

Clinical Surgery

Diabetes is associated with perforated appendicitis: evidence from a population-based study



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Abstract

BACKGROUND: The purpose of this study was to investigate the relationship between perforated appendicitis and patient with diabetes using a population-based data set.

METHODS: This study used data from the Longitudinal Health Insurance Database 2005 in Taiwan. We identified 4,806 patients hospitalized with acute appendicitis. The independent variable was whether a patient had ever received a diagnosis of diabetes before the index hospitalization. We performed a conditional logistic regression model to explore the odds ratio and its corresponding 95% confidence interval of perforated appendicitis.

RESULTS: Rates of perforated appendicitis for patients with and those without diabetes were 46.2% and 28.3%, respectively. A chi-square test revealed that there was a significant difference in rates of perforated appendicitis between patients with and those without diabetes ($P < .001$). The conditional logistic regression model revealed that the adjusted odds ratio of perforated appendicitis for patients with diabetes was 1.35 (95% confidence interval = 1.11 to 1.65) compared with patients without diabetes.

CONCLUSIONS: Our study demonstrated that a history of diabetes is an important factor with regard to the rate of perforated appendicitis.

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Appendicitis is one of the most common causes of acute abdomen.¹ The goal of management of acute appendicitis is a correct diagnosis and prevention of perforated appendicitis. However, the incidence of perforated appendicitis is still around 20% to 25%.^{2,3} Patients with perforated appendicitis were shown to have a higher risk of postoperative complications, such as an intra-abdominal

abscess, wound infection, and postoperative paralytic ileus (39% vs 8%).^{4,5}

The pathogenesis of perforated appendicitis is a result of an appendiceal luminal obstruction, which increases the intraluminal pressure and decreases blood flow to the wall of the appendix. Subsequently, necrosis and perforation of the appendix occur. The course of progression of appendicitis to necrosis and perforation varies among patients. Although perforation is an important issue of patients with more than 24 hours of symptoms, perforation can develop more rapidly. About 20% of patients with perforated appendicitis present within 24 hours of the onset of symptoms,⁶ so searching for risk factors for early perforation of appendicitis is an important issue.

The prevalence of diabetes mellitus is persistently increasing. Diabetes is associated with complications such as myocardial infarction,⁷ cerebrovascular accidents,^{8,9} end-stage renal disease,¹⁰ retinopathies, and foot ulcers.¹¹ Morbidity from diabetes is a consequence of macrovascular and microvascular diseases induced by diabetes. Since necrosis and perforation of appendicitis are consequence of decreased blood flow to the wall of appendix, diabetes-induced microvascular diseases can further compromise blood flow to the intestines. Therefore, patients with diabetes may have increased risk for perforated appendicitis. The purpose of this study was to investigate the relationship between perforated appendicitis and patient with diabetes using a population-based data set.

Methods

Database

We used data sourced from the Longitudinal Health Insurance Database 2005 (LHID 2005), published by the Taiwan National Health Research Institute. Taiwan initiated its single-payer National Health Insurance (NHI) program in 1995. The LHID 2005 includes claims data of 1,000,000 individuals randomly sampled from the 2000 Registry for Beneficiaries ($n = 25.68$ million) of the Taiwan NHI program. The LHID 2005 provides an excellent opportunity for researchers to trace the medical services of these 1,000,000 individuals since the beginning of the Taiwan NHI program. Hundreds of studies have been performed and published based on this data set.

This study was exempted from full review by the Institutional Review Board of National Defense Medical Center since the LHID 2005 consists of deidentified secondary data released to the public for research purposes.

Study sample

We identified 5,814 patients who were hospitalized with a principal diagnosis of acute appendicitis (*International Classification of Disease, Ninth Revision, Clinical*

Modification [ICD-9-CM] codes 540, 540.0, 540.1, and 540.9) between January 2006 and December 2012. If a patient had two or more hospitalizations within a 30-day period, these were regarded as the same episode, and we only included the first hospitalization. We further excluded patients aged less than 18 ($n = 1,008$) to limit the study sample to adult population. As a result, 4,806 patients with acute appendicitis were included in the study.

Key variables of interest

The key independent variable of interest was whether a patient had ever received a diagnosis of diabetes (ICD-9-CM code 250) before the index hospitalization. To increase the diagnostic validity of the administrative data set, this study only included those subjects who had received two or more diagnoses of diabetes coded in the outpatient claims. The key dependent variable was whether a patient had perforated appendicitis. Patients were regarded as having perforated appendicitis if they had an ICD-9-CM code of 540.0 (acute appendicitis with generalized peritonitis) or 540.1 (acute appendicitis with peritoneal abscess).

Statistical analysis

This study used the SAS package (version 9.1, SAS Institute, Cary, NC, USA) for the statistical analyses. Chi-square tests were used to examine differences between diabetes and patient characteristics. Patient characteristics included age, gender, monthly income, geographical location, urbanization level of the patient's residence (5 levels with 1 being the most urbanized and 5 being the least), and the Charlson Comorbidity Index (CCI). We further carried out a conditional (fixed-effect) logistic regression model (conditioned on hospitals to partition out systematic hospital-specific variations) to explore the odds ratio (OR) and its corresponding 95% confidence interval (CI) of perforated appendicitis among sampled patients. A 2-sided P value of $\leq .05$ was considered to be statistically significant.

Results

Table 1 presents distributions of sociodemographic characteristics stratified by the presence of diabetes. Of the 4,806 patients admitted for treatment of acute appendicitis, 1,449 (30.2%) had received a diagnosis of perforated appendicitis. Mean ages of patients with and those without diabetes were 58.4 (± 14.8) and 44.3 (± 16.3) years, respectively ($P < .001$). In addition, patients with diabetes were more likely to have a monthly income of $< \text{NT\$}15,841$ ($P = .002$) and have a CCI ≥ 3 ($P < .001$) than those without diabetes. However, there was no significant difference in gender, urbanization level, or geographic region between patients with and those without diabetes.

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