

Clinical Science

Impact of fluid resuscitation on major adverse events following pancreaticoduodenectomy



Ramy Behman, M.D.^{a,b}, Sherif Hanna, M.D.^{a,b},
Natalie Coburn, M.D., M.P.H.^{a,b}, Calvin Law, M.D., M.P.H.^{a,b},
David P. Cyr, M.D., M.Sc.^a, Jessica Truong, M.D.^a,
Jenny Lam-McCulloch, M.Sc.^a, Paul McHardy, M.D.^c,
Jason Sawyer, N.P., M.N.^c, Chris Idestrup, M.D., M.Sc.^c,
Paul J. Karanicolas, M.D., Ph.D.^{a,b,*}

^aDepartment of Surgery, Sunnybrook Health Sciences Centre, 2075 Bayview Avenue, Toronto, ON M4N 3M5, Canada; ^bDepartment of Surgery, University of Toronto, Toronto, ON, Canada; ^cDepartment of Anaesthesia, Sunnybrook Health Sciences Centre, Toronto, ON, Canada

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Abstract

BACKGROUND: Pancreaticoduodenectomy remains a major undertaking with substantial perioperative morbidity and mortality. Previous studies in the colorectal population have noted a correlation between excessive postoperative fluid resuscitation and anastomotic complications. This study sought to assess the relationship between perioperative fluid management and clinical outcomes in patients undergoing pancreaticoduodenectomy.

METHODS: Data from a single institution, prospective database over a 10-year period (2002 to 2012) were reviewed. Patients were compared for perioperative fluid balance and postoperative outcomes. Multivariable analysis was performed to assess the relationship between perioperative fluid administration and incidence of major adverse events.

RESULTS: Higher positive fluid balance on postoperative day 0, postoperative day 1, and postoperative day 2 was associated with increased incidence of major adverse events, increased postoperative intensive care unit admission, and longer hospital stay. Higher positive fluid balance on postoperative day 0 was most strongly associated with postoperative morbidity (odds ratio 1.39, confidence interval 1.16 to 1.66, $P = .0003$). Fluid balance on postoperative day 3 was not associated with adverse events.

CONCLUSIONS: Increased early perioperative fluid resuscitation is associated with major adverse events in patients undergoing pancreaticoduodenectomy. More restrictive fluid administration may improve postoperative outcomes; further prospective clinical trials focused on fluid resuscitation and goal-directed therapy are needed.

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* Corresponding author. Tel.: +1-416-480-4774; fax: +1-416-480-6002.
E-mail address: paul.karanicolas@sunnybrook.ca
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Pancreaticoduodenectomy (PD) is the primary treatment for resectable tumors of the pancreatic head and periampullary region. While mortality of this procedure has decreased substantially over the last several years to less than 5%, the postoperative morbidity remains around 50%. Complications associated with the pancreaticojejunal (PJ)

anastomosis are found in up to 22% of these patients and are associated with prolonged hospitalization and mortality rates of 20% to 40% when they occur.¹⁻⁴

Patients frequently receive large volumes of intravenous fluid in the early postoperative period following major intra-abdominal operations with the intention of replacing operative fluid losses.⁵ However, several recent studies have examined the impact of fluid resuscitation on the development of postoperative complications and have correlated liberal fluid administration with bowel edema and anastomotic compromise.⁶⁻¹⁴ Specifically, excessive postoperative fluid resuscitation has been found to cause bowel edema at the site of the anastomosis and has been implicated to cause anastomotic leak in colorectal surgery.

While leaks and subsequent fistulae formation from the PJ anastomosis are not uncommon adverse events following PD, the pathophysiology behind the anastomotic compromise is not clearly elucidated. Risk factors such as soft pancreatic texture and small diameter of the pancreatic duct are well known.¹⁵ However, the impact of postoperative fluid resuscitation on bowel edema and anastomotic compromise has primarily been studied in the colorectal surgery population and has not been clearly shown in the PD population.

The purpose of this study was to examine the relationship between perioperative fluid resuscitation and postoperative complications in patients undergoing PD. The hypothesis was that excessive perioperative fluid resuscitation would be associated with increased rates of anastomotic leak and complications following PD.

Methods

A retrospective review was performed on a prospectively maintained database of patients undergoing PD between

June 1, 2002 and May 30, 2012 at Sunnybrook Health Sciences Centre, a tertiary referral center in Toronto, Canada. Surgeons at our center perform conventional PD including resection of the pylorus except in unique situations. Fluid used for resuscitation in the early postoperative course is almost exclusively Lactated Ringers, with occasional variations based on clinical situation and practitioner preference. The database was supplemented with an extensive review of fluid administration records for each patient.

Data extraction included review of intraoperative anesthesia records as well as postoperative nursing logs for the first 3 postoperative days. Fluid administration was recorded in 8-hour increments for each patient. For the purposes of this study, postoperative day (POD) 0 was defined as beginning when the patient left the operating room and ending at 0800 the following day. Each subsequent POD began and ended at 0800. Intraoperative blood loss and blood product transfusion were included in the overall calculation of intraoperative balance. Postoperative transfusion was included in the balance for the respective POD.

Postoperative adverse events were graded based on the revised Clavien classification.¹⁶ The primary outcome was major adverse event, defined as Grade 3 or greater within 90 days. These included complications that required surgical, endoscopic, or radiological intervention, those that required intensive care unit (ICU) management, or those that resulted in death. Additionally, complications likely related to anastomotic compromise were grouped into a composite that included pancreatic leaks, biliary leaks, abdominal abscess, abdominal collection, and sepsis. The 2005 International Study Group on Pancreatic Fistula (ISGPF) definition of pancreatic fistula based on drain amylase concentration

Table 1 Baseline characteristics: all patients (grouped by quartiles of overall fluid balance: intraoperative POD3)

	Overall (n = 251)	First quartile	Second quartile	Third quartile	Fourth quartile	P value
Mean age (standard deviation)	67.6 (15.6)	65.1 (12.8)	65.1 (13.9)	66.6 (11.0)	65.8 (12.6)	.942
Mean BMI (standard deviation)	25.8 (5.0)	25.6 (4.5)	25.6 (4.5)	25.7 (5.1)	26.5 (6.2)	.801
ASA (%)						.190
1-2	10.5	9.1	18.2	3.8	10.6	
3	67.5	74.5	58.2	75.0	61.7	
4-5	22.0	16.4	23.6	21.2	27.7	
Charlson Score (%)						.344
0-2	91.2	93	87.7	93	91.1	
3-4	7.5	7	12.3	3.5	7	
>4	1.3	0	0	3.5	1.8	
Indication for PD						.281
Adenocarcinoma	76.9%	73.7%	77.2%	71.9%	82.1%	
Neuroendocrine	5.6%	10.5%	5.3%	1.8%	3.6%	
Cystic neoplasm	5.6%	5.3%	8.8%	5.3%	3.6%	
Other	11.9%	10.5%	8.8%	21.1%	8.9%	
Vascular resection	55 (24.2%)	9 (15.8%)	11 (19.3%)	16 (28.1%)	19 (33.9%)	.098
Multivisceral resection	27 (11.9%)	6 (10.5%)	5 (8.8%)	7 (12.3%)	9 (16.1%)	.666
Mean lesion size (cm)	3.38	3.26	3.64	3.30	3.32	.637

ASA = American Society of Anesthesiologists; BMI = body mass index; PD = pancreaticoduodenectomy; POD3 = postoperative day 3.

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