) definition. Surgery. 2007 Jul;142(1):205.



Right side pancreatic resection

Left side pancreatic resection

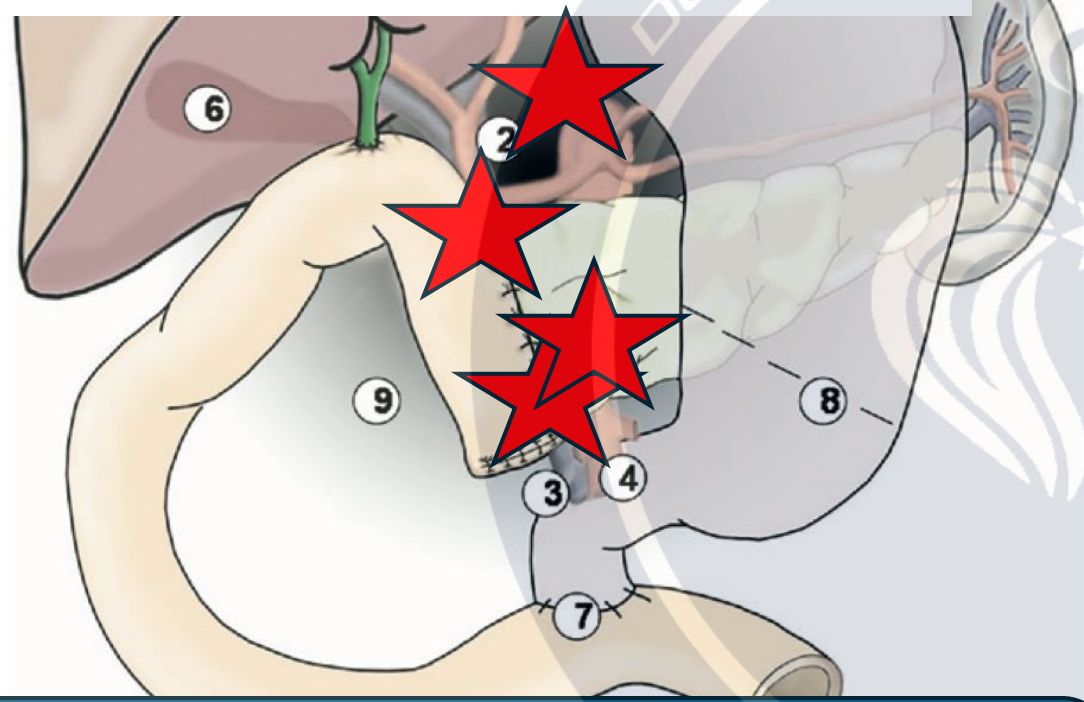
Wente MN, Veit JA, Bassi C, et al. Postpancreatectomy hemorrhage (PPH): an International Study Group of Pancreatic Surgery (ISGPS) definition. Surgery. 2007 Jul;142(1):205.

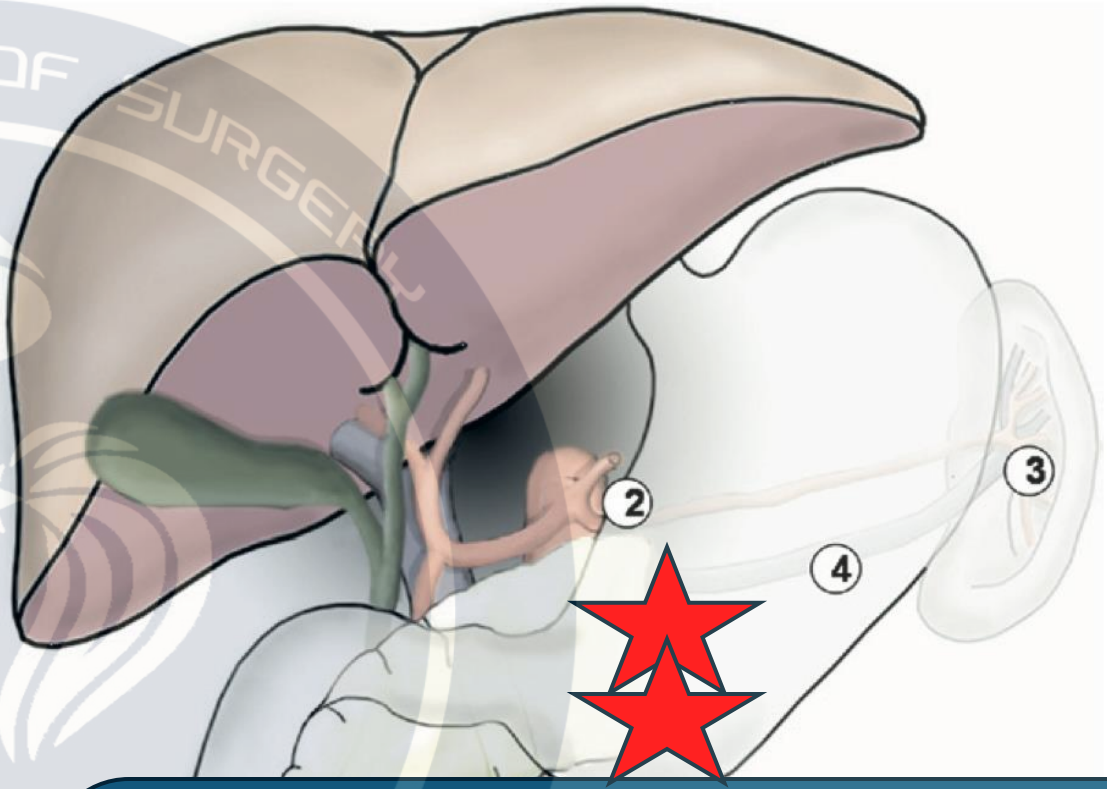
ORIGINAL ARTICLE

A systematic review of post-pancreatectomy haemorrhage management stratified according to ISGPS grading

Thomas A. Maccabe[1], Harry F. Robertson[1], James Skipworth[1], Jonathan Rees[1], Keith Roberts[1,2] & Samir Pathak[1]

[1]Department of Hepatopancreatobiliary Surgery, University Hospitals Bristol and Weston NHS Foundation Trust, Bristol, and
[2]Department of Pancreatic Surgery, University Hospitals Birmingham, UK





Early PPH

- Pancreatic remnant in 41.2%(7/17)

Late PPH

- GDA stump in 27.4%
- CHA in 21.4%
- Pancreatic remnant in 9.3%

Wente MN, Veit JA, Bassi C, et al. Postpancreatectomy hemorrhage (PPH): an International Study Group of Pancreatic Surgery (ISGPS) definition. Surgery. 2007 Jul;142(1):205.

Thomas A. Maccabe, Harry F. Robertson, James Skipworth, et als, A systematic review of post-pancreatectomy haemorrhage management stratified according to ISGPS grading, HPB, Volume 24, Issue 7, 2022

Postpancreatectomy hemorrhage

- Location
  - Intraluminal
    - anastomosis suture line at stomach or duodenum
    - pancreatic surface at anastomosis
    - stress ulcer
    - pseudoaneurysm
  - Extraluminal
    - anastomosis suture line at stomach or duodenum
    - pancreatic surface at anastomosis
    - stress ulcer
    - pseudoaneurysm

Wente MN, Veit JA, Bassi C, et al. Postpancreatectomy hemorrhage (PPH): an International Study Group of Pancreatic Surgery (ISGPS) definition. Surgery. 2007 Jul;142(1):205.

Postpancreatectomy hemorrhage

- Defined by 3 parameters;
  - Onset : Early(within 24 hours) vs Late(more than 24 hours)
  - Location : Right vs Left pancreatic resection, Intraluminal vs Extraluminal
  - Severity : Mild vs Severe

Wente MN, Veit JA, Bassi C, et al. Postpancreatectomy hemorrhage (PPH): an International Study Group of Pancreatic Surgery (ISGPS) definition. Surgery. 2007 Jul;142(1):205.

