30-Day Readmissions and the Need for Emergent Surgery Following Nonoperative Management of Perforated Diverticulitis

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Abstract

Background

Limited data is available on the evaluation of patients with perforated diverticulitis who were managed without surgery and their outcomes.

Aims

This retrospective review was aimed at investigating the 30-day non-elective readmission rates for patients hospitalized with perforated diverticular disease who were managed without surgery, rates of patients requiring surgery on readmission and the independent predictors of readmission.

Methods

A total of 143, 546 patients from the National Readmission Database between 2016 to 2020 who were admitted with perforated diverticulitis and managed nonoperatively were reviewed. Readmitted patients were compared to those not readmitted. Comparisons for continuous and categorical variables were made using the student t-test and chi-squared test, respectively. A logistic regression model was used to determine independent factors associated with readmission. All analysis were done with SAS 9.4; P values < 0.05 identified significance.

Results

Among patients with perforated diverticulitis who were managed non-operatively, 17,868 (12.4%) were readmitted within 30 days and 4,924 (27.6%) of patients readmitted required surgical intervention. The greatest independent predictors of readmission include: patient insurance status, index length of stay, and patient disposition. Comorbidities predicting readmission include renal failure, chronic pulmonary disease, diabetes, fluid and electrolyte disorders, and hypertension. Hospital total charges were higher at the index admission for patients requiring readmission.

Conclusion

Nonoperative management of perforated diverticulitis is safe for many patients but the risks for readmission and subsequent need for emergent surgery require special consideration.

Background

Diverticulitis accounts for 208,000 inpatient admissions in the United States per year. Perforated diverticulitis is one of the most devastating consequences of diverticular disease and accounts for 12% of diverticulitis admissions [1]. Due to the high morbidity and mortality associated with emergency colectomy, nonoperative management of perforated diverticulitis is increasingly considered for select patients. In the last decade, researchers have worked to identify which patients with perforated diverticulitis can be successfully managed without surgery [2]. A nonoperative approach used in the management of stable patients with diverticular disease includes fasting, intravenous fluids, antibiotic therapy, pain management, and percutaneous radiological drainage when indicated [3]. Data for perforated diverticulitis using this approach is currently limited to a few small retrospective studies [4–9] and one population-based study from the UK [10]. These studies have produced varying results for the successful management of perforated diverticulitis in the acute setting and there is a paucity of data evaluating readmissions for patients who were managed without surgery. Even less is known about the risk factors associated with nonoperative treatment failure, the risk for readmission and the need for subsequent emergency surgery for this distinct disease entity.

We aimed to identify 30-day non-elective readmission rates for patients hospitalized with perforated diverticular disease who were managed nonoperatively, rates of patients requiring surgery on readmission and the independent predictors of readmission. We hypothesized that 10–15% of patients will require non-elective readmission within 30 days of discharge.

Methods

After Institutional Review Board approval, a retrospective analysis was performed using the National Readmission Database (NRD). All NRD data is accessible at https://hcup-us.ahrq.gov/nrdoverview.jsp. The STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guideline was used for proper reporting of methods, results, and discussion. Data was extracted and analyzed from the NRD, which is obtained from the Healthcare Cost and Utilization Project (HCUP). The NRD is a reliable and verified way to track patients across hospitals within a state and accounts for over 62% of the total U.S. resident population. The database includes insured and non-insured patients across 31 states. This database was utilized to ensure a balanced representation of the target population to prevent bias.

We identified patients 18 years of age or older admitted with the principal diagnosis of perforated diverticulitis using ICD-10 codes K57.20 and K57.21 (diverticulitis of large intestine with perforation and abscess without bleeding and diverticulitis of large intestine with perforation and abscess with bleeding, respectively) from the years 2016–2020 and excluded patients who underwent surgery during the index hospitalization using the ICD-10 PCS codes used for laparoscopic and laparotomy procedures. ICD-10 PCS codes for drainage procedures were not used to exclude patients from the cohort. The analysis also excluded patients for whom 30-day readmission data could not be calculated including those admitted in December, elective admissions, and mortalities. The final analytical cohort was comprised of 143,546 patients.

Variables collected included demographics, comorbidities on admission, insurance status, economic status, hospital bed size, hospital teaching status, length of stay (LOS), patient disposition, and total hospital charges. Clinical Classifications Software (CCS) was used to identify smoking, diabetes mellitus, atrial fibrillation/flutter, coronary artery disease, prior myocardial infarction, and chronic blood loss anemia.

The primary outcome was 30-day, all-cause, non-elective readmissions for patients with a primary diagnosis of perforated diverticulitis who were managed nonoperatively. If a patient had multiple readmissions within 30 days, only the first was included and the primary diagnosis for readmission was used for analysis. The secondary outcomes included independent predictors of readmission, rates of surgery on readmission, and resource utilization including total hospital cost and length of stay (LOS).

