



Retrospective Cohort Study

Rescue from complications after pancreaticoduodenectomies at a low-volume Caribbean center: Value of tailored peri-pancreatectomy protocols

Shamir O Cawich, Elijah Dixon, Parul J Shukla, Shailesh V Shrikhande, Rahul R Deshpande, Fawwaz Mohammed, Neil W Pearce, Wesley Francis, Shaneeta Johnson, Johann Bujhawan

Specialty type: Surgery

Provenance and peer review:

Unsolicited article; Externally peer reviewed.

Peer-review model: Single blind

Peer-review report's scientific quality classification

Grade A (Excellent): 0

Grade B (Very good): 0

Grade C (Good): C

Grade D (Fair): 0

Grade E (Poor): 0

P-Reviewer: Dilek ON, Turkey

Received: December 6, 2023

Peer-review started: December 6, 2023

First decision: December 28, 2023

Revised: January 3, 2024

Accepted: January 27, 2024

Article in press: January 27, 2024

Published online: March 27, 2024



Shamir O Cawich, Fawwaz Mohammed, Department of Surgery, University of the West Indies, St Augustine 000000, Trinidad and Tobago

Elijah Dixon, Department of Surgery, Faculty of Medicine, University of Calgary, Calgary, Alberta T2N2T9, Canada

Parul J Shukla, Department of Surgery, Weill Cornell Medical College, New York, NY 10065, United States

Shailesh V Shrikhande, Department of Surgical Oncology, Tata Memorial Center, Homi Bhabha National University, Mumbai 400012, India

Rahul R Deshpande, Department of Surgery, Manchester Royal Infirmary, Manchester M13 9WL, United Kingdom

Neil W Pearce, University Surgical Unit, Southampton General Hospital, Southampton SO16 6YD, United Kingdom

Wesley Francis, Department of Surgery, University of the West Indies, Nassau N-1184, Bahamas

Shaneeta Johnson, Department of Surgery, Morehouse School of Medicine, Atlanta, GA 30310, United States

Johann Bujhawan, Department of Surgery, General Hospital in Port of Spain, Port of Spain 000000, Trinidad and Tobago

Corresponding author: Shamir O Cawich, FACS, Professor, Department of Surgery, University of the West Indies, St Augustine Campus, St Augustine 000000, Trinidad and Tobago.

socawich@hotmail.com

Abstract

BACKGROUND

Pancreaticoduodenectomy (PD) is a technically complex operation, with a relatively high risk for complications. The ability to rescue patients from post-PD

complications is as a recognized quality measure. Tailored protocols were instituted at our low volume facility in the year 2013.

AIM

To document the rate of rescue from post-PD complications with tailored protocols in place as a measure of quality.

METHODS

A retrospective audit was performed to collect data from patients who experienced major post-PD complications at a low volume pancreatic surgery unit in Trinidad and Tobago between January 1, 2013 and June 30, 2023. Standardized definitions from the International Study Group of Pancreatic Surgery were used to define post-PD complications, and the modified Clavien-Dindo classification was used to classify post-PD complications.

RESULTS

Over the study period, 113 patients at a mean age of 57.5 years (standard deviation [SD] \pm 9.23; range: 30-90; median: 56) underwent PDs at this facility. Major complications were recorded in 33 (29.2%) patients at a mean age of 53.8 years (SD: \pm 7.9). Twenty-nine (87.9%) patients who experienced major morbidity were salvaged after aggressive treatment of their complication. Four (3.5%) died from bleeding pseudoaneurysm (1), septic shock secondary to a bile leak (1), anastomotic leak (1), and myocardial infarction (1). There was a significantly greater salvage rate in patients with American Society of Anesthesiologists scores \leq 2 (93.3% *vs* 25%; $P = 0.0024$).

CONCLUSION

This paper adds to the growing body of evidence that volume alone should not be used as a marker of quality for patients requiring PD. Despite low volumes at our facility, we demonstrated that 87.9% of patients were rescued from major complications. We attributed this to several factors including development of rescue protocols, the competence of the pancreatic surgery teams and continuous, and adaptive learning by the entire institution, culminating in the development of tailored peri-pancreatectomy protocols.

Key Words: Pancreas; Complication; Rescue; Failure; Morbidity; Mortality; Pancreaticoduodenectomy

©The Author(s) 2024. Published by Baishideng Publishing Group Inc. All rights reserved.