Severity of Hemorrhage

Mild

- Small or medium volume blood loss (from drains, nasogastric tube, or on ultrasonography, decrease in hemoglobin concentration <3 g/dl)
- Mild clinical impairment of the patient, no therapeutic consequence, or at most the need for noninvasive treatment with volume resuscitation or blood transfusions (2-3 units packed cells within 24 h of end of operation or 1-3 units if later than 24 h after operation)
- No need for reoperation or interventional angiographic embolization; endoscopic treatment of anastomotic bleeding may occur provided the other conditions apply

Severe

- Large volume blood loss (drop of hemoglobin level by ≥3 g/dl)
- Clinically significant impairment (eg, tachycardia, hypotension, oliguria, hypovolemic shock), need for blood transfusion (>3 units packed cells)
- Need for invasive treatment (interventional angiographic embolization, or relaparotomy)

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Wente MN, Veit JA, Bassi C, et al. Postpancreatectomy hemorrhage (PPH): an International Study Group of Pancreatic Surgery (ISGPS) definition. Surgery. 2007 Jul;142(1):205.

Table II. Proposed classification of PPH: clinical condition, diagnostic and therapeutic consequences

Grade	*Time of onset, location, severity and clinical impact of bleeding*		*Clinical condition*	*Diagnostic consequence*	*Therapeutic consequence*
A	Early, intra- or extraluminal, mild		Well	Observation, blood count, ultrasonography and, if necessary, computed tomography	No
B	Early, intra- or extraluminal, severe	Late, intra- or extraluminal, mild*	Often well/ intermediate, very rarely life-threatening	Observation, blood count, ultrasonography, computed tomography, angiography, endoscopy†	Transfusion of fluid/ blood, intermediate care unit (or ICU), therapeutic endoscopy,† embolization, relaparotomy for early PPH
C		Late, intra- or extraluminal, severe	Severely impaired, life-threatening	Angiography, computed tomography, endoscopy†	Localization of bleeding, angiography and embolization, (endoscopy†) *or* relaparotomy, ICU

Wente MN, Veit JA, Bassi C, et al. Postpancreatectomy hemorrhage (PPH): an International Study Group of Pancreatic Surgery (ISGPS) definition. Surgery. 2007 Jul;142(1):205.

ORIGINAL ARTICLE

Reappraisal of post-pancreatectomy hemorrhage (PPH) classifications: do we need to redefine grades A and B?

Alvaro A. Duarte Garcés[1,2], Stefano Andrianello[2], Giovanni Marchegiani[2], Roberta Piccolo[2], Erica Secchettin[2], Salvatore Paiella[2], Giuseppe Malleo[2], Roberto Salvia[2] & Claudio Bassi[2]

[1]Departamento Cirugía Hepato Biliar y Pancreatica, Hospital Pablo Tobon Uribe, Medellìn, Colombia, and [2]General and Pancreatic Surgery – The Pancreas Institute, University of Verona Hospital Trust, Verona, Italy

		Cohort without PPH (n = 2264)	A (n = 21)	B (n = 100)	C (n = 44)	P
Sex	M	1137 (50.2%)	8 (38.1%)	55 (55%)	28 (63.6%)	0.3
	F	1127 (49.8%)	13 (61.9%)	45 (45%)	16 (36.4%)	
Age		61 (20–77)	59 (33–62)	60 (24–77)	60 (24–77)	0.4
BMI		23 (17.5–35.2)	25.3 (18–32.2)	23 (19–35.2)	23 (17–31.2)	0.7
Type of surgery	Whipple	1378 (60.8%)	15 (71.4%)	71 (71%)	34 (77.2%)	0.5
	DP	624 (27.5%)	4 (19%)	18 (18%)	6 (13.6%)	
	TP	100 (4.4%)	2 (9.5%)	6 (6%)	0	
	Limited resections	162 (7.1%)	0	4 (4%)	4 (9%)	
POPF		158 (7%)	3 (14.3%)	25 (25%)	18 (63.6%)	<0.01
Abscess		393 (17.4%)	7 (33.3%)	47 (47%)	29 (65.9%)	0.04
BF		51 (2.3%)	1 (4.8%)	7 (7%)	11 (25%)	<0.01
POAP		68 (3%)	0	12 (12%)	13 (29.5%)	0.01
EF		30 (1.3%)	0	7 (7%)	9 (20.5%)	0.04
DGE		105 (4.6%)	2 (10%)	9 (9%)	8 (18.6%)	<0.01
ICU stay		0	1 (4.8%)	18 (18%)	18 (41.9%)	<0.01
LHS (median, range)						
Mortality						
Readmission						
Site of PPH	Ex					
	Int					
Management	Su					
	Int					
	Ob					

Table 1 PPH definition according to the ISGPS[8]

Time of onset	Early	<24 h from surgery
	Late	>24 h from surgery
Location	Intraluminal	Intra-enteric
	Extraluminal	Bleeding in the abdominal cavity or evident by drains
Severity	Mild	- Small amount of blood from NGT, drains or at US - Hgb drop <3 g/dL - Mild clinical impairment - No therapeutic consequence - 2–3 PRBC if < 24 h from surgery - 1–3 if > 24 h from surgery
	Severe	- large blood loss - Hgb drop > 3 g/dL - Significant clinical impairment - > 3 PRBC - invasive treatment
Grade A	Early	- no clinical impairment - observation - no therapeutic consequence
	Mild	
Grade B	Early and severe or Late and mild	- Rarely life-threatening - CT scan, angiography, endoscopy - Endoscopy, embolization or severe PPH
		ing giography, embolization,

Grade A PPH shared the same outcome of patients without PPH. Grade B PPH included two categories of patients with different treatment modalities

Duarte Garcés AA, Andrianello S, Marchegiani G, et al. Reappraisal of post-pancreatectomy hemorrhage (PPH) classifications: do we need to redefine grades A and B? HPB (Oxford). 2018 Aug;20(8):702-707.

Postpancreatectomy hemorrhage

- Prevention techniques
  - 5 RCT reported in strategies that significantly reduced the rate of PPH after PD
    - small jejunal incision
    - falciform ligament wrap around the gastroduodenal artery stump
    - pancreaticojejunostomy (vs pancreaticogastrostomy)
    - perioperative pasireotide administration
    - algorithm-based postoperative patient management
  - No significant reported to reduced the rate of PPH after distal pancreatectomy

Montorsi RM, Zonderhuis BM, Daams F et al, Treatment strategies to prevent or mitigate the outcome of postpancreatectomy hemorrhage: a review of randomized trials. Int J Surg. 2024 Oct 1;110(10):6145-6154.

End-to-side duct-to-mucosa pancreaticojejunostomy after pancreaticoduodenectomy

A comparison trial of small *versus* larger jejunal incision. A single center experience

Ann. Ital. Chir., 2020 91, 5: 469-477
pii: S0003469X20032996

F. Francesco di Mola*/**, Tommaso Grottola*/**, Paolo Panaccio*, Francesca Tavano***, Antonio De Bonis**, Maria Rosa Valvano***, Pierluigi di Sebastiano*/**

**Unit of General and Oncological Surgery, Casa di Cura Pierangeli, University G. D'Annunzio Pescara, Italy*
***Department of Surgery IRCCS, Hospital "Casa Sollievo della Sofferenza", San Giovanni Rotondo, Italy*
****Division of Gastroenterology, IRCCS, Hospital "Casa Sollievo della Sofferenza", San Giovanni Rotondo, Italy*

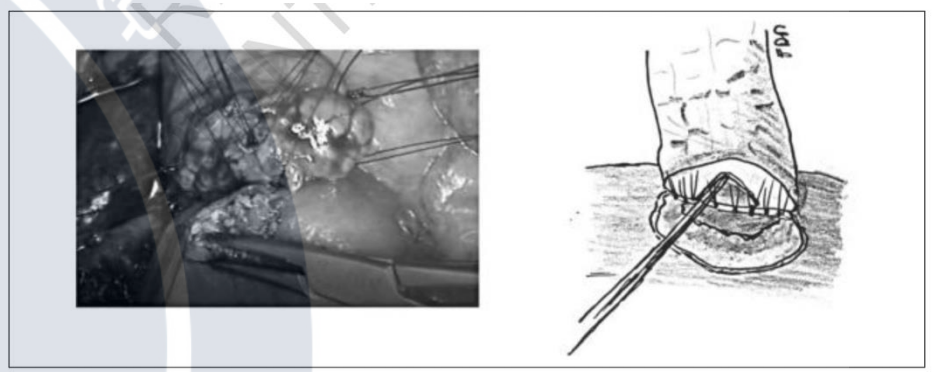


Fig. 1: Large Jejunal Incision (LJI)