Continuous variables are reported as means with standard deviations and categorical variables are reported as percentages. Comparisons for continuous variables were made using the student t-test. The chi-squared test was used for categorical variables. Our primary outcome was a 30-day readmission. Next, we used a logistic regression model to determine independent factors associated with readmission. We chose the variables a priori as disposition, LOS, payor, chronic obstructive pulmonary disease (COPD), diabetes mellitus (DM), renal failure, electrolyte disorder, and hypertension (HTN). Adjusted Odds Ratios (ORs) are displayed. All analysis was done with SAS 9.4 (Cary, NC)

Results

Using the NRD, a total of 237,352 patients were identified between the years of 2016 and 2020 with a primary admission diagnosis of perforated diverticulitis. Of those, 143,546 patients were managed nonoperatively during their index admission. A total of 17,868 (12.4%) patients were non-electively readmitted within 30 days and 4,924 (27.6%) of those patients required surgical intervention upon their readmission (Fig. 1).

The mean age for patients who were not readmitted (NR) and those non-electively readmitted within 30-days (NER) were 57.2 and 59.7, respectively. The NR group comprised 51.4% males and 48.6% females and the NER group comprised 44.8% males and 55.2% females. The percentage of patients discharged routinely (home with self-care or family support) in the NR group was higher at 85.7% versus 73.1% in the NER group and the percentage of patients discharged with home health in the NR was 10.2% and 17.0% in the NER group. The mean LOS for NR and NER patients was 4.3 days and 5.4 days, respectively. Private insurance was the most common insurance for the NR group (48.3%) and Medicare was the most common insurance in the NER group (41.6%). Mean total charges were higher in the NER group ($44,830) compared to the NR group ($34,611). Hypertension and fluid and electrolyte disorders were the two most common comorbidities for both the NR and NER groups (Table 1).

The greatest independent predictors of 30-day readmission by multivariate testing were patient disposition, index length of stay, and insurance status (Table 2). NER patients were more likely to discharge non-routinely (reference Table 1), (1.7, 1.63–1.77). Length of stay greater than 5 days was also

predictive of a non-elective readmission within 30-days (1.45, 1.4–1.5). Medicaid (1.5, 1.42–1.58), Medicare (1.24, 1.2–1.29) and Self-pay (1.2, 1.11–1.3) were all found to be independent predictors of readmission. Age and ownership of the hospital (government, private, not-for-profit, private) were not found to be predictors of readmission by multivariate regression.

The most significant patient comorbidities that independently predicted readmission included COPD, DM, renal failure, fluid and electrolyte disorders, and HTN. Liver disease was not associated with 30-day readmission (Table 2).

Discussion

Perforated diverticulitis is a challenging disease with a spectrum of severity and varied clinical presentations. Patients with signs of hemodynamic instability or diffuse peritonitis undergo urgent surgery, while those without are increasingly being managed without an operation on their index admission. Over the last decade, there has been a shift toward nonoperative management for perforated diverticulitis with little data to guide clinicians on which patients are at risk for failing nonoperative management. Since there are no large U.S. population based studies evaluating non-elective readmissions and the risk factors for readmissions in this patient population, our results are not comparable to those in the literature. A smaller population study performed in the United Kingdom evaluating patients with perforated diverticulitis managed nonoperatively found that 203 of 767 (26.5%) patients required non-elective readmission at 1-year follow-up [10]. Of those non-electively readmitted, 3% required an emergency operation. Their study reported a non-elective readmission rate two times that of our study (26.5% versus 12.4%.) This may be due to their 1-year follow-up study timeframe when compared to our 30-day follow-up study timeframe. Their study also differed in the number of patients requiring emergency surgery upon readmission (3%) compared to our study (27.6%).

Several small retrospective studies have evaluated the success rates of the nonoperative management of perforated diverticulitis at index admission and identified the risk factors for failed management. In a cohort of 132 patients with perforated diverticulitis, Sallinen et al. [4], reported the successful non-operative management of 112 (85%) with 20 patients (15%) requiring emergent surgery. They identified abundant or distant free air and fluid in the fossa of Douglas on computed tomography (CT) imaging to be risk factors for nonoperative treatment failure [4]. In another study of 64 patients, Titos-Garcia et al. [5], found nonoperative management was successful in 54 patients (83.1%) with extraluminal air identified on their index admission for complicated diverticulitis [5]. Their work echoed the work of Sallinen et al. [4], in that distant free air on CT imaging was a risk factor for failed nonoperative management. Interestingly, two other studies reported a higher success rate of nonoperative management in patients with distant free air when compared to pericolic air [6, 8]. Both of these studies reported similar overall success rates of nonoperative management with Dharmarajan et al. [6], reporting success in 131 of 136 (91%) patients and Costi et al. [8], reporting success in 36 of 39 (92.3%) patients. Risk factors for nonoperative failure reported by Costi et al. [8], included severe sepsis, previous antibiotic therapy, duration of symptoms prior to presentation, higher CRP and WBC values, and presence of fluid in the pouch of Douglas on CT

imaging. These studies did not report on readmission rates. A systematic review by Chua et al. [2], revealed 407 of the 479 (85%) included patients with acute perforated diverticulitis were successfully managed non-operatively. Hartmann's procedure and resection with anastomosis with or without stoma were the most common operations performed in patients who failed nonoperative treatments [2].