Core Tip: Pancreaticoduodenectomy is a technically complex operation, with a relatively high risk for complications. Conventional teaching suggests that these operations should only be done in high-volume centers. Rescue, defined as the proportion of patients who were salvaged after treatment of a major complication, is a recognized quality measure. We have shown that acceptable rescue rates can be achieved at low volume centers once there is attention to detail and protocols tailored to the hospital environment.

Citation: Cawich SO, Dixon E, Shukla PJ, Shrikhande SV, Deshpande RR, Mohammed F, Pearce NW, Francis W, Johnson S, Bujhawan J. Rescue from complications after pancreaticoduodenectomies at a low-volume Caribbean center: Value of tailored peri-pancreatectomy protocols. *World J Gastrointest Surg* 2024; 16(3): 681-688

URL: <https://www.wjgnet.com/1948-9366/full/v16/i3/681.htm>

DOI: <https://dx.doi.org/10.4240/wjgs.v16.i3.681>

INTRODUCTION

Pancreaticoduodenectomy (PD) remains the best therapeutic option for peri-ampullary malignancies^[1,2]. As it is a technically complex operation, PDs should be performed by experienced teams who are facile with the operative steps and management of complications when they occur. The ability to rescue patients from succumbing to post-PD complications is recognized as a quality measure in modern practice^[3-7].

Our facility in the Caribbean is a tertiary referral center where experienced pancreatic surgeons perform PD at low volumes. The primary aim of this study was to evaluate rescue rates after PD and to document short-term outcomes using tailored peri-pancreatic protocols.

MATERIALS AND METHODS

We secured ethics approval to collect data for this study from a pancreatic surgery unit in the Eastern Caribbean. A dedicated unit was established on January 1, 2013, staffed by pancreatic surgeons, anesthesiologists, and support staff.

In this study, we carried out an audit to identify all consecutive patients who underwent PD at this facility over one decade, from January 1, 2013 to June 30, 2023. Patients were identified from operating room registers. Then hospital records were retrieved to identify patients who experienced a major complication after PD. The following data were collected from these records: patient demographics, operative details, postoperative complications, and 30-d mortality.

The criteria to be eligible for inclusion were: Age > 18 years, PD during the specified study period, availability of hospital records, and documentation of a major complication. Patients were excluded if they underwent left-sided or total pancreatic resections, had missing or incomplete records, were transferred to other facilities for any reason, and experienced minor or no complications.

We used standardized definitions from the International Study Group of Pancreatic Surgery[8,9] to define post-PD complications and the definition of pancreatic fistula proposed by the International Study Group on Pancreatic Fistula criteria[10,11]. The modified Clavien-Dindo classification[12] was used to classify post PD complications. Complications were further divided into medical and procedure-related complications using standardized classifications[13,14]. Procedure-related complications include pancreatic fistula, delayed gastric emptying, surgical site infection, organ space collection, post-pancreatectomy hemorrhage, anastomotic leaks, and bile leaks[13,14].

Rescue was defined as the proportion of patients who were salvaged after a major (Clavien-Dindo $\geq 3a$) post-PD complication was treated[3]. Descriptive statistics were generated using SPSS version 16.0. The χ^2 and *t*-tests were used to compare rescue rates based on patient sex, patient age (≤ 55 years *vs* > 55 years), type of complication (medical *vs* procedure-related), Eastern Cooperative Oncology Group performance scores (ECOG 0-1 *vs* 2-4), and physical status using the American Society of Anesthesiologists' risk score (ASA 1-2 *vs* 3-5). $P < 0.05$ was considered statistically significant.

RESULTS

Over the study period, 113 patients underwent PDs at this facility. There were 71 males and 62 females at a mean age of 57.5 years (standard deviation [SD] ± 9.23 ; range: 30-90; median: 56). Major complications were recorded in 33 (29.2%) patients after PD. In the subgroup with major complications, there were 23 males and 10 females at a mean age of 53.8 years (SD: ± 7.9 ; range: 30-70; median: 53). Table 1 outlines the individual complications.

Twenty-nine patients who experienced major morbidity were salvaged after aggressive treatment of their complication. Therefore, the salvage rate at this facility was 87.9%.

Four (3.5%) patients died as a direct consequence of their complications, resulting in an FTR rate of 12.1%. The complications from which patients could not be rescued included: Post-pancreatectomy hemorrhage from a bleeding pseudoaneurysm, septic shock secondary to a bile leak, intra-abdominal collections from an anastomotic leak, and a cardiac insufficiency due to myocardial infarction.

There were seven major medical complications and six (85.6%) were rescued after treatment of the complication. There were 26 patients with procedure-related complications and 23 (88.5%) of these patients were rescued. There was no statistically significant difference in salvage rates for medical *vs* procedure-related complications ($P = 0.0391$).