TABLE III - *Postoperative course and complications of 48 patients who underwent pancreaticoduodenectomy*

	Group LJI n=22	Group SJI n=26	*P*-value
Pancreatic fistula, y/n (%y)	3/19 (13,6)	1/25 (4)	0.341
PPH, y/n (%y)	8/14 (36)	2/24 (8)	*0.018
DGE, y/n (%y)	5/17 (23)	4/22 (15)	0.389
Therapy with Octreotide (days), median (IQR)	7 (5-10)	6 (5-7)	*0.040
Removal of left drainage			
Postoperative hospital sta			
Amylase content in drain			

PPH: Post-pancreatectom

Small jejunal incision groups was significant reduced the rate of PPH

di Mola FF, Grottola T, Panaccio P, Tavano F, De Bonis A, Valvano MR, Di Sebastiano P. End-to-side duct-to-mucosa pancreaticojejunostomy after pancreaticoduodenectomy A comparison trial of small versus larger jejunal incision. A single center experience. Ann Ital Chir. 2020

Contents lists available at ScienceDirect

Surgery

journal homepage: www.elsevier.com/locate/surg

Retromesenteric omental flap as arterial coverage in pancreaticoduodenectomy: A novel technique to prevent postpancreatectomy hemorrhage

Lancelot Marique, MD, Tatiana Codjia, MD, Jeanne Dembinski, MD, Safi Dokmak, MD, PhD, Beatrice Aussilhou, MD, François Jehaes, MD, François Cauchy, MD, Mickaël Lesurtel, MD, PhD, Alain Sauvanet, MD*

Department of HPB Surgery and Liver Transplantation, Beaujon Hospital, APHP, University of Paris Cité, Clichy, France

scientific reports

OPEN

Prevention of postpancreatectomy hemorrhage after laparoscopic pancreaticoduodenectomy by wrapping ligamentum teres hepatis surrounding hepatic portal artery

Zhicheng Wang[1,2,3], Yong Wang[1,3], Chao Zhu[1], Hongtao Pan[1], Shilei Chen[1], Xiaosi Hu[1], Shuai Zhou[1], Huichun Liu[1], Qing Pang[1] & Hao Jin[1]

OXFORD

BJS, 2022, **109**, 37–45

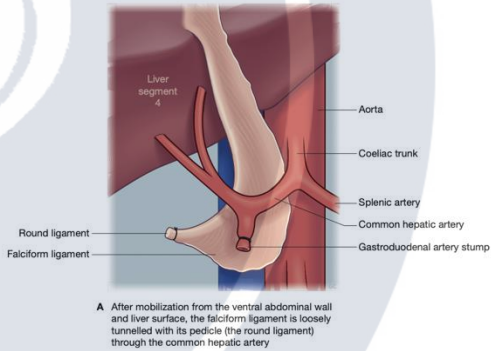
DOI: 10.1093/bjs/znab363

Advance Access Publication Date: 8 November 2021

Randomized Clinical Trial

Pancreatoduodenectomy with or without prophylactic falciform ligament wrap around the hepatic artery for prevention o… randomized…

Thilo Welsch[1,*], Benjam…
Anna Klimova[3], Nicole Treb…
Jörg Kleeff[7], Octavian Popes…
Maximilian Brunner[10], Henr…



A After mobilization from the ventral abdominal wall and liver surface, the falciform ligament is loosely tunnelled with its pedicle (the round ligament) through the common hepatic artery

445 patients were randomized in 2 groups

Per protocol analysis showed a significant reduction in the …ntervention group (odds ratio …nt c.i. 0.09 to …7)

Arterial coverage with omental flap

was significant reduced the rate of PPH

Welsch T, Müssle B, Kong S, et al. Pancreatoduodenectomy with or without prophylactic falciform ligament wrap around the hepatic artery for prevention of postpancreatectomy haemorrhage: randomized clin- ical trial (PANDA trial). Brit Surg 2021;109:37–45.
Marique L, Codjia T, Dembinski J, Dokmak S, Aussilhou B, Jehaes F, Cauchy F, Lesurtel M, Sauvanet A. Retromesenteric omental flap as arterial coverage in pancreaticoduodenectomy: A novel technique to prevent postpancreatectomy hemorrhage. Surgery. 2024 Aug;176(2):440-446.
Wang, Z., Wang, Y., Zhu, C. et al. Prevention of postpancreatectomy hemorrhage after laparoscopic pancreaticoduodenectomy by wrapping ligamentum teres hepatis surrounding hepatic portal artery. Sci Rep 14, 18332 (2024). https://doi.org/10.1038/s41598-024-69292-9

Management

- Depend on grading and center experience

Contents lists available at ScienceDirect

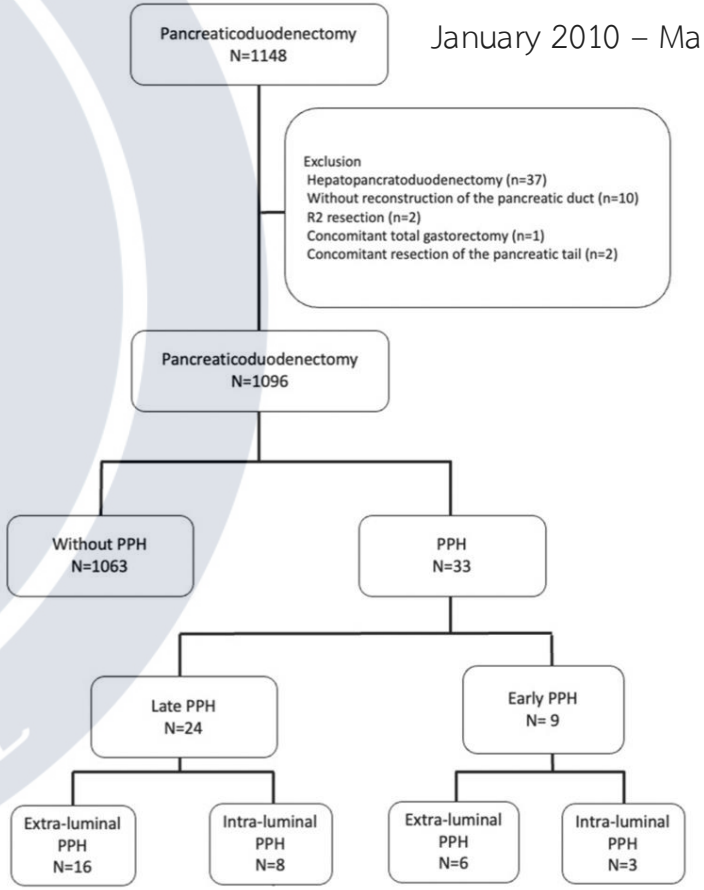
Pancreatology

journal homepage: www.elsevier.com/locate/pan

Diagnosis and management of postpancreatectomy hemorrhage: A single-center experience of consecutive 1,096 pancreatoduodenectomies

