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ORIGINAL ARTICLE

# Improved peri-operative outcomes with epidural analgesia in patients undergoing a pancreatectomy: a nationwide analysis

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## Abstract

**Background:** In spite of limited evidence demonstrating a benefit, epidural analgesia (EA) is often used for patients undergoing a pancreatectomy. In the present study, the impact of epidural analgesia on post-operative outcomes after a pancreatectomy is examined.

**Methods:** Utilizing the Nationwide Inpatient Sample, the effect of EA on peri-operative outcomes after a pancreatectomy was examined. Multivariable logistic and linear regression with propensity score matching were utilized for risk adjustment.

**Results:** From 2008–2011, 12 440 patients underwent a pancreatectomy. Of these, 1130 (9.1%) patients received epidural analgesia. Using univariate comparison, patients receiving EA had a significantly decreased length of stay (LOS), hospital charges and post-operative inpatient mortality. In multivariate analyses, EA was independently associated with a decreased post-operative LOS (adjusted mean difference = −1.19 days, $P < 0.001$), decreased hospital charges (adjusted mean difference = −$16 814, $P = 0.002$) and decreased post-operative inpatient mortality [adjusted odds ratio (OR) = 0.42, $P < 0.001$]. Using 1:1 propensity score matching, patients who received an EA ($n = 1070$) had significantly decreased post-operative LOS (11.0 versus 12.1 days, $P = 0.011$), lower hospital charges ($112 086 versus $128 939, $P = 0.001$) and decreased post-operative inpatient mortality (1.5% versus 3.6%, $P = 0.002$) compared with matched controls without EA ($n = 1070$).

**Conclusion:** Analysis of a large hospital database reveals that EA is associated with improved peri-operative outcomes after a pancreatectomy. Additional studies are required to understand fully if this relationship is causal.

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## Background

Epidural Analgesia (EA) improves peri-operative outcomes in patients undergoing select operations. For example, EA has been associated with improved pain control as well as decreased post-operative respiratory failure, decreased post-operative pneumonia and quicker return of post-operative bowel function compared with standard methods of pain control.[1–6] A pancreatectomy is a morbid procedure with a high rate of complications, which influence post-operative length of stay (LOS), hospital cost and post-operative mortality. However, the role of EA in patients undergoing a pancreatectomy is poorly defined. Thus, further investigation regarding the role of EA in the care of patients undergoing a pancreatectomy is warranted.

In spite of minimal evidence demonstrating the benefit after a pancreatectomy, EA is frequently used. Many pancreatic surgeons extrapolate data from studies using EA in other abdominal operations, and routinely use EA in their patients. With the growing use of enhanced recovery after surgery (ERAS) programmes in pancreatectomy patients, many of which incorporate EA, it is imperative to understand what role, if any, EA should play in post-operative care.[7,8] Thus, large multi-institutional studies would be ideal to help determine the impact of EA on post-operative outcomes in the pancreatectomy population.

This study sought to examine the impact of EA on post-operative outcomes after a pancreatectomy on a national level. The Agency for Healthcare Research and Quality (AHRQ)

 

Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample (NIS) for 2008 to 2011 was utilized to determine whether EA had an effect on post-operative outcomes in patients undergoing a pancreatectomy. The hypothesis was that patients, who receive EA, have decreased post-operative LOS, decreased hospital charges and decreased post-operative inpatient mortality after risk-adjustment for patient, operative and hospital factors.

## Patients and methods

### Study design and patient population

This was a retrospective cohort study using the AHRQ HCUP NIS for 2008 to 2011 to identify patients age 18 years or older undergoing a pancreaticoduodenectomy [International Classification of Diseases, Ninth Revision, Clinical Modification (ICD9-CM) procedure codes: 52.51 and 52.7], total pancreatectomy (ICD9-CM procedure code: 52.6) and distal pancreatectomy (ICD9-CM procedure codes: 52.52). Twenty-seven patient admissions were deleted because these were duplicate records. The NIS is the largest publicly available all-payer inpatient health care database in the United States, containing data from more than 7 million hospital stays each year.