We found that salvage rates were slightly higher in patients with age ≤ 55 years (89.5% *vs* 83.3%; $P = 0.743$) and ECOG scores ≤ 1 (91.3% *vs* 80%; $P = 0.361$), female sex (90% *vs* 87%; $P = 0.951$), although neither achieved statistical significance. Due to the retrospective nature of data collection, we could not evaluate the relationship between salvage rates and body mass index (BMI). However, there was a significantly greater salvage rate in patients with ASA scores ≤ 2 (93.3% *vs* 25%; $P = 0.0024$).

DISCUSSION

Rescue from salvageable complications requires early recognition and treatment of complications. Since PD is recognized to be a technically challenging procedure with high inherent complication rates[1-4], isolated analyses of morbidity and mortality are not the best quality measures[3,6,7]. Instead, interhospital variations in mortality bear a closer relationship to the rates of rescue or failure thereof[3-7].

At our center, PD was accompanied by 29.2% major morbidity and 3.5% mortality, which is on par with reports in the surgical literature[3,13-18]. More importantly, we were able to rescue 89% of patients from major complications. The failure rate (12.1%) was at the upper limit of that reported from high-volume centers, ranging from 5.4%[8] to 12.5%[19]. This means there may still be room for improvement in complication management at our center.

Prior data suggest that rescue rates are directly proportional to hospital case volume[3,6,7,20,21]. Although there is no consensus on what constitutes a high-volume center, most authors consider high-volume hospitals as those performing > 18 PDs annually[22-26]. van Rijssen *et al*[3] suggested that hospital volume > 40 per year was an independent predictor of rescue. Therefore, with an annual volume of 11.3 PDs per year, our hospital does not qualify as high volume.

We found that the only factor that predicted rescue was the patients' physical status using the ASA risk score, in agreement with published data[3,27,28]. The surgical literature suggests that other factors predicting failure to rescue include patient-related factors, such as male sex[3], increasing age[3,27], high BMI[3], and co-morbidities[6,28,29]. Hospital-specific factors include understaffing[6,28,30], intensive care unit support[6,28,29], hospital technology status[3], nurse-to-patient ratio[6,28,29], and availability of interventional radiology[27].

Table 1 Complications after 113 pancreaticoduodenectomies

Overall morbidity	52 (46%)
Minor morbidity	19 (16.8%)
Pneumonia	3
Deep vein thrombosis	3
Delayed gastric emptying - grade A	2
Post-pancreatectomy hemorrhage - grade A	4
Superficial surgical site infection	5
Bile leaks - grade A	2
Major morbidity	33 (29.2%)
Major medical complications	
Renal failure	1
Respiratory complications	1
Cardiac complications	3
Systemic sepsis	2
Major procedure-related complications	
Delayed gastric emptying - grade B/C	3
Bile leak - grade B/C	5
Organ space collection	2
Anastomotic dehiscence	1
Post-operative pancreatic fistula	10
Post-pancreatectomy hemorrhage - grade B/C	5
30-d mortality	4 (3.5%)

Our results suggest that rescue is not necessarily related to case volumes alone. It is a much more complex issue that requires a multidisciplinary team approach, appropriate hospital equipment, and diligence on the part of the care team. In our setting where a new pancreatic service was being formed, we appreciated that a surgeon-led drive was necessary to ensure that the facility focused on recognized factors contributing to good outcomes, such as quaternary training for hepato-pancreato-biliary teams[31], trained nursing teams[32], development of care pathways[32], multidisciplinary approach to care[1,2], tailored centralization pathways[33], and continuous hospital learning[32]. We took a holistic approach, by creating peri-pancreatic protocols that are tailored to our resource-poor system, as summarized in Table 2.

We also needed to compensate for institutional deficiencies. For example, after we recognized that optimal care could not be delivered on the general wards in our setting, all our patients were admitted to the intensive care unit for the first 72 h. Post-operative surveillance was also inconsistent at our facility, so we compensated by scheduling members of the surgical team to physically review the patients on a 4-h rotation for the first 36 h post PD. This allowed early identification of complications and facilitated the early activation of rescue protocols. In this regard, we agree with van Rijssen *et al*[3] that failure to rescue was partly due to slow escalation of care[3], inadequate recognition and communication of patient deterioration to a senior colleague[30,34-36], lack of established protocols or support of team members[3], hierarchy[3], and understaffing[3].