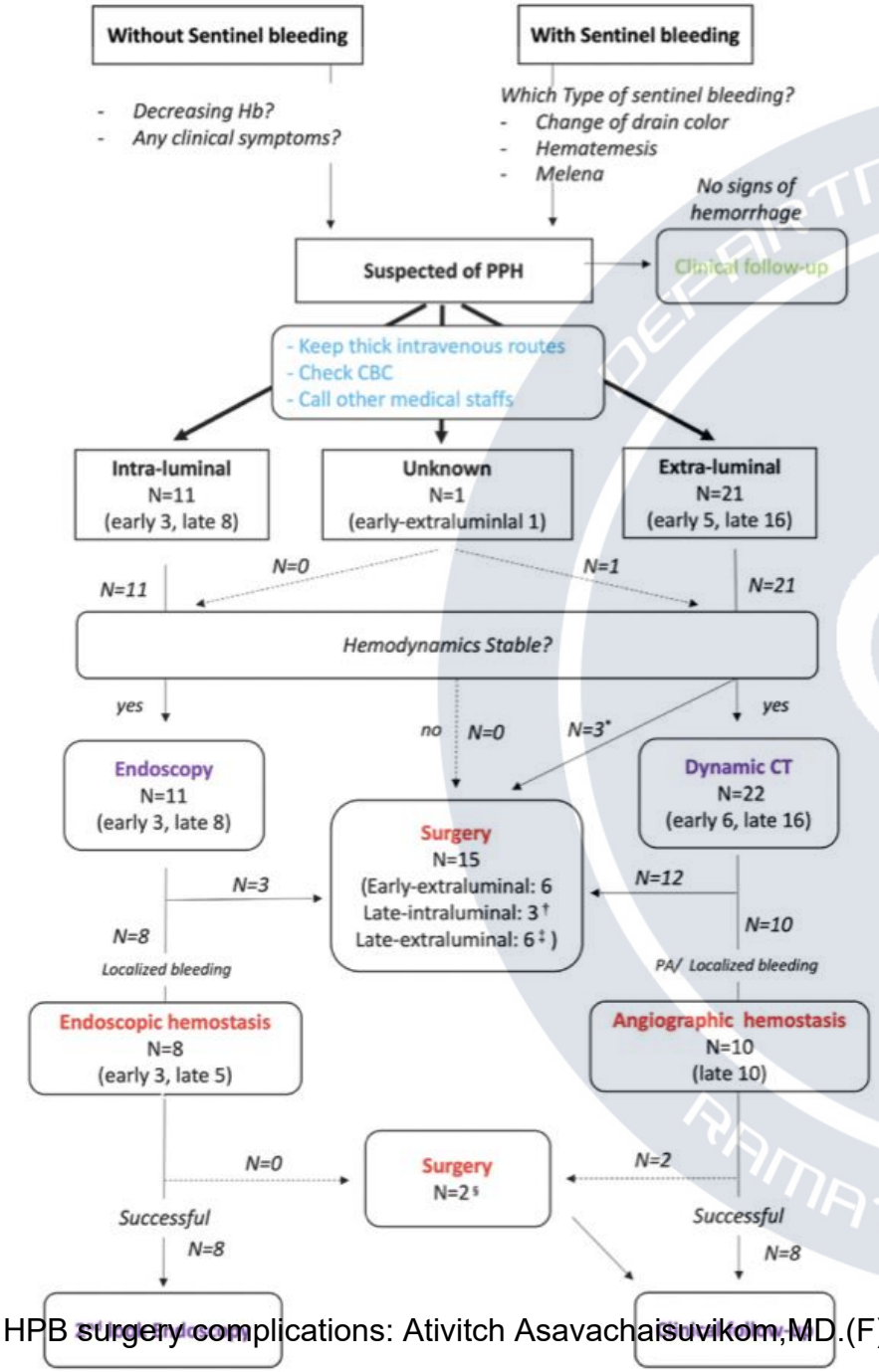
Kosuke Kobayashi [a], Yosuke Inoue [a,*], Kojiro Omiya [a], Shoki Sato [a], Tomotaka Kato [a], Atsushi Oba [a], Yoshihiro Ono [a], Takafumi Sato [a], Hiromichi Ito [a], Kiyoshi Matsueda [b], Akio Saiura [c], Yu Takahashi [a]

[a] Division of Hepatobiliary and Pancreatic Surgery, Cancer Institute Hospital, Japanese Foundation for Cancer Research, Tokyo, Japan
[b] Department of Diagnostic Ultrasound, Interventional Radiology, Cancer Institute Hospital, Japanese Foundation for Cancer Research, Tokyo, Japan
[c] Department of Hepatobiliary and Pancreatic Surgery, Juntendo University School of Medicine, Tokyo, Japan



January 2010 – March 2021

Kosuke Kobayashi, Yosuke Inoue, Kojiro Omiya, et al, Diagnosis and management of postpancreatectomy hemorrhage: A single-center experience of consecutive 1,096 pancreatoduodenectomies, Pancreatology, Volume 23, Issue 3, 2023



Laparotomy was indicated in

- Early extraluminal PPH
- Patients whom no imaging modality or physical examination could identify the source of bleeding
- Hemodynamic unstable

Kosuke Kobayashi, Yosuke Inoue, Kojiro Omiya, et al, Diagnosis and management of postpancreatectomy hemorrhage: A single-center experience of consecutive 1,096 pancreatoduodenectomies, Pancreatology, Volume 23, Issue 3, 2023

Take home message for PPH

- Definition : postoperative hemorrhage after pancreatic resection
- Grading depend on onset, location and severity
- Management
  - Resuscitation
  - Intervention : Endoscopy vs angioembolization
  - Laparotomy : early extraluminal PPH, Hemodynamic unstable

Delayed gastric emptying(DGE)

- Definition

  "The inability to tolerate solid food or prolonged nasogastric tube requirement."

Table II. Consensus definition of DGE after pancreatic surgery

DGE grade	*NGT required*	*Unable to tolerate solid oral intake by POD*	*Vomiting/gastric distension*	*Use of prokinetics*
A	4–7 days or reinsertion > POD 3	7	±	±
B	8–14 days or reinsertion > POD 7	14	+	+
C	>14 days or reinsertion > POD 14	21	+	+

- Incidence 3.2 – 59% (Average clinically relevant DGE (grades B and C) in 46 studies with 10013 cases was 14.3%)

Wente MN, Bassi C, Dervenis C, et al. Delayed gastric emptying (DGE) after pancreatic surgery: a suggested definition by the International Study Group of Pancreatic Surgery (ISGPS). Surgery. 2007 Nov;142(5):761-8. doi: 10.1016/j.surg.2007.05.005. PMID: 17981197

Panwar R, Pal S. The International Study Group of Pancreatic Surgery definition of delayed gastric emptying and the effects of various surgical modifications on the occurrence of delayed gastric emptying after pancreatoduodenectomy. HepatobiliaryPancreat Dis Int. 2017 Aug 15;16(4):353-363..

Table III. Parameters for grading of DGE

DGE	*Grade A*	*Grade B*	*Grade C*
Clinical condition	Well	Often well/minor discomfort	Ill/bad/severe discomfort (increased overall risk owing to complications and procedures)
Comorbidities	No	Possibly yes (pancreatic leak or fistula, intraabdominal abscess)	Possibly yes (pancreatic leak or fistula, intraabdominal abscess)
Specific treatment	Possibly yes (prokinetic drugs)	Yes (prokinetic drugs, potential reinsertion of NGT)	Yes (prokinetic drugs, NGT)
Nutritional support (enteral or parenteral)	Possibly yes (slower return to solid food intake)	Yes (partial parenteral nutrition)	Yes (total parenteral or enteral nutrition via NGT, prolonged, i.e., >3 weeks postoperatively)
Diagnostic evaluation	No	Possibly yes (endoscopy, upper GI contrast study, CT)	Yes (endoscopy, upper GI contrast study, CT)
Interventional treatment	No	No	Possibly yes (e.g., abscess drainage, relaparotomy for complication, relaparotomy for DGE)
Prolongation of hospital stay	Possibly yes	Yes	Yes
Delay of potential adjuvant therapy	No	No	Yes

CT, Computed tomography; *DGE,* Delayed gastric emptying; *GI,* Gastrointestinal; NGT, nasogastric tube.

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Wente MN, Bassi C, Dervenis C, et al. Delayed gastric emptying (DGE) after pancreatic surgery: a suggested definition by the International Study Group of Pancreatic Surgery (ISGPS). Surgery. 2007 Nov;142(5):761-8. doi: 10.1016/j.surg.2007.05.005. PMID: 17981197.