### Study variables

Common post-operative complications using ICD9-CM diagnosis codes in pancreatectomy patients have been identified in a similar AHRQ HCUP database.[9] Patients who received EA were identified by *ICD-9-CM* procedure codes 03.90 and 03.91, as has been done previously using the NIS.[10] The AHRQ comorbidity software, Version 3.7, was used to identify comorbidities present at admission by utilizing measures defined by Elixhauser *et al.* based on ICD9-CM diagnosis codes.[11] The other race category included Asians, Pacific Islanders, Native Americans and Hispanics. Hospital pancreatectomy volume quartiles were defined using the total number of pancreatectomies performed at individual hospitals between 2008 and 2011. The American Hospital Association (AHA) Annual Survey of the Hospitals file was used to determine hospital bed size and teaching status. AHA hospital size is based on the number of hospital beds, specific to the hospital's location and teaching status. Cells with fewer than 11 patients per variable were relabelled as '<11' in compliance with the HCUP data use agreement.

### Statistical analysis

Chi-square and Student's *t* tests were used for univariate comparisons. Multivariable logistic and linear regression were used to examine the association of EA with LOS, hospital charges and inpatient mortality as appropriate. Propensity scores were estimated using a non-parsimonius multivariable logistic regression model including age, gender, race, comorbidities (congestive heart failure, chronic lung disease, diabetes, chronic renal failure, obesity, weight loss, alcohol abuse and drug abuse), insurance status, pancreatectomy type, cancer status, hospital pancreatectomy volume, hospital teaching status, and AHA hospital size with epidural analgesia as the dependent variable.[12] Patients who received EA were then matched 1:1 to patients who did not receive EA using a greedy matching algorithm with a caliper width of 0.2 standard deviations of the logit of the propensity score.[13] Covariate balance between matched pairs was assessed using the standardized difference, with values less than 10% indicating minimal imbalance.[14] All *P*-values were two-sided and values $<0.05$ were considered statistically significant in all analyses. All statistics were performed using SAS version 9.3 (SAS Inc. Cary, NC, USA).

## Results

From 2009 through to 2011, 12 440 patients underwent a pancreatectomy in the NIS. The mean age was 61.9 years (standard deviation: 13.8 years) and 51.0% were women. Patient, operative and hospital statistics are summarized in Table 1.

Unadjusted outcomes by EA status after a pancreatectomy are shown in Table 2. After adjusting for age, gender, race, comorbidities, insurance status, pancreatectomy type, cancer status, hospital pancreatectomy volume, hospital teaching status and AHA hospital size (Table 3), EA was independently associated with decreased post-operative LOS, decreased hospital charges and decreased inpatient mortality.

A 1:1 propensity score matching was performed using variables shown in Table 4. In all, 1070 matched pairs were obtained for the comparison, a match rate of 94.7% for all patients with epidurals (Table 4). The groups were well balanced with standardized differences of less than 10% for all variables. Patients, who received EA, had significantly improved outcomes compared with propensity score-matched controls without EA (Table 5).

## Discussion

Previous studies examining the role of EA in pancreatectomy patients have failed to show a benefit. In a study of patients undergoing a pancreaticoduodenectomy, Pratt *et al.*[15] found that patients, who received EA, had lower pain scores, but also had increased rates of major complications. In a study including gastrectomy and pancreatectomy patients, Shah *et al.*[16] found that EA did not significantly improve pain control nor was it associated with significantly different rates of post-operative complications, such as pneumonia and ileus, or death. It is likely that the efficacy of epidural catheters is dependent on multiple factors. For example, the skill level and experience of the anaesthesiologist, the use of narcotics versus local anesthetics and how catheters are managed intra- and post-operatively all likely play a major role in whether EA is effective.[17] Thus, there may be tremendous institutional bias in a single institution studies regarding the efficacy of EA. A population-level