It is important to recognize that the attending surgeon has less control in the post-operative period. It is the diligence of the nursing and support staff that allows complications to be recognized early, the experience of junior medical staff that allows appropriate steps to be taken and seniors to be notified, and the quality of care from the entire care team that will determine whether a patient is rescued. Team leaders/attending surgeons must recognize that they need cooperation from all categories of hospital staff and, many times, this is an exercise in diplomacy. To do this, attending surgeons must rely on charisma power (the ability to influence behavior through force of character) instead of coercive power (influencing others through fear or the ability to punish subordinates)[37].

It is also important for the surgeon to be able to adapt to their working environment. For example, we understood early that our facility battled with unavailability of intensive care unit space, paucity of blood products, shortage of consumables, and inconsistent supply of drugs, among others. Recognizing that these would have a negative impact on patient recovery, we emphasized good interdisciplinary relationships and the surgical team took the responsibility to ensure that everything needed was available prior to surgery. This was an example of continuous, adaptive learning by the entire institution[1,12,32], culminating in the development of the tailored peri-pancreatectomy protocols[32]. We firmly believe that this holistic approach has contributed to the good outcomes in this resource-poor, low-volume facility.

Table 2 Caribbean peri-pancreatic surgery protocols

Pre-operative	Multidisciplinary care	All patients presented at a weekly multidisciplinary team meeting to review images and consensus decision making
	Patient consultation	Patient evaluated by attending surgeon to relay multidisciplinary team decisions
	Pre-operative counseling	Verbal information during pre-operative consultation
		Ensure patient receives a written pamphlets with information
	Patient education	Refer to AHPBA Caribbean Chapter video resources
		Part one of informed consent process as outpatient
	Medical clearance	Pre-operative cardiopulmonary exercise testing
		Evaluation and clearance from cardiology/pulmonology teams
		Pre-operative consultations with anesthesia team in patients with borderline fitness as a condition for acceptance for surgery
	Prehabilitation	Patients encouraged to discontinue smoking
		Discuss exercise regime pre-operatively
		Pre-operative chest physiotherapy
		Supervised exercise regime with physical trainer
	Fasting guidelines	Discourage prolonged fasting
		Encourage a carbohydrate-rich drink on the morning of surgery
Intra-operative	Biliary decompression	Appropriate decompression, as decided by multidisciplinary team
		Ensure standard blood tests are available within 48 h of surgery
	Supportive care	Ensure ICU bed is reserved prior to surgery
		Ensure ≥ 2 units of packed cells are available in the operating room
	Pre-operative anesthesia	Avoid routine sedatives prior to surgery
		Regional block and/or rectal sheath blocks prior to surgery
	Surgical team	Two experienced HPB surgeons operate together
		Dedicated nursing team
		Dedicated anesthetic team
	Prevention of intra-operative hypothermia	Close monitoring to maintain normothermia
		Active warming devices
		Pneumatic compression device available
	Peri-operative fluid management	Patients receive intra-operative restricted goal directed fluid therapy
		Ensure warmed fluids
Post-operative	Specialized equipment	Ensure specialty equipment is available: Omni-Tract [®] , staplers
	Peri-operative tasks	Administer thrombo-prophylaxis at induction
		Administer prophylactic antibiotics at induction
		Place central line, urinary catheter, arterial lines prior to surgery
	Escalation	Follow rescue protocols and inform attending surgeon if there is any deviation from expected post-operative course
	Ambulation	Patients encouraged to ambulate on the same day post-operatively
	Post-operative review	Surgical team rostered to physically review patient on 4 hourly shifts for 1 st 36 h
	Fluid balance	Ensure adequate urine output of 0.5-1 mL/kg/h
		Ensure appropriate intravenous fluid regime is being followed
	Respiratory	Encourage coughing
		Encourage use of incentive spirometer

	Ensure physiotherapist input
Analgesia	Stepwise multimodal pain management to minimize opioid administration
Tubes	Consider early removal of urinary catheter
	Consider early removal of nasogastric tubes
	Drain evaluation at post-operative day 3
Post-operative diet	Consider early oral fluid intake, once clinically appropriate
Thrombo-prophylaxis	Ensure pneumatic compression device is being used
	Ensure prophylactic low molecular weight heparin is being administered

AHPBA: Americas Hepato-Pancreato-Biliary Association; HPB: Hepato-pancreato-biliary; ICU: Intensive care unit.

CONCLUSION

This paper adds to the growing body of evidence that volume alone should not be used as a marker of quality for patients requiring PD. Despite low volumes at our facility, we demonstrated that 87.9% of patients were rescued from major complications. We attributed this to several factors including development of rescue protocols, the competence of the pancreatic surgery teams and continuous, adaptive learning by the entire institution, culminating in the development of tailored peri-pancreatectomy protocols.

