

## ORIGINAL ARTICLE

# Surgical management of chronic pancreatitis: current utilization in the United States

Lindsay A. Bliss<sup>1</sup>, Catherine J. Yang<sup>1</sup>, Mariam F. Eskander<sup>1</sup>, Susanna W. L. de Geus<sup>1</sup>, Mark P. Callery<sup>1</sup>, Tara S. Kent<sup>1</sup>, A. James Moser<sup>1</sup>, Steven D. Freedman<sup>2</sup> & Jennifer F. Tseng<sup>1</sup>

<sup>1</sup>Surgical Outcomes Analysis & Research, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA, and <sup>2</sup>Division of Gastroenterology, Department of Medicine, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, MA, USA

## Abstract

**Background:** Surgical intervention is uncommon in chronic pancreatitis. Literature largely describes single institution or international experiences. This study describes US-based chronic pancreatitis surgical management.

**Methods:** Retrospective analysis of chronic pancreatitis patients in the Healthcare Cost and Utilization Project Florida State Inpatient Database 2007–2011. Patients with malignancy or congenital abnormalities were excluded. Univariate analysis using the chi-square test. The number of readmissions, inpatient length of stay and cost using Wilcoxon's signed-rank test. Multivariate analysis of surgery by logistic regression.

**Results:** Twenty-one thousand four hundred and forty-five patients with chronic pancreatitis. 10.8% (2 307) underwent surgery including 1652 cholecystectomies, 564 drainage procedures and 498 pancreatectomies. Procedures decreased from 12.1% to 8.3% over time ( $P < 0.001$ ), but intervention within 3 months increased (7.2% to 8.4%;  $P = 0.017$ ). 15.3% (3 278) had pancreatic cysts/pseudocysts and 43.4% (9 312) had diabetes. The median numbers of admissions were 2 [interquartile range (IQR) 1,5] and 3 (IQR 2,7) among non-surgical and surgical patients, respectively ( $P < 0.001$ ). Predictors of surgery were fewer co-morbidities, private insurance, and either diabetes mellitus or pancreatic cyst/pseudocyst.

**Conclusion:** Chronic pancreatitis leads to numerous inpatient readmissions, but surgical intervention only occurs in a minority of cases. Complicated patients are more likely to undergo surgery. The complexities of chronic pancreatitis management warrant early multidisciplinary evaluation and ongoing consideration of surgical and non-surgical options.

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## Correspondence

Jennifer F. Tseng, Division of Surgical Oncology, Department of Surgery, BIDMC Cancer Center, Harvard Medical School, Beth Israel Deaconess Medical Center, 330 Brookline Ave, Stoneman 9, Boston, MA 02215, USA. Tel.: +1 617 667 3746. Fax: +1 617 667 2792. E-mail: jftseng@bidmc.harvard.edu

## Background

Chronic pancreatitis is a serious and potentially debilitating condition. Patients may develop complications including chronic pain, weight loss, pancreatic endocrine or exocrine insufficiency, malignancy, intestinal obstruction, haemorrhage

and acute fluid collections.<sup>1–4</sup> The symptoms of chronic pancreatitis, and often its aetiology, can be managed medically, endoscopically and surgically.<sup>5–8</sup>

Previous work has demonstrated that surgical management of chronic pancreatitis, including extensive procedures such as a pancreatectomy, can be performed with an acceptable risk profile. Further, surgery offers more complete pain relief than endoscopic interventions with no negative effect on long-term mortality.<sup>2,9</sup> US-based practice patterns outside of large, academic institutions remain poorly characterized and the

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ongoing impact on inpatient care utilization in chronic pancreatitis patients who do or do not receive surgery is unknown.

This study examined the utilization of surgery in the inpatient management of chronic pancreatitis patients in a US-based population cared for in a broad range of inpatient centres. The timing and nature of surgical interventions, as well as the associated inpatient outcomes, were analysed.

## Patients and methods

### Design

A retrospective review of the Healthcare Cost and Utilization Project (HCUP) Florida State Inpatient Database (SID) was performed. The SID is an administrative all-payer inpatient discharge database assembled by the Agency for Healthcare Research and Quality (AHRQ) HCUP.<sup>10</sup> Patients can be followed across time and institutions through the use of a unique visit link variable. The database includes patient demographics, hospital characteristics, and admission diagnosis codes, procedure codes and charges.