Delayed gastric emptying(DGE)

Surgical technique and DGE

- PPPD vs Standard PD
  - There was no difference in the DGE rates between PPPD and standard PD in a Cochrane review by Diener et al

- Pylorus and DGE
  - Hypothesis : rate of DGE was increase in PPPD group due to pyloric spasm
  - Few meta-analysis(retrospective data) : SSPD was decrease rate of DGE when compare with PPPD
  - SSPD vs Whipple operation still unknown

Diener MK, Fitzmaurice C, Schwarzer G, Seiler CM, Huttner FJ, Antes G, et al. Pylorus-preserving pancreaticoduodenec- tomy (pp Whipple) versus pancreaticoduodenectomy (clas- sic Whipple) for surgical treatment of periampullary and pancreatic carcinoma. Cochrane Database Syst Rev 2014;11: CD006053.

Zhou Y, Lin L, Wu L, Xu D, Li B. A case-matched comparison and meta-analysis comparing pylorus-resecting pancreatico- duodenectomy with pylorus-preserving pancreaticoduodenec- tomy for the incidence of postoperative delayed gastric empty- ing. HPB (Oxford) 2015;17:337-343.

Delayed gastric emptying(DGE)

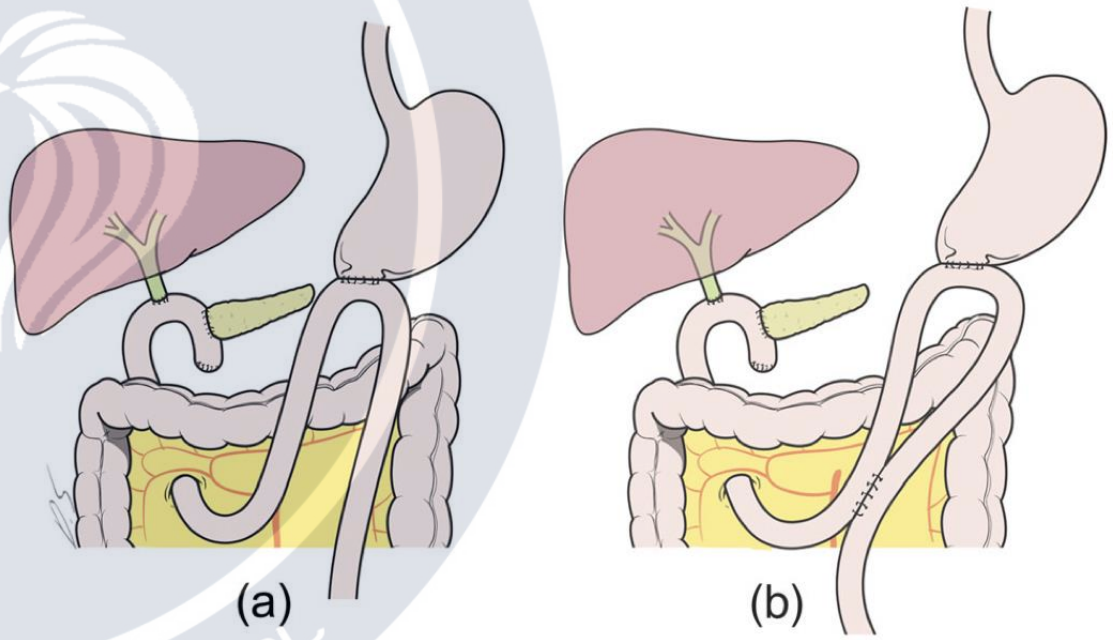
- Billroth I vs Billroth II vs Roux-en-Y reconstruction
  - No statistically significant difference in the rate of DGE grade B/C between Roux-en-Y compared to Billroth (overall OR 1.83 [CI 95% 0.76-4.42], p= 0.18).

- Antecolic vs retrocolic gastrojejunal anastomosis
  - Zhou et al. meta-analysis : recruited 5 RCTS, 534 patients showed that no significant difference in route of GJ anastomosis(odds ratio, 0.66; 95 % confidence interval, 0.32 to 1.33; P = 0.24)

Zhou Y, Lin J, Wu J, *et al*. Effect of antecolic or retrocolic reconstruction of the gastro/duodenojejunostomy on delayed gastric emptying after pancreaticoduodenectomy: a meta-analysis. *BMC Gastroenterol* 15, 68 (2015).
Montorsi, Roberto M., Strijbos, Bo T.M., Stommel, Martijn W.J., et al.. Preventing and Treating Delayed Gastric Emptying (DGE) after Pancreatic Surgery: A Systematic Review and Metaanalysis of Randomized Controlled Trials. Annals of Surgery ():10.1097/SLA.0000000000006642, January 29, 2025
Hwang HK, Lee SH, Han DH, Choi SH, Kang CM, Lee WJ. Impact of Braun anastomosis on reducing delayed gastric emptying following pancreaticoduodenectomy: a prospective, randomized controlled trial. J Hepatobiliary Pancreat Sci. 2016 Jun;23(6):364-72. doi: 10.1002/jhbp.349. Epub 2016 Apr 24.

Delayed gastric emptying(DGE)

- Braun's enteroenterostomy
  - Clinically relevant DGE (grades B and C) was marginally more frequent in the No-Braun group (23.3% vs. 3.3%, P = 0.052).
  - In a multivariable analysis, No-Braun anastomosis was an independent risk factor for developing clinically relevant DGE (odds ratio = 16.489;95%CI[1.287,211.195]; P = 0.031).



Hwang HK, Lee SH, Han DH, Choi SH, Kang CM, Lee WJ. Impact of Braun anastomosis on reducing delayed gastric emptying following pancreaticoduodenectomy: a prospective, randomized controlled trial. J Hepatobiliary Pancreat Sci. 2016 Jun;23(6):364-72. doi: 10.1002/jhbp.349. Epub 2016 Apr 24.

Contents lists available at ScienceDirect

Surgery

journal homepage: www.elsevier.com/locate/surg

Delayed gastric emptying after pancreatoduodenectomy: One complication, two different entities

Giovanni Marchegiani, MD, PhD[a], Anthony Di Gioia, MD[a], Tommaso Giuliani, MD[a], Michela Lovo, MD[a], Eleonora Vico, MD[b], Marco Cereda, MD[b], Claudio Bassi, MD[a,*], Luca Gianotti, MD, PhD[b], Roberto Salvia, MD, PhD[a]

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Intraoperative findings

		Total (N = 1170)	No DGE (N = 982) 83.9%	DGE (n = 188) 16.1%	P value
PD type	Pylorus-preserving	899 (76.8%)	769 (78.3%)	130 (69.1%)	.008
	Whipple	271 (23.2%)	213 (21.7%)	58 (30.9%)	
PD type of reconstruction	PJ	1085 (92.7%)	919 (93.6%)	166 (88.3%)	.014
	PG	85 (7.3%)	63 (6.4%)	22 (11.7%)	
Vascular resection		154 (13.2%)	135 (13.7%)	19 (10.1%)	.196
Total operative time (min, median, IQR)		417 (362–475)	415 (360–470)	427 (380–480)	.005
Gland texture	Firm	536 (45.8%)	479 (48.8%)	57 (30.3%)	< .005
	Soft	634 (54.2%)	503 (51.2%)	131 (69.7%)	
Main pancreatic duct diameter (mm, median, IQR)		4 (3–5)	4 (3–5)	3 (2–4)	< .005
Estimated blood loss (mL, median, IQR)		400 (300–600)	400 (300–600)	483 (300–785)	< .005
FRS (median, IQR)[21]		4 (2–6)	3 (2–5)	5 (3–7)	< .005
FRS (risk zone)	Negligible/Low risk (0–2)	392 (33.5%)	355 (36.2%)	37 (19.7%)	< .005
	Intermediate risk (3–6)	630 (53.8%)	531 (54,1%)	99 (52.7%)	
	High risk (7–10)	149 (12.7%)	97 (9.9%)	52 (27.7%)	
Need for intraoperative blood transfusions		123 (10.5%)	89 (9.1%)	34 (18.1%)	< .005
Lymphadenectomy (harvested nodes, median, IQR)		39 (29–48)	39 (29–49)	38 (28–47)	.226
Optimal lymphadenectomy (>28 nodes)[37]		932 (79.7%)	783 (79.7%)	149 (79.3%)	.842

DGE, delayed gastric emptying; *FRS*, fistula risk score; *PD*, pancreatoduodenectomy; *PJ*, pancreatojejunostomy; *PG*, pancreatogastrostomy.