ARTICLE HIGHLIGHTS

Research background

Peri-operative outcomes differ between institutions due to a variety of factors. This can affect the way individual hospitals manage complications, and also their mortality rates after pancreaticoduodenectomies (PDs).

Research motivation

Our facility in the Caribbean is a low-volume center with numerous challenges. Tailored peri-pancreatic protocols were devised specifically to compensate for challenges at our facility. These have not been evaluated prior to this study.

Research objectives

The ability to rescue patients from post-PD complications is as a recognized quality measure. This study sought to document the rate of rescue from post-PD complications with tailored protocols in place as a measure of quality.

Research methods

A 10-year retrospective audit was performed to evaluate rescue rates in patients who experienced major post-PD complications. Standardized definitions from the International Study Group of Pancreatic Surgery were used to define post-PD complications and the modified Clavien-Dindo classification was used to classify post-PD complications. All data were examined with SPSS version 18.0.

Research results

There were 113 patients who underwent PDs and 33 experienced major morbidity. Twenty-nine (87.9%) patients were salvaged after aggressive treatment of their complication. There was a significantly greater salvage rate in patients with American Society of Anesthesiologists scores ≤ 2 (93.3% *vs* 25%; $P = 0.0024$).

Research conclusions

Despite low volumes and multiple hospital challenges, we were able to achieve acceptable rescue rates after post-PD complications. We attributed this to several factors including development tailored peri-pancreatectomy protocols.

Research perspectives

This adds to existing data that volume alone should not be used as a quality measure. It encourages further research with larger numbers since this early research shows encouraging results.

FOOTNOTES

Author contributions: Cawich SO, Dixon E, Sukla PJ, and Shrikhande SV designed the research; Cawich SO, Mohammed F, Pearce NW, and Francis W performed the research; Deshpande R, Pearce NW, Johnson S, and Bujhawan J contributed data analytic tools; Cawich SO,

Mohammed F, Deshpande R, Pearce NW, and Johnson S analyzed the data; Cawich SO, Dixon E, Sukla PJ, and Shrikhande SV wrote the paper; Cawich SO, Dixon E, Sukla PJ, Shrikhande SV, Deshpande R, Mohammed F, Pearce NW, Francis W, Johnson S, and Bujhawan J checked the manuscript for scientific accuracy.

Institutional review board statement: This study was approved by the Campus Research Ethics Committee, St. Augustine.

Informed consent statement: This was a retrospective review of written hospital records, the requirement for informed consent was waived by the local institutional review board.

Conflict-of-interest statement: The authors have no conflicts of interest to declare.

Data sharing statement: All data are stored by the corresponding author and will be released upon reasonable request.

STROBE statement: The authors have read the STROBE Statement—checklist of items, and the manuscript was prepared and revised according to the STROBE Statement—checklist of items.

Open-Access: This article is an open-access article that was selected by an in-house editor and fully peer-reviewed by external reviewers. It is distributed in accordance with the Creative Commons Attribution NonCommercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited and the use is non-commercial. See: <https://creativecommons.org/licenses/by-nc/4.0/>

Country/Territory of origin: Trinidad and Tobago

ORCID number: Shamir O Cawich 0000-0003-3377-0303; Parul J Shukla 0000-0003-3599-4968; Shailesh V Shrikhande 0000-0002-8036-4212; Rahul R Deshpande 0000-0002-1368-4144; Fawwaz Mohammed 0000-0002-1346-8628; Neil W Pearce 0000-0002-3182-7268; Wesley Francis 0000-0003-3174-1015.

