

ORIGINAL ARTICLE

National trends in pancreaticoduodenal trauma: interventions and outcomes

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Abstract

Objectives: Pancreaticoduodenal trauma (PDT) is associated with substantial mortality and morbidity. In this study, contemporary trends were analysed using national data.

Methods: The Nationwide Inpatient Sample for 1998–2009 was queried for patients with PDT. Interventions including any operation (Any-Op) and pancreas-specific surgery (PSURG) were identified. Trends in treatment and outcomes were determined [complications, length of stay (LoS), mortality] for the Any-Op, PSURG and non-operative (Non-Op) groups. Analyses included chi-squared tests, Cochran–Armitage trend tests and logistic regression.

Results: A total of 27 216 patients (nationally weighted) with PDT were identified. Over time, the frequency of PDT increased by 8.3%, whereas the proportion of patients submitted to PSURG declined (from 21.7% to 19.8%; $P = 0.0004$) and the percentage of patients submitted to non-operative management increased (from 56.7% to 59.1%; $P = 0.01$). In the Non-Op group, mortality decreased from 9.7% to 8.6% ($P < 0.001$); morbidity and LoS remained unchanged at ~40% and ~12 days, respectively. In the PSURG group, mortality remained stable at ~15%, complications increased from 50.2% to 71.8% ($P < 0.0001$) and LoS remained stable at ~21 days. For all PDT patients, significant independent predictors of mortality included: the presence of combined pancreatic and duodenal injuries; penetrating trauma, and age >50 years. Having any operation (Any-Op) was associated with mortality, but PSURG was not a predictor of death.

Conclusions: The utilization of operations for PDT has declined without affecting mortality, but operative morbidity increased significantly over the 12 years to 2009. The development of an evidence-based approach to invasive manoeuvres and an early multidisciplinary approach involving pancreatic surgeons may improve outcomes in patients with these morbid injuries.

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Introduction

Pancreaticoduodenal trauma (PDT) in the setting of abdominal trauma is rare, representing 0.5–5.0% of all such traumas.^{1,2} However, these injuries have historically carried a risk for mortality ranging from 10% to 40%.^{1,3–6} Recent expert recommendations have urged the more conservative management of many intra-abdominal organ injuries, including PDT.⁷ The current guidelines issued by the Eastern Association for the Surgery of Trauma

Table 1 Cohort assembly: definitions used to define injury of the pancreas and/or duodenum (PDT), and to define any surgical intervention (Any-Op) and pancreas-specific interventions (PSURG)

ICD-9 CM diagnoses and procedure codes	
PDT	863.21, 863.31, 863.82, 863.84, 863.94, 863.92, 863.81, 863.83, 863.91, 863.93
Any-Op	
Non-PSURG	45.01, 45.02, 45.51, 45.6x, 52.13, 51.11, 51.10, 54.19, 54.11, 54.12, 88.95, 52.93
PSURG	52.52, 52.51, 52.53, 52.59, 52.6, 52.7, 52.95

recommend non-operative management for Grade I and II injuries, and operation (resection or drainage) for injuries of Grade III and higher.⁷

Both operative and non-operative protocols for the management of PDTs are among the most challenging clinical scenarios faced by surgeons. Prior research has focused on rates of mortality after PDT and thus little is known about the extent of complications in patients following PDT and whether surgical interventions exacerbate or alleviate the risk for complications.

This project was undertaken to study the changing patterns of intervention for PDT on a national basis over a period of 12 years, to investigate patterns of surgical intervention, and to establish whether new practice patterns have improved mortality and morbidity in patients with PDT.

Materials and methods

Data source

The US Nationwide Inpatient Sample (NIS) was queried for the 12-year period from 1998 to 2009 for all patients with pancreatic or duodenal trauma. The NIS, a part of the Healthcare Cost and Utilization Project (HCUP), is a national, all-payer discharge database containing information on a representative stratified sample of 20% of non-federal US community hospitals in participating states, including academic and specialty hospitals.⁸ The NIS weighting strategy facilitates the drawing of population-based estimates at the national level.

Cohort assembly

Patients with PDT were identified if they had been admitted emergently or had a primary ICD-9 CM (International Classification of Diseases, Revision 9, Clinical Modification)⁹ diagnosis code for injury to the pancreas or duodenum (codes 863.21, 863.31, 863.82, 863.84, 863.94, 863.92, 863.81, 863.83, 863.91 and 863.93) (Table 1). Patient data were then analysed to identify any surgical intervention (Any-Op), including exploratory laparotomy, small bowel resections, or pancreas-specific intervention using ICD-9 CM procedure codes 45.01, 45.02, 45.51, 45.6x, 52.13, 51.11, 51.10, 54.19, 54.11, 54.12, 52.52, 52.51, 52.53, 52.59, 52.6, 52.7, 52.95, 88.95 and 52.93. This surgical group was subdivided into two cohorts according to the presence or absence of pancreas-specific surgeries (PSURG) using ICD-9 CM procedure codes 52.52,

52.51, 52.53, 52.59, 52.6, 52.7 and 52.95. The non-operative (Non-Op) group included patients who did not undergo any of the surgical interventions defined here. Patients were excluded if they were aged ≤ 18 years or ≥ 95 years, had been admitted electively or had an invalid admission type.

Outcomes

The primary outcome measures were rates of surgical interventions in PDT patients over time. Secondary outcomes included mortality, length of stay (LoS), and the occurrence of major in-hospital complications, including cardiovascular or deep vein thrombosis (CV/DVT), gastrointestinal, pulmonary or urinary complications, infection and myocardial infarction, as defined by the present authors and others.^{10–12}

Statistical analysis

All analyses were performed using SAS Version 9.2 (SAS Institute, Inc., Cary, NC, USA).¹³ Univariate analyses were used to compare differences between subsets of treatment groups and included chi-squared tests of association for categorical variables. Trend tests for annual point estimates were performed using the Cochran–Armitage trend test for binary variables. A linear regression model was used to determine trends over time for continuous variables. *P*-values of < 0.05 were considered to indicate statistical significance. All data were weighted to nationally representative numbers using the validated weighting strategies provided by HCUP.⁸

Multivariable logistic regression models were constructed with the occurrence of mortality or a major in-hospital complication as the dependent variable (outcome). Independent variables with both statistical significance at the $P < 0.05$ level on univariate analyses or clinical relevance (established *a priori*) were included in multivariable models; these included race (White, Black, Hispanic, other/missing), age (< 40 years, ≥ 40 years), sex, Elixhauser comorbidity score (0, 1, ≥ 2),¹⁴ hospital characteristics including location (urban versus rural), region, size and teaching status, and type of insurance (Medicare, Medicaid, private, uninsured, other/missing). Adjusted odds ratios (AORs) were calculated to determine the effects of the covariates on outcomes of interest.

This study was determined to be exempt from requirements for ethical approval by the University of Massachusetts Medical School Institutional Review Board.

Results

Patient and hospital characteristics

During the study period, 27 216 nationally weighted patients with PDT were admitted. Nearly three-quarters of this cohort (73.6%) were male. The mean age of the patients was 37.7 years; the mean Elixhauser score was only 0.8. The majority of patients were treated at urban (93.1%), large (73.4%) and teaching (74.0%) hospitals (Table 2). From 1998 to 2009, the number of patients admitted with PDT increased by 8.3% from 2115 to 2290. Patients admitted more recently were older at presentation (37 years versus

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