Table IV
Comparison between primary and secondary DGE

		Total (N = 188)	Primary DGE (N = 53, 28.2%)	Secondary DGE (N = 135, 71.8%)	P value
DGE ISGPS grade[5]	Grade A	34 (18.1%)	16 (30.2%)	18 (13.3%)	< .005
	Grade B	92 (48.9%)	30 (56.6%)	62 (45.9%)	
	Grade C	62 (33.0%)	7 (13.2%)	55 (40.8%)	
CR DGE		154 (81.9%)	37 (69.8%)	117 (86.7%)	.011
DGE ACB (SD)		0.296 (0.09)	0.279 (0.10)	0.303 (0.09)	.256
Day of onset (median, IQR)		5 (3–7)	4 (2–8)	5 (3–7)	.243
Day of resolution (median, IQR)		13 (9–21)	11 (9–14)	14 (10–25)	.007
Time to resolution (d, median, IQR)		8 (5–14)	6 (4–10)	9 (5–17)	.009
Use of total parenteral nutrition		150 (79.8%)	42 (79.2%)	108 (80%)	1.000
Duration of parenteral nutritional support (d, median, IQR)		10 (6–20)	6 (4–10)	13 (8–24)	< .005
Use of enteral nutrition		143 (76.1%)	30 (56.6%)	113 (83.7%)	< .005
Duration of enteral nutritional support (d, median, IQR)		11 (6–18)	7 (4–10)	12 (7–20)	.016

Primary DGE : otherwise

Secondary DGE : occurring contemporarily or immediately afterward (<5 days) with the development of another complication including perigastric collection, POPF, PPH, chyle leak, biliary leak, and gast

The primary form resolves earlier, and its occurrence might be reduced by pylorus preservation. For the secondary form, clinicians should focus on preventing and treating other trigger complications

Marchegiani G, Di Gioia A, Giuliani T, et al. Delayed gastric emptying after pancreatoduodenectomy: One complication, two different entities. Surgery. 2023 May;173(5):1240-1247.

Delayed gastric emptying(DGE)

- Management
  - Work up :
    - CT for evaluate collection
    - Upper GI swallowing or EGD for evaluate mechanical obstruction
  - NG tube for decompression
    - The time of removal of NGT was determined when drainage is less than 500mL/day.
  - Motilin receptors agonists like erythromycin have shown to decrease postoperative DGE
  - If DGE persists, endoscopic insertion of a jejunal feeding tube
  - Correct cause

Lytras D, Paraskevas KI, Avgerinos C, Manes C, Touloumis Z, Paraskeva KD, et al. Therapeutic strategies for the management of delayed gastric emptying after pancreatic resection. Langenbecks Arch Surg. 2007;392(1):1-12.

Post pancreatectomy acute pancreatitis (PPAP)

- ISGPS 2022 Definition

"acute inflammatory condition of the pancreatic remnant occurring in the setting of a partial pancreatic resection and initiated early in the perioperative period within the first 3 PODs."

- POH (Postoperative Hyperamylasemia)

"As only biochemical evidence, POH had, by definition, no clinically relevant impact. Notably, POH did not result in any deviation in the normal postoperative recovery course."

Marchegiani G, Barreto SG, Bannone E, et al. International Study Group for Pancreatic Surgery. Postpancreatectomy Acute Pancreatitis (PPAP): Definition and Grading From the International Study Group for Pancreatic Surgery (ISGPS). Ann Surg. 2022 Apr 1;275(4):663-672.

Postpancreatectomy Acute Pancreatitis (PPAP)

Definition and Grading From the International Study Group for Pancreatic Surgery (ISGPS)

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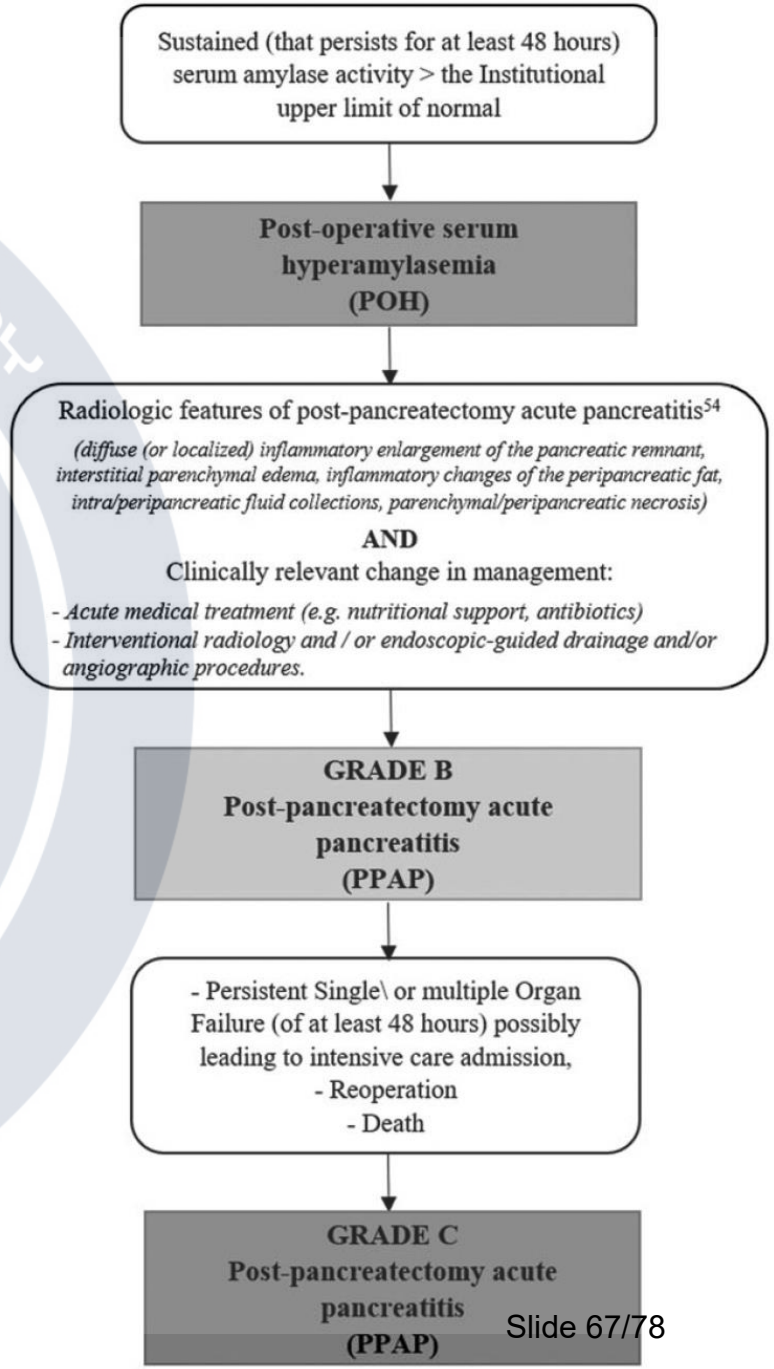
TABLE 1. The ISGPS classification and grading of PPAP

	Biochemical features	Radiologic features[†,53]	Grade	Clinical impact
PPAP Postpancreatectomy acute pancreatitis	Sustained (that persists for at least 48 h) serum amylase* activity > the institutional upper limit of normal	Yes	GRADE B	Mild or moderate complications that require: - Acute medical treatment (eg, antibiotics, steroids, supplementary nutritional support), - Interventional radiology and / or endoscopic-guided drainage and/or angiographic procedures.
		Yes	GRADE C	Severe life-threatening complications that lead to: persistent organ failure (of at least 48 h), possibly leading to intensive care admission; surgical intervention; or death.



Marchegiani G, Barreto SG, Bannone E, et al. International Study Group for Pancreatic Surgery. Postpancreatectomy Acute Pancreatitis (PPAP): Definition and Grading From the International Study Group for Pancreatic Surgery (ISGPS). Ann Surg. 2022 Apr 1;275(4):663-672.