S-Editor: Gong ZM

L-Editor: Filipodia

P-Editor: Xu ZH

REFERENCES

- 1 Vawter K, Kuhn S, Pitt H, Wells A, Jensen HK, Mavros MN. Complications and failure-to-rescue after pancreatectomy and hospital participation in the targeted American College of Surgeons National Surgical Quality Improvement Program registry. *Surgery* 2023; **174**: 1235-1240 [PMID: 37612210 DOI: 10.1016/j.surg.2023.07.023]
- 2 Schmidt CM, Turrini O, Parikh P, House MG, Zyromski NJ, Nakeeb A, Howard TJ, Pitt HA, Lillemoe KD. Effect of hospital volume, surgeon experience, and surgeon volume on patient outcomes after pancreaticoduodenectomy: a single-institution experience. *Arch Surg* 2010; **145**: 634-640 [PMID: 20644125 DOI: 10.1001/archsurg.2010.118]
- 3 van Rijssen LB, Zwart MJ, van Dieren S, de Rooij T, Bonsing BA, Bosscha K, van Dam RM, van Eijck CH, Gerhards MF, Gerritsen JJ, van der Harst E, de Hingh IH, de Jong KP, Kazemier G, Klaase J, van der Kolk BM, van Laarhoven CJ, Luyer MD, Molenaar IQ, Patijn GA, Rupert CG, Scheepers JJ, van der Schelling GP, Vahrmeijer AL, Busch ORC, van Santvoort HC, Groot Koerkamp B, Besselink MG; Dutch Pancreatic Cancer Group. Variation in hospital mortality after pancreatoduodenectomy is related to failure to rescue rather than major complications: a nationwide audit. *HPB (Oxford)* 2018; **20**: 759-767 [PMID: 29571615 DOI: 10.1016/j.hpb.2018.02.640]
- 4 Rosero EB, Romito BT, Joshi GP. Failure to rescue: A quality indicator for postoperative care. *Best Pract Res Clin Anaesthesiol* 2021; **35**: 575-589 [PMID: 34801219 DOI: 10.1016/j.bpa.2020.09.003]
- 5 Portuondo JI, Shah SR, Singh H, Massarweh NN. Failure to Rescue as a Surgical Quality Indicator: Current Concepts and Future Directions for Improving Surgical Outcomes. *Anesthesiology* 2019; **131**: 426-437 [PMID: 30860985 DOI: 10.1097/ALN.0000000000002602]
- 6 Burke JR, Downey C, Almoudaris AM. Failure to Rescue Deteriorating Patients: A Systematic Review of Root Causes and Improvement Strategies. *J Patient Saf* 2022; **18**: e140-e155 [PMID: 32453105 DOI: 10.1097/PTS.0000000000000720]
- 7 Endo I, Watanabe J. Hospital volume, failure to rescue, and surgeon skills: What is a good indicator of a quality hospital? *Ann Gastroenterol Surg* 2020; **4**: 606-607 [PMID: 33319149 DOI: 10.1002/ags3.12410]
- 8 Wente MN, Veit JA, Bassi C, Dervenis C, Fingerhut A, Gouma DJ, Izbicki JR, Neoptolemos JP, Padbury RT, Sarr MG, Yeo CJ, Büchler MW. Postpancreatectomy hemorrhage (PPH): an International Study Group of Pancreatic Surgery (ISGPS) definition. *Surgery* 2007; **142**: 20-25 [PMID: 17629996 DOI: 10.1016/j.surg.2007.02.001]
- 9 Wente MN, Bassi C, Dervenis C, Fingerhut A, Gouma DJ, Izbicki JR, Neoptolemos JP, Padbury RT, Sarr MG, Traverso LW, Yeo CJ, Büchler MW. Delayed gastric emptying (DGE) after pancreatic surgery: a suggested definition by the International Study Group of Pancreatic Surgery (ISGPS). *Surgery* 2007; **142**: 761-768 [PMID: 17981197 DOI: 10.1016/j.surg.2007.05.005]
- 10 Bassi C, Marchegiani G, Dervenis C, Sarr M, Abu Hilal M, Adham M, Allen P, Andersson R, Asbun HJ, Besselink MG, Conlon K, Del Chiaro M, Falconi M, Fernandez-Cruz L, Fernandez-Del Castillo C, Fingerhut A, Friess H, Gouma DJ, Hackert T, Izbicki J, Lillemoe KD, Neoptolemos JP, Olah A, Schulick R, Shrikhande SV, Takada T, Takaori K, Traverso W, Vollmer CR, Wolfgang CL, Yeo CJ, Salvia R, Buchler M; 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; **161**: 584-591 [PMID: 28040257 DOI: 10.1016/j.surg.2016.11.014]
- 11 Shrikhande SV, D'Souza MA. Pancreatic fistula after pancreatectomy: evolving definitions, preventive strategies and modern management. *World J Gastroenterol* 2008; **14**: 5789-5796 [PMID: 18855976 DOI: 10.3748/wjg.14.5789]
- 12 Téoule P, Bartel F, Birgin E, Rückert F, Wilhelm TJ. The Clavien-Dindo Classification in Pancreatic Surgery: A Clinical and Economic

