Original Research

Retrospective review of postoperative glycemic control in patients after distal pancreatectomy

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HIGHLIGHTS

- The blood glucose levels were relatively well controlled, and the incidence of hypoglycemia was minimal after DP.
- Patients might require small doses of insulin for postoperative glycemic control.
- Insulin dose range of 0.05-0.20 units/kg seemed appropriate for postoperative glycemic control among patients with DP.

ARTICLE INFO

ABSTRACT

Background: Distal pancreatectomy (DP) is carried out for resection of lesions in the body and tail of the pancreas. DP may lead to both insulin and glucagon deficiency, which may worsen diabetes mellitus and render patients more vulnerable to severe hypoglycemia. Maintaining glycemic control can be challenging after DP, and no guidelines have been established for clinicians. The objective of this study was to investigate postoperative glycemic control and insulin dose among patients after DP.
Methods: The medical records from 82 eligible adult patients after DP between 2013 and 2014 were reviewed retrospectively.
Results: Twenty-one (25.6%) patients had pre-existing diabetes. The average length of stay was 5.8 ± 2.6 days. The average resected volume was 193 ± 313 cm^3. Of 2124 blood glucose (BG) values, only 0.3% were <70 mg/dL (3.9 mmol/L); 45% were 140—180 mg/dL (7.8—10.0 mmol/L); and 14% were >180 mg/dL. Postoperatively, insulin was the most common agent prescribed for glycemic control. Among those who received insulin, 86.8% used rapid-acting correction insulin, 4.4% prandial insulin, and 8.8% long-acting insulin. On postoperative day 1 through 6 and on the day before hospital discharge, <30% of patients received insulin, and a total daily dose (TDD) of <0.10 units/kg was frequently needed for glycemic control. At discharge, 35.3% of patients with pre-existing diabetes improved; 23.2% required diabetic medications, of whom 50% took insulin. Only 2 patients without pre-existing diabetes required medications.
Conclusion: Postoperative BG levels were relatively well controlled. The majority of BG levels were in the optimal range, and the incidence of hypoglycemia or clinically significant hypoglycemia was minimal with our current regimen. Postoperative patients required small TDD of insulin for glycemic control. Our data suggested that 0.05—0.20 units/kg was an appropriate dose range for postoperative glycemic control among the vulnerable population. Our findings provide guidance for clinicians to dose insulin safely for postoperative patients with DP in a hospital setting.

1. Introduction

Distal pancreatectomy (DP) is carried out for resection of neoplastic and non-neoplastic lesions in the body and the tail of the pancreas. Altered endocrine function may occur after pancreatic

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resection. Some patients may experience improved glycemic control after surgery [1,2]. In contrast, other patients may experience worsened glycemic control or develop pancreatogenic diabetes [1,3,4]. Postoperatively, 4.8%–39% of DP patients developed pancreatogenic diabetes [5–8]; and the incidence of diabetes was higher when DP was performed for chronic pancreatitis [8].

The American Diabetes Association (ADA) Standards of Care recommend initiating insulin therapy for treating persistent hyperglycemia ≥180 mg/dL (10.0 mmol/L), and to maintain blood glucose (BG) levels between 140 mg/dL (7.8 mmol/L) and 180 mg/dL for the majority of critically and non-critically ill patients in the hospital setting. ADA also defines BG < 70 mg/dL (3.9 mmol/L) as hypoglycemia, BG ≤ 54 mg/dL (3.0 mmol/L) as clinically significant hypoglycemia, and BG > 140 mg/dL as hyperglycemia in the hospital [9]. Postoperative glycemic control can be influenced by many factors, including the types of pancreatic surgery, patient's conditions, nutritional status, and insulin regimen. After major pancreatic resection, patients may present frequent episodes of iatrogenic hypoglycemia due to increased sensitivity to insulin and reduced or lack of glucagon response [5,10]. Maintaining glycemic control can be more challenging among patients after DP. Despite these challenges, no guidelines have been established to assist clinicians in postoperative glycemic management for DP patients. The objective of this study was to investigate postoperative glycemic control and insulin dose among patients after DP.

The second objective was to examine the association of volume of resected pancreas and mean glucose values in a hospital setting.