Post pancreatectomy acute pancreatitis (PPAP)

Retrospective studies

- PPAP may also lead to other local complications especially peripancreatic collections and PPH developing severe morbidity showed concurrent complications.
- Postpancreatectomy necrotizing pancreatitis is extremely rare

	POAP		
	No (n = 129)	Yes (n = 163)	*P*
Clavien–Dindo ≥IIIB	5 (3.8%)	23 (14.1%)	<0.01
POPF	6 (4.7%)	59 (36.2%)	<0.01
B	4 (4.1%)	46 (35.4%)	<0.01
C	2 (2.4%)	13 (10.3%)	
PPH	8 (6.2%)	21 (12.9%)	0.04
A	1 (12.5%)	3 (14.3%)	<0.01
B	6 (75%)	11 (52.4%)	
C	1 (12.5%)	7 (33.3%)	
DGE	16 (12.4%)	22 (13.5%)	0.8
A	3 (18.8%)	0	0.08
B	7 (43.8%)	12 (54.5%)	
C	6 (37.5%)	10 (45.5%)	
Abscess	17 (13.2%)	75 (46%)	<0.01
Chyle leak	1 (0.8%)	9 (5.5%)	0.03
Biliary fistula	4 (3.1%)	11 (6.7%)	0.2
Sepsis	8 (6.2%)	26 (16%)	0.01
Pneumonia	14 (10.9%)	38 (23.3%)	<0.01
Cardiac morbidity	4 (3.1%)	18 (11%)	0.02
Wound infection	13 (10.1%)	28 (17.2%)	0.08
Relaparotomy	5 (3.9%)	20 (12.3%)	0.01
ICU stay	7 (5.4%)	19 (11.7%)	0.04
Mortality at 90 d	2 (1.6%)	11 (6.7%)	0.03
Readmission	3 (2.3%)	11 (6.7%)	0.06
Serum pancreatic amylase (U/L, median, range)			
POD0	11 (0 – 52)	114 (53 – 934)	< 0.01
POD1	7 (0 – 46)	186 (53 – 973)	< 0.01
Drain amylase (U/L, median, range)			
POD1	164 (20 – 7500)	3042 (101 – 7500)	< 0.01
POD5	22 (13 – 7500)	163 (10 – 7500)	0.1
C-reactive protein (mg/L, median, range)			
POD1	88 (8 – 253)	101 (3 – 316)	0.07
POD2	152 (26 – 359)	220 (32 – 297)	< 0.01
POD3	122 (20 – 443)	219 (40 – 507)	< 0.01

DGE indicates delayed gastric emptying.

Marchegiani G, Barreto SG, Bannone E, et al. International Study Group for Pancreatic Surgery. Postpancreatectomy Acute Pancreatitis (PPAP): Definition and Grading From the International Study Group for Pancreatic Surgery (ISGPS). Ann Surg. 2022 Apr 1;275(4):663-672.

Bannone, Elisa MD; Andrianello, Stefano MD; Marchegiani, Giovanni MD, PhD, et al.Postoperative Acute Pancreatitis Following Pancreaticoduodenectomy: A Determinant of Fistula Potentially Driven by the Intraoperative Fluid Management. Annals of Surgery 268(5):p 815-822, November 2018

Contents lists available at ScienceDirect

Pancreatology

journal homepage: www.elsevier.com/locate/pan

Post-pancreatectomy acute pancreatitis after pancreatoduodenectomy: Analysis of a clinically-relevant complication in a single-center retrospective study

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Characteristics	No PPAP n (%)	PPAP n (%)	p
CR-POPF	27 (11.6)	22 (55.0)	**<0.001**
Completion Pancreatectomy	7 (3.0)	7 (17.5)	**<0.001**
Biliary leakage	12 (5.2)	4 (10.0)	0.231
DGE	41 (17.7)	14 (35.0)	**0.012**
PPH	31 (13.4)	19 (47.5)	**<0.001**
Wound infection	31 (13.4)	9 (22.5)	0.132
Pleural effusion	62 (26.7)	17 (42.5)	**0.042**
Re-Laparotomy	37 (15.9)	17 (42.5)	**<0.001**
Clavien-Dindo ≥ 3a	66 (28.4)	32 (80.0)	**<0.001**
Hospital stay[a]	14.5 (6–137)	24.5 (12–100)	**<0.001**
Readmission	50 (21.6)	10 (25.0)	0.627
90 days mortality	8 (3.4)	4 (10.0)	0.062

Table 4
Patient outcomes stratified by PPAP and CR-POPF occurrence.

Characteristics	CR-POPF-/PPAP-(n = 205)	CR-POPF-/PPAP+(n = 18)	p[a]	CR-POPF+/PPAP-(n = 27)	CR-POPF+/PPAP+(n = 22)	p**	p***
Completion Pancreatectomy	0 (0.0)	0 (0.0)	1.000	7 (25.9)	7 (31.8)	0.650	**0.008**
Biliary leakage	8 (3.9)	1 (5.6)	0.733	4 (14.8)	3 (13.6)	0.907	0.397
DGE	33 (16.1)	5 (27.8)	0.206	8 (29.6)	9 (40.9)	0.409	0.386
PPH	20 (9.8)	7 (38.9)	**<0.001**	11 (40.7)	12 (54.5)	0.336	0.324
Wound infection	21 (10.2)	3 (16.7)	0.399	10 (37.0)	6 (27.3)	0.468	0.424
Pleural effusion	48 (23.4)	6 (33.3)	0.346	14 (51.9)	11 (50.0)	0.897	0.289
Re-Laparotomy	25 (12.3)	7 (38.9)	**0.002**	12 (44.4)	10 (45.5)	0.944	0.676
Clavien-Dindo ≥ 3a	44 (21.5)	10 (55.6)	**0.001**	27 (100.0)	22 (100.0)	1.000	**<0.001**
Hospital stay[§]	14 (6–137)	21.5 [12–32]	**<0.001**	35 (7–97)	32.5 (18–100)	0.874	**0.004**
ICU costs (Euro)[§]	2332.8 (0–91888.0)	3620.4 (0–42416.0)	**0.029**	8854.2 (1631.0–140317.0)	9985.6 (1647.0–75499.0)	0.568	0.153
Total costs (Euro)[§]	18870.3 (10267.0 –193539.0)	19950.0 (1146.0 –69726.0)	0.320	30856.7 (13337.0 –252353.0)	30237.2 (17146.0 –136674.0)	0.292	**0.021**
Readmission	40 (19.5)	4 (22.2)	0.782	10 (37.0)	6 (27.3)	0.468	0.714
90 days mortality	5 (2.4)	2 (11.1)	**0.043**	3 (11.1)	2 (9.1)	0.902	0.832

CR-POPF: clinically relevant postoperative pancreatic fistula; PPAP: post-pancreatectomy acute pancreatitis; DGE: delayed gastric emptying; PPH: post-pancreatectomy hemorrhage; ICU: intensive care units.

[a] CR-POPF-/PPAP- vs CR-POPF-/PPAP+; **CR-POPF+/PPAP- vs CR-POPF+/PPAP+; ***CR-POPF-/PPAP + vs CR-POPF+/PPAP+; [§]median (range).

Bellotti R, Pably D, Morell-Hofert D, et al. Post-pancreatectomy acute pancreatitis after pancreatoduodenectomy: Analysis of a clinically-relevant complication in a single-center retrospective study. Pancreatology. 2024 Feb;24(1):137-145.

Post hepatectomy hemorrhage

- ISGLS 2011 Definition

"Hb drop >3 g/dl post-operatively compared with post-operative baseline level and/or any post-operative transfusion of PRBCs for a falling Hb and/or the need for invasive re-intervention (e.g. embolization or re-laparotomy) to stop bleeding."

- Incidence 4.2-10%

Rahbari NN, Garden OJ, Padbury R, et al.. Post-hepatectomy haemorrhage: a definition and grading by the International Study Group of Liver Surgery (ISGLS). HPB (Oxford). 2011 Aug;13(8):528-35.

