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# Predictors of 30 d readmission following percutaneous cholecystostomy

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ABSTRACT

*Background:* High-risk patients undergoing cholecystectomy may experience increased morbidity and mortality. Percutaneous cholecystostomy (PC) has been utilized as a treatment option for acute cholecystitis in this cohort. Little is known about risk factors for readmission following PC.

*Materials and methods:* Patients who had PC from 2013 to 2014 were identified from the National Readmission Database by the Healthcare Cost and Utilization Project. A 30-d readmission was defined as a subsequent admission within 30 d following the first admission discharge date. Multivariate logistic regression models using stepwise selection were employed to select significant predictive variables for subsequent readmission.

*Results:* Three thousand three hundred sixty-eight patients were identified with 698 (20.7%) readmissions during the study period. Of the readmitted patients, 79 (2.35%) had two readmissions and six patients (0.19%) had three or more readmissions within 30 d of their index procedure. In addition, alcohol use (odds ratios [OR] 1.58, confidence intervals [CI] 1.10-2.29), uncomplicated diabetes (OR 1.21, CI 1.00-1.47), congestive heart failure (OR 1.28, CI 1.03-2.44), depression (OR 1.42, CI 1.08-1.86), and metastatic cancer (OR 1.65, CI 1.11-2.46) were significantly correlated with risk for readmission. Readmitted patients had longer hospital stays (OR 1.38 CI 1.09-1.74, length of stay >8 d).

*Conclusions:* A significant proportion of patients are readmitted within 30 d following PC. These patients may benefit from increase care coordination starting at their index admission. Studies are needed to determine patient selection for upfront cholecystectomy.

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## Background

Percutaneous cholecystostomy (PC) is utilized in patients who are deemed high risk for cholecystectomy. In fact, cholecystectomy for critically ill elderly patients with acute calculous cholecystitis (AC) has been demonstrated to carry morbidity and mortality rates of 31% and 15%, respectively.[1] PC was first performed in 1980[2] and has been suggested as appropriate therapy for patients with Tokyo Criteria grade III AC (acute cholecystitis with end organ dysfunction)[3] or patients who are nonoperative candidates.[4] PC has demonstrated safety and efficacy in resolving sepsis from AC[5-7] and some suggest using PC as definitive therapy for patients with elevated operative risk.[8-11]

Although there is increasing utilization of PC as an alternative to laparoscopic cholecystectomy (LC),[12] PC is fraught with potential postprocedure challenges. For example, PC is associated with low rates of interval cholecystectomy,[12,13] potentially placing patients at risk for tube-related complications and repeat episodes of acute cholecystitis or gallstone-related complications. Although PC procedural complication rates remain unknown, they are estimated at 3%-11% and include vasovagal syncope, hemobilia, pneumothorax, bile leak, catheter dislodgement, and recurrent cholecystitis.[9,10,14] Recurrent cholecystitis has been documented in 11%-41% of patients after PC[9,15-18] with single center readmission rates ranging widely from 23% to 41%.[17,19] Emergency department visits for gallstone-related complications within 1 y following PC are estimated at 50%,[13] though to the authors knowledge no national database has been able to evaluate this.

Anecdotally, patients undergoing PC may need to be readmitted, but the true incidence of and predictors for readmission were difficult to ascertain as there was no national data that allowed accurate tracking of readmissions if the readmission was not at the index hospital. Although LC is preferred for AC when feasible and is safe and effective after PC is utilized to overcome the acute illness,[20] there is little evidence directing practitioners to favor PC over LC for AC despite its increasing utilization.[17,21] This study evaluates the risk factors for readmission after PC for AC and rates of readmission following PC.

## Materials and methods

Patients who had PC (International Classification of Diseases, 9th Revision procedure code: 51.01) for acute cholecystitis between 2013 and 2014 were identified from the Nationwide Readmission Database (NRD) by the Healthcare Cost and Utilization Project.[22] This database is a nationally representative database representing approximately 17 million discharges annually and accounts for all payers and the uninsured. A 30-d readmission was defined as a subsequent admission within 30 d following the index admission discharge date during which PC was performed. Patients who had their index discharge date in December 2013 or 2014 were excluded to allow for 30 d of follow-up from their index admission. Patients who died during their first admission ($n = 200$) were excluded because there was no chance for them to have a readmission. This study was exempt from the Institutional Review Board.

Univariate analyses (chi-square test for categorical variables and student's *t*-test for continuous variables) were performed to compare differences in demographic and patient characteristics between those with and without readmission. Multivariate logistic regression models were utilized to predict variables for readmission for PC using stepwise selection approach with a *P* value cutoff of 0.2 for inclusion within the model, which controlled for patient characteristics. Odds ratios (OR) with 95% confidence intervals (CI) were calculated to estimate associations between predictive variables and readmission. The discharge-level weight was multiplied to each admission to calculate estimated national readmission rate. Statistical significance was set at *P* value of 0.05. All analysis was performed using SAS version 9.4 (SAS Institute, Cary, NC).

## Results

Overall, there were 3368 patients who underwent PC during the study period. Of these, there were 698 (20.7%) patients who were readmitted within 30 d, whereas 2670 (79.3%) patients were not readmitted within 30 d (Table 1). One hundred twenty-two patients (17.5%) were readmitted to the nonindex hospital. There was no difference in readmission rate between calculous and acalculous cholecystitis (327 [50.54%] *versus* 320 [49.46%], respectively, $P = 0.11$). There were 51 readmissions with a diagnosis code that could not be attributed to either calculous or acalculous cholecystitis.

The estimated national readmission rate was 21.1%. There was no difference in the age (70.13 ± 16.47 *versus* 70.9 ± 16.55 y) or gender composition ($P = 0.53$) of those who were not readmitted compared to those who were readmitted. Comorbidities varied significantly in only collagen vascular disease/rheumatoid arthritis, congestive heart failure, depression, history of fluid/electrolyte disorders, and recent weight loss. Although baseline insurance status was significantly different ($P = 0.03$), elective *versus* nonelective admission, weekend day of admission, hospital disposition, hospital bed size, and hospital teaching status did not differ significantly between those who were readmitted and those who were not.

Of the readmitted patients, 79 (2.35%) had two readmissions within the study period, and six patients (0.19%) had three or more readmissions within 30 d of their index procedure. Several comorbidities were associated with readmission within 30 d after PC (Table 2). Alcohol use (OR 1.58, CI 1.10-2.29), congestive heart failure (OR 1.28, CI 1.03-1.60), depression (OR 1.42, CI 1.08-1.86), uncomplicated diabetes (OR 1.21, CI 1.00-1.47), metastatic cancer (OR 1.65, CI 1.11-2.46), and index length of stay of nine or more days (OR 1.38, CI 1.09-1.74) were all significantly associated with an increased risk for 30-d readmission. Peripheral vascular disorders (OR 0.72, CI 0.53-0.98) and self-pay (OR 0.48, CI 0.26-0.89) were significantly associated with a reduced risk of 30-d readmission. Rheumatoid arthritis/collagen vascular diseases (OR 1.53, CI 0.96-2.44), solid tumor without metastases (OR 1.51, CI 0.99-2.30), recent weight loss (OR 1.29, CI 0.99-1.69), and index length of stay from 5 to 8 d (OR 1.23, CI