2. Methods

2.1. Study design and patient selection

This was a retrospective chart review. The study was approved by the Institutional Review Board. Charts from 84 patients who underwent DP between January 1st, 2013 and December 31st, 2014 at this 1,200-bed hospital were retrospectively reviewed. All surgeries were performed by a hepatobiliary pancreatic specialty surgeon at Washington University Medical School affiliated with this hospital. Patients were identified from a clinical database based on the international classification of disease (ICD)-9 procedure code 52.52 for DP. Two patients who had previously undergone a Whipple procedure were excluded from this study, with a final study population of 82 patients.

2.2. Data collection

Data collection included the following: demographics, history of diabetes and pancreatic resection, pathologic data, laboratory and point-of-care (POC) blood values (e.g. hemoglobin A1c [HbA1c], BG and creatinine levels), postoperative complications, length of stay (LOS), and treatment for glycemic control before and after DP. The ADA Standards of Care for glucose levels in hospitalized patients were used to develop categories of glucose control. The percentage for each category of blood glucose level ≤54 mg/dL, 55–69 mg/dL, 70–139 mg/dL, 140–180 mg/dL, or >180 mg/dL was calculated. Hypoglycemia was defined as any BG level <70 mg/dL; clinically significant hypoglycemia was BG level ≤54 mg/dL (3.0 mmol/L); and hyperglycemia was BG level >140 mg/dL.

Data were extracted from patient's electronic medical records by one of the investigators and entered manually into a database. Accuracy of the data was ensured by random verification by other investigators.

2.3. Calculating the volume of resected pancreas

The volume of resected pancreas (VRP) was calculated by subtracting the lesion volume from the total volume of the resected pancreas based on the pathologic measurement.

2.4. Definition of total daily dose of insulin

Total daily dose (TDD) of insulin was defined as the total insulin usage for the 24-hour period from midnight to next midnight. Estimated weight-based insulin dosing was calculated by the total insulin dose per body weight in kilograms (units/kg) for the 24-hour period.

2.5. Statistical analysis

Descriptive statistics (means, standard deviations, percentages) were computed for baseline patient characteristics, such as age, gender, race, body weight, and body mass index. In order to determine if groups differed on key study variables, we compared values using either the chi-square test for categorical dependent variables or a one-way analysis of variance (ANOVA) for continuous dependent variables; we did not include any covariates in these analyses. In order to evaluate the relationship between mean blood glucose values and the volume of the resected pancreas, we computed using the Pearson's correlation. Patients with missing HbA1c were excluded from diabetes categorization. Variables with missing data for other analyses were excluded on a pairwise basis. Within the cohort of patients, variable frequency of point of care glucose values were conducted. Mean glucose values were calculated with laboratory and point of care testing measurements available. All analyses were performed with SPSS version 22 (IBM Corp., Armonk, New York).

3. Results

3.1. Patient characteristics

Demographics and clinical characteristics of the patients are summarized in Table 1. In this study, there were more women than men (59.8% versus 40.2%), and the majority of the patients were Caucasian (87.8%). Twenty-one patients (25.6%) had pre-existing

Table 1
Patient demographics and clinical characteristics (n = 82).

Demographics and Characteristics	Result
Mean age, years	58.5 ± 13.9
Gender, n (%)	
Male	33 (40.2)
Female	49 (59.8)
Ethnicity, n (%)	
Caucasian	72 (87.8)
African American	10 (12.2)
Mean body mass index, kg/m^2	28 ± 6
Pre-existing diabetes, n (%)	21 (25.6)
HbA1c measurement, n (%)	23 (28)
Pathologic diagnosis, n (%)	
Adenocarcinoma	22 (26.8)
Neuroendocrine tumor	21 (25.6)
Mucinous cystic neoplasm	16 (19.5)
Chronic pancreatitis	7 (8.5)
Intraductal papillary mucinous neoplasm	5 (6.1)
Pseudopapillary neoplasm	3 (3.7)
Paragangliomas	2 (2.4)
Cystadenoma	2 (2.4)
Other	4 (5.0)
Mean lesion size, cm^3	77.5 ± 241.7
Average volume of resected pancreas, cm^3	193 ± 313
Mean length of stay, days	5.79 ± 2.57

Values are mean ± standard deviation (SD), or n (%).
HbA1c = Hemoglobin A1c; n = Number of patients.