- Validation. *J Invest Surg* 2019; **32**: 314-320 [PMID: 29336625 DOI: 10.1080/08941939.2017.1420837]
- 13 **Karim SAM**, Abdulla KS, Abdulkarim QH, Rahim FH. The outcomes and complications of pancreaticoduodenectomy (Whipple procedure): Cross sectional study. *Int J Surg* 2018; **52**: 383-387 [PMID: 29438817 DOI: 10.1016/j.ijsu.2018.01.041]
 - 14 **Simon R**. Complications After Pancreaticoduodenectomy. *Surg Clin North Am* 2021; **101**: 865-874 [PMID: 34537148 DOI: 10.1016/j.suc.2021.06.011]
 - 15 **Narayanan S**, Martin AN, Turrentine FE, Bauer TW, Adams RB, Zaydfudim VM. Mortality after pancreaticoduodenectomy: assessing early and late causes of patient death. *J Surg Res* 2018; **231**: 304-308 [PMID: 30278945 DOI: 10.1016/j.jss.2018.05.075]
 - 16 **Moazzam Z**, Lima HA, Alaimo L, Endo Y, Ejaz A, Beane J, Dillhoff M, Cloyd J, Pawlik TM. Hepatopancreatic Surgeons Versus Pancreatic Surgeons: Does Surgical Subspecialization Impact Patient Care and Outcomes? *J Gastrointest Surg* 2023; **27**: 750-759 [PMID: 36857013 DOI: 10.1007/s11605-023-05639-3]
 - 17 **Nimptsch U**, Krautz C, Weber GF, Mansky T, Grützmann R. Nationwide In-hospital Mortality Following Pancreatic Surgery in Germany is Higher than Anticipated. *Ann Surg* 2016; **264**: 1082-1090 [PMID: 26978570 DOI: 10.1097/SLA.0000000000001693]
 - 18 **Cannas S**, Casciani F, Vollmer CM; Pancreas Fistula Study Group. Extending Quality Improvement for Pancreatoduodenectomy Within the High-Volume Setting: The Experience Factor. *Ann Surg* 2023 [PMID: 37522844 DOI: 10.1097/SLA.0000000000006060]
 - 19 **Lequeu JB**, Cottenet J, Facy O, Perrin T, Bernard A, Quantin C. Failure to rescue in patients with distal pancreatectomy: a nationwide analysis of 10,632 patients. *HPB (Oxford)* 2021; **23**: 1410-1417 [PMID: 33622649 DOI: 10.1016/j.hpb.2021.02.002]
 - 20 **Amini N**, Spolverato G, Kim Y, Pawlik TM. Trends in Hospital Volume and Failure to Rescue for Pancreatic Surgery. *J Gastrointest Surg* 2015; **19**: 1581-1592 [PMID: 25794484 DOI: 10.1007/s11605-015-2800-9]
 - 21 **Merath K**, Chen Q, Bagante F, Sun S, Akgul O, Idrees JJ, Dillhoff M, Schmidt C, Cloyd J, Pawlik TM. Variation in the cost-of-rescue among medicare patients with complications following hepatopancreatic surgery. *HPB (Oxford)* 2019; **21**: 310-318 [PMID: 30266495 DOI: 10.1016/j.hpb.2018.08.005]
 - 22 **Bliss LA**, Yang CJ, Chau Z, Ng SC, McFadden DW, Kent TS, Moser AJ, Callery MP, Tseng JF. Patient selection and the volume effect in pancreatic surgery: unequal benefits? *HPB (Oxford)* 2014; **16**: 899-906 [PMID: 24905343 DOI: 10.1111/hpb.12283]
 - 23 **McPhee JT**, Hill JS, Whalen GF, Zayaruzny M, Litwin DE, Sullivan ME, Anderson FA, Tseng JF. Perioperative mortality for pancreatectomy: a national perspective. *Ann Surg* 2007; **246**: 246-253 [PMID: 17667503 DOI: 10.1097/01.sla.0000259993.17350.3a]
 - 24 **Alsasser G**, Kittner J, Eisold S, Klar E. Volume-outcome relationship in pancreatic surgery: the situation in Germany. *Surgery* 2012; **152**: S50-S55 [PMID: 22763260 DOI: 10.1016/j.surg.2012.05.011]
 - 25 **Meguid RA**, Ahuja N, Chang DC. What constitutes a "high-volume" hospital for pancreatic resection? *J Am Coll Surg* 2008; **206**: 622.e1-622.e9 [PMID: 18387466 DOI: 10.1016/j.jamcollsurg.2007.11.011]
 - 26 **Briceno P**, Hutson J, Shridhar R, Meredith K. Pancreatic Resection at High Volume Centers Improves Survival. *HPB* 2017; **19**: 131 [DOI: 10.1016/j.hpb.2017.02.384]