While our study cannot be directly compared to earlier studies since we looked at 30-day readmissions, our study reports a similar success rate of nonoperative management at 87.6%. We did not report on CT imaging findings including volume or location of pericolic air or intraabdominal fluid. The NRD does not include laboratory or imaging data for comparison. We found the greatest independent predictors of readmission were patient disposition, index LOS, and insurance status. A longer LOS on the index readmission may highlight longer times to resolve the initial disease process or patients presenting with more severe disease.

To our knowledge, this is the only population-based study and the largest study in the United States evaluating the predictors of nonoperative treatment failure in this distinct patient population. Our study echoes that nonoperative management of acute perforated colonic diverticulitis is safe and effective for most stable patients. However, the decision to employ a nonoperative approach to manage perforated colonic diverticulitis should be based on individual patient characteristics including comorbid diseases, morbidity of emergent surgery, ongoing symptoms, and the complexity and severity of disease at presentation. Early recognition of patients who show clinical signs of persistent perforation after nonoperative management remains crucial to the success of this strategy. Considering the finding that 27.6% of readmitted patients required an emergent operation, clinicians should pay special attention to those at risk for readmission. The highest readmission rates were found in those discharged with home health, which may cautiously be interpreted that these patients were either frailer on admission or upon discharge. Our study also found that readmitted patients were more likely to have Medicare compared to private insurance. This is an alarming disparity that deserves attention. These findings highlight a vulnerable population and an unsatisfactory trend in the management of perforated diverticulitis. This should be considered when caring for diverse populations of patients and creates opportunities for quality improvement projects.

Our study has many strengths including a large sample size of 143,546 and vast diversity geographically. However, database studies may allow for skewed data as they rely on the proper coding that may overestimate or underestimate the disease being studied. With a large sample size, it is also possible that statistical differences detected are amplified and may not be clinically meaningful. Additionally, this study is limited by its retrospective methodology and the NRD does not include data points of interest including radiographic findings and laboratory values.

In conclusion, the nonoperative management of perforated diverticulitis may be a safe and effective way to treat stable patients. However, if nonoperative management fails, this study found that 27.6% of readmitted patients will require surgical intervention. The high morbidity associated with delayed surgery mandates patient care is tailored to individual patient characteristics including those characteristics that

portend a higher risk of readmission. Finally, the disparities related to insurance coverage need to be promptly addressed with future studies. There is an opportunity to study this patient population prospectively to better define candidates safe for nonoperative management.

Declarations

Author Contribution: J.G. conceived the idea. R.O. and J.G. performed the literature search and review. J.G. and S.N. contributed to the study design, data analysis and data interpretation. AF assisted with data analysis and interpretation. All authors, J.G, S.N., R.O., A.F., and A.B. participated in writing the final manuscript and critical revision.

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Tables

Tables 1 and 2 are available in the Supplementary Files section.

Figures

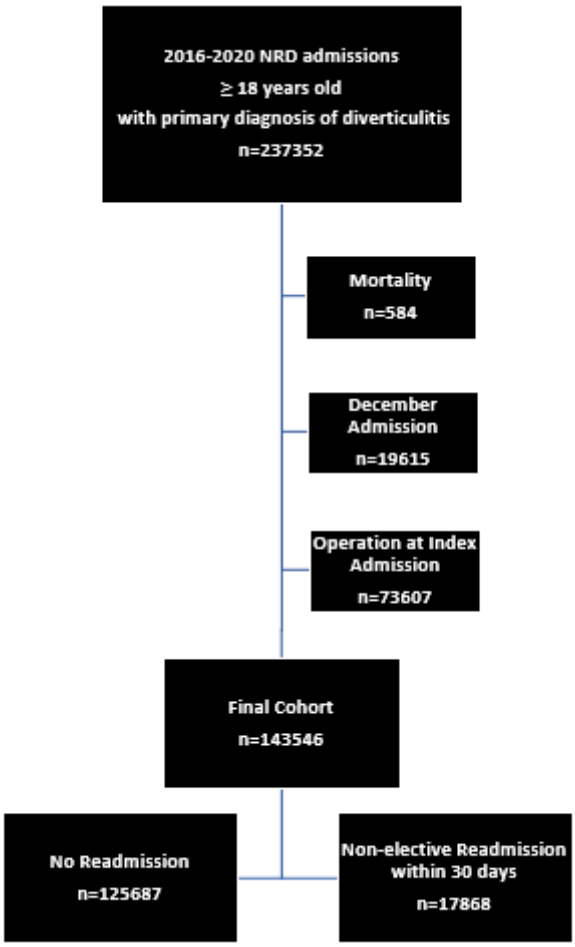

Figure 1

Flowchart of patient selection and patient outcome

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table1ppt.pptx
- Table2ppt.pptx
- OnlineAbstractFigure.pptx