Post hepatectomy hemorrhage

Table 2 Consensus proposal of the ISGLS for the definition and severity grading of post-hepatectomy haemorrhage (PHH)

Definition	Post-hepatectomy haemorrhage (PHH) is defined as a drop of haemoglobin level >3 g/dl after the end of surgery compared to postoperative baseline level and/or any postoperative transfusion of PRBCs for a falling hemoglobin and/or the need for invasive re-intervention (e.g. embolization or re-laparotomy) to stop bleeding. To diagnose PHH (and to exclude other sources of haemorrhage) evidence of intraabdominal bleeding should be obtained such as frank blood loss via the abdominal drains if present (e.g. haemoglobin level in drain fluid >3 g/dl) or detection of an intra-abdominal haematoma or active haemorrhage by abdominal imaging (ultrasound, CT, angiography). Patients who are transfused immediately postoperatively for intra-operative blood loss by a maximum of two units of PRBCs (i.e. who do not have evidence of active haemorrhage) are *not* diagnosed with PHH.	
Grading	A	PHH requiring transfusion of up to 2 units of PRBCs
	B	PHH requiring transfusion of >2 units of PRBCs but manageable without invasive intervention
	C	PHH requiring radiological interventional treatment (e.g. embolization) or re-laparotomy

Rahbari NN, Garden OJ, Padbury R, et al.. Post-hepatectomy haemorrhage: a definition and grading by the International Study Group of Liver Surgery (ISGLS). HPB (Oxford). 2011 Aug;13(8):528-35.

Post hepatectomy hemorrhage

Table 3 Common clinical characteristics of patients with different severity grades of post-hepatectomy hemorrhage (PHH)

	Grade A	Grade B[a]	Grade C
Clinical condition[b]	Not impaired	Impaired	Life-threatening
Clinical symptoms	No	May have hypotension and tachycardia	May have haemodynamic instability (severe hypotension and tachycardia) Potential hypovolemic shock with organ dysfunction/failure
Adequate response to transfusion of PRBCs[c]	Yes	Yes/no	No
Need for diagnostic assessment	No	Yes	Yes
Radiological evaluation	Possible free intra-abdominal fluid/ haematoma	Free intra-abdominal fluid/ hematoma May have active bleeding on angiography	Free intra-abdominal fluid/ haematoma Active bleeding on angiography
Hospital stay	Commonly not prolonged	Commonly prolonged	Prolonged
Specific treatment	Discontinuation of anticoagulants Intravenous fluid therapy Transfusion of ≤2 units of PRBCs	Discontinuation of anticoagulants Intravenous fluid therapy Transfusion of >2 units of PRBCs	Discontinuation of anticoagulants Intravenous fluid therapy Transfusion of PRBCs Vasopressor therapy Embolization and/ or re-laparotomy

Rahbari NN, Garden OJ, Padbury R, et al.. Post-hepatectomy haemorrhage: a definition and grading by the International Study Group of Liver Surgery (ISGLS). HPB (Oxford). 2011 Aug;13(8):528-35.

Post hepatectomy hemorrhage

- Causes
  - Bleeding from the surfaces of the residual liver
  - Incomplete intraoperative hemostasis
  - Vascular sutures loosened or fallen off

Jin, Shan & Fu, Quan & Wuyun, Gerile & Wuyun, Tu. (2013). Management of post-hepatectomy complications. World journal of gastroenterology : WJG. 19. 7983-7991. 10.3748/wjg.v19.i44.7983.

Post hepatectomy hemorrhage

DOI:10.1111/hpb.12255

HPB

ORIGINAL ARTICLE

Post-hepatectomy haemorrhage: a single-centre experience

Aijun Li*, Bin Wu*, Weiping Zhou, Weifeng Yu, Li Li, Hang Yuan & Mengchao Wu

Eastern Hepatobiliary Surgery Hospital, Second Military Medical University, Shanghai, China

- Retrospectively, 77 patients (0.2% of 32 856 hepatectomy patients) for re-exploration from 2001 to 2010
- The most common anatomic site of intra-abdominal haemorrhage
  - cut surface of the liver (*n* = 51, 66.2%)
  - perihepatic ligaments (*n* = 19, 24.7%)
  - splenic fossa (*n* = 7, 9.1%)
  - the diaphragm (*n* = 6, 7.8%)
  - retroperitonium (*n* = 6, 7.8%)
  - right adrenal gland (*n* = 3, 3.9%)
  - gallbladder bed (*n* = 2, 2.6%).

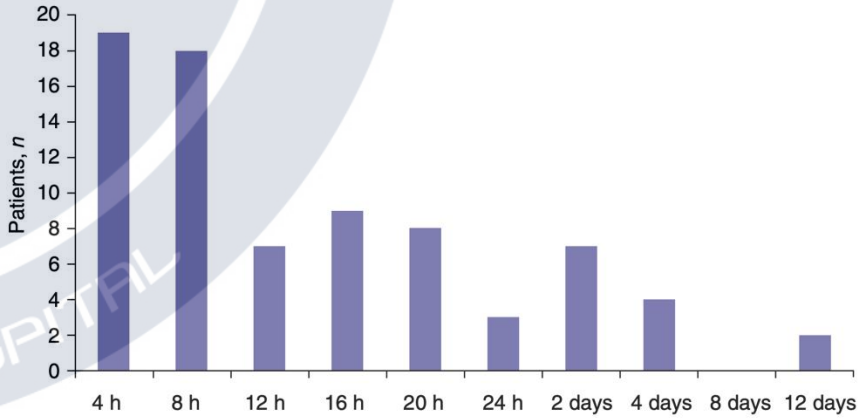

Figure 1 Time between the initial hepatectomy and return to the operating room

Aijun Li, Bin Wu, Weiping Zhou, Weifeng Yu, Li Li, Hang Yuan, Mengchao Wu, Post-hepatectomy haemorrhage: a single-centre experience, HPB, Volume 16, Issue 11, 2014,

Post hepatectomy hemorrhage

DOI:10.1111/hpb.12255 HPB

ORIGINAL ARTICLE

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Aijun Li*, Bin Wu*, Weiping Zhou, Weifeng Yu, Li Li, Hang Yuan & Mengchao Wu

Eastern Hepatobiliary Surgery Hospital, Second Military Medical University, Shanghai, China

- Timing for return to OR based on surgeon adjustment
- The most common clinical signs of haemorrhage in patients who were returned to the OR after hepatectomy were ***blood in the drain postoperative shock and a decrease in serum haemoglobin.***

Aijun Li, Bin Wu, Weiping Zhou, Weifeng Yu, Li Li, Hang Yuan, Mengchao Wu, Post-hepatectomy haemorrhage: a single-centre experience, HPB, Volume 16, Issue 11, 2014,

ORIGINAL ARTICLE

Reoperation for post-hepatectomy hemorrhage: increased risk of mortality

Chetana Lim · Safi Dokmak · Olivier Farges · Béatrice Aussilhou · Alain Sauvanet · Jacques Belghiti

- From January 2000 to December 2009, 2,086 elective liver resections were performed in the Department of HBP Surgery and Liver Transplantation at Beaujon Hospital
- Reoperation for bleeding was required in 12 (0.6 %)
- Criteria for re-laparotomy included evidence of blood loss via abdominal drain and/or imaging associated with
    (1) Hb drop >= 3 g/dL from baseline or
    (2) Hemodynamic instability with continuing requirement of packed red blood.
- The causes of bleeding were the hepatic vein branch (n=4), liver cut surface (n=3), and a hepatic artery branch (n=2). In three cases, no bleeding spot was identified.
- Postoperative death occurred in 3 patients (25 %) between 15 and 18 days after re-laparotomy

Lim, C., Dokmak, S., Farges, O. *et al.* Reoperation for post-hepatectomy hemorrhage: increased risk of mortality. *Langenbecks Arch Surg* **399**, 735–740 (2014). https://doi.org/10.1007/s00423-014-1189-3

Post hepatectomy hemorrhage

Role for embolization?

Insufficient data

May have role in delayed onset (more than 24 hours)

level of evidence : opinion

Lim, C., Dokmak, S., Farges, O. *et al.* Reoperation for post-hepatectomy hemorrhage: increased risk of mortality. *Langenbecks Arch Surg* **399**, 735–740 (2014). https://doi.org/10.1007/s00423-014-1189-3

Thank you