 - 27 **Gleeson EM**, Pitt HA, Mackay TM, Wellner UF, Williamsson C, Busch OR, Koerkamp BG, Keck T, van Santvoort HC, Tingstedt B, Besselink MG; Global Audits on Pancreatic Surgery Group (GAPASURG). Failure to Rescue After Pancreatoduodenectomy: A Transatlantic Analysis. *Ann Surg* 2021; **274**: 459-466 [PMID: 34132696 DOI: 10.1097/SLA.0000000000005000]
 - 28 **Pastrana Del Valle J**, Mahvi DA, Fairweather M, Wang J, Clancy TE, Ashley SW, Urman RD, Whang EE, Gold JS. The improvement in post-operative mortality following pancreaticoduodenectomy between 2006 and 2016 is associated with an improvement in the ability to rescue patients after major morbidity, not in the rate of major morbidity. *HPB (Oxford)* 2021; **23**: 434-443 [PMID: 32798109 DOI: 10.1016/j.hpb.2020.07.013]
 - 29 **Koerner AS**, Thomas AS, Chabot JA, Kluger MD, Sugahara KN, Schrope BA. Associations Between Patient Characteristics and Whipple Procedure Outcomes Before and After Implementation of an Enhanced Recovery After Surgery Protocol. *J Gastrointest Surg* 2023; **27**: 1855-1866 [PMID: 37165160 DOI: 10.1007/s11605-023-05693-x]
 - 30 **Johnston MJ**, Arora S, King D, Bouras G, Almoudaris AM, Davis R, Darzi A. A systematic review to identify the factors that affect failure to rescue and escalation of care in surgery. *Surgery* 2015; **157**: 752-763 [PMID: 25794627 DOI: 10.1016/j.surg.2014.10.017]
 - 31 **Francis W**, Arra A, Bonadie KO, Cawich SO. Evolution of Liver and Pancreas Surgical Sub-Specialty in the Caribbean: Caribbean Chapter of the Americans Hepatopancreatobiliary Association. *J Carib Coll Surg* 2021; **1**: 51-54 [DOI: 10.7759/cureus.11126]
 - 32 **Cawich SO**, Cabral R, Douglas J, Thomas DA, Mohammed FZ, Naraynsingh V, Pearce NW. Whipple's procedure for pancreatic cancer: training and the hospital environment are more important than volume alone. *Surg Pract Sci* 2023; **14**: 100211 [DOI: 10.1016/j.sipas.2023.100211]
 - 33 **Cawich SO**, Pearce NW, Naraynsingh V, Shukla P, Deshpande RR. Whipple's operation with a modified centralization concept: A model in low-volume Caribbean centers. *World J Clin Cases* 2022; **10**: 7620-7630 [PMID: 36158490 DOI: 10.12998/wjcc.v10.i22.7620]
 - 34 **Khan MA**, Muhammad S, Mehdi H, Parveen A, Soomro U, Ali JF, Khan AW. Surgeon's Experience May Circumvent Operative Volume in Improving Early Outcomes After Pancreaticoduodenectomy. *Cureus* 2023; **15**: e42927 [PMID: 37667689 DOI: 10.7759/cureus.42927]
 - 35 **Stevenson R**, Ngai J, Gudlaugsdottir K, Mansouri D, Haslett A, Smith L, Stevenson K, Jackson A, Oliphant R; West of Scotland Virtual Journal Club. Escalation of Care in Surgery: a Systematic Risk Assessment to Prevent Avoidable Harm in Hospitalized Patients. *Ann Surg* 2017; **266**: e27-e28 [PMID: 28692556 DOI: 10.1097/SLA.0000000000001318]
 - 36 **Ghaferi AA**, Dimick JB. Understanding failure to rescue and improving safety culture. *Ann Surg* 2015; **261**: 839-840 [PMID: 25607758 DOI: 10.1097/SLA.0000000000001135]
 - 37 **Cawich SO**, Johnson PB, Dan D, Naraynsingh V. Surgical leadership in the time of significant generational diversity. *Surgeon* 2014; **12**: 235-236 [PMID: 24731408 DOI: 10.1016/j.surge.2014.03.007]



Published by **Baishideng Publishing Group Inc**
7041 Koll Center Parkway, Suite 160, Pleasanton, CA 94566, USA

Telephone: +1-925-3991568

E-mail: office@baishideng.com

Help Desk: <https://www.f6publishing.com/helpdesk>

<https://www.wjgnet.com>