Using ICD-9 diagnosis codes, all discharge records for patients greater than or equal to 18 years of age during 2007 to 2011 with the diagnosis of chronic pancreatitis (ICD-9 577.1) were identified. All subsequent inpatient admissions were linked and analysed. Patients with evidence of anatomic anomalies of the pancreas (751.7) or neoplasms of the pancreas, extrahepatic bile ducts or ampulla (156.1, 156.2, 156.8, 157, 211.6, 235.5, 230.9, 239.0) were excluded from analysis.

### Patient characteristics

Patient demographic information collected from the initial admission with coding of chronic pancreatitis included gender, age, median ZIP code income, insurance type and race. The patient comorbidity burden was calculated as an Elixhauser score, generated using the HCUP Comorbidity Software, Version 3.7.<sup>11</sup> All inpatient admissions were queried to identify chronic pancreatitis-related diagnoses for subset analysis: pancreatic cyst or pseudocyst (577.2), pancreatic steatorrhea (579.4) and diabetes mellitus (249, 250).

### Procedures

Chronic pancreatitis-related surgeries during the index or any subsequent admissions were identified by ICD-9 procedure code. Surgical procedures were divided into pancreatectomies (52.22, 52.51, 52.52, 52.53, 52.59, 52.6, 52.7), drainage procedures (52.3, 52.4, 52.96, 52.01, 52.09), sphincter-related procedures (51.82, 51.83, 81.89) and cholecystectomies (51.21, 51.22, 51.23, 51.25) (Appendix A1). Surgeries performed among all admissions as well as within 1 year of first admission and within 3 months of first admission for patients with at least 1 year of follow-up time were identified. All inpatient endoscopic interventions were identified by ICD-9 procedure codes (51.1, 51.64, 51.84, 51.85, 51.86, 51.87, 51.88, 52.13, 52.21, 52.93, 52.94, 52.97, 52.98).

### Patient outcomes

The primary outcome was the number of inpatient admissions occurring after the diagnosis of chronic pancreatitis, including the first admission. Readmissions were identified using the HCUP Supplemental Variables for revisit analyses. These provide unique visit links to allow patients to be tracked across all inpatient admissions, including those that occur at other institutions in the state.<sup>10</sup>

Other patient outcomes recorded were total inpatient length of stay (LOS) across all admissions after a chronic pancreatitis diagnosis, the number of inpatient admissions prior to any surgical intervention, inpatient death and the total cost of all inpatient care after chronic pancreatitis diagnosis. Further, post-operative complications were identified for any admission with a surgical procedure. Complications were identified using secondary diagnosis codes and included infectious, respiratory, cardiac, wound, thromboembolic and gastrointestinal complications.

### Cost

The charge the hospital billed for each admission was abstracted from the SID. To convert charge information to approximate costs, the supplemental SID HCUP Cost-to-Charge Ratio files were used.<sup>10</sup> The costs for all inpatient hospitalizations after chronic pancreatitis diagnosis were aggregated for each patient.

### Statistical analysis

Race and payer categories with a small number of patients were collapsed into larger categories. Continuous variables, age, median ZIP income and Elixhauser score, were categorized to enhance clinical interpretability. Patient characteristics for those patients with and without chronic pancreatitis-related surgery were compared using chi-square tests. The presence of chronic pancreatitis-related diagnoses and the use of endoscopic interventions in the surgical and non-surgical groups were compared using chi-square tests.

Univariate regression modelling of the likelihood of undergoing chronic pancreatitis-related surgery was performed. A multivariate regression model predicting chronic pancreatitis-related surgery was created using all available patient predictors, including chronic pancreatitis-related diagnoses.

Median values and interquartile ranges (IQRs) were calculated for the total number of inpatient admissions, days to the surgical procedure, inpatient costs, inpatient LOS and the number of endoscopic interventions. Outcomes were compared by surgery status using Wilcoxon's signed-rank test. Surgery and endoscopic intervention rates during each time period were analysed for trends over the course of the study using the Cochran-Armitage trend test.

Owing to the broader range of indications for a cholecystectomy, compared with a pancreatectomy, sphincter-related procedures and drainage procedures, a sensitivity analysis was

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