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Inpatient outcomes of Dieulafoy's lesions in the United States

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ABSTRACT

Dieulafoy's lesions are arguably underidentified rather than an infrequent cause of gastrointestinal bleeding. No population-based study exists regarding its inpatient outcomes in the United States. We evaluated the characteristics and inpatient outcomes for Dieulafoy's lesions using the National Inpatient Sample from 2016 to 2019. We identified 30,015 weighted hospitalizations for Dieulafoy's lesions. An initial diagnosis of Dieulafoy's lesions was established for 53.85% of patients on admission. The mean age was 68.7 ± 0.04 years, with male (56%) and white race predominance (70%). The mean length of stay and hospital cost were 7.87 days and $111,914, respectively. Significant predictors of inpatient mortality included heart failure, cardiac arrhythmias, coagulopathy, protein-calorie malnutrition, and alcoholism ($P < 0.001$). During inpatient hospitalization, 78% of patients underwent endoscopies, and 11% had colonoscopies. Inpatient mortality was 4.65%. Common comorbidities in Dieulafoy's lesions patients included heart failure (34%), cardiac arrhythmias (41%), hypertension (32%), chronic obstructive pulmonary disorders (25%), coagulopathic disorders (22%), and alcohol abuse (12%). Dieulafoy's lesions have a significant effect on length of stay and hospital cost. Endoscopies were used substantially more than colonoscopies for Dieulafoy's lesions, indicating a predominant presentation as upper gastrointestinal bleed. Cardiac disorders increase mortality in patients with Dieulafoy's lesions.

KEYWORDS Dieulafoy's lesions; National Inpatient Sample; prevalence; upper gastrointestinal bleeding

Dieulafoy's lesions were first described in 1884 by M. T. Gallard and were later explained by Paul Georges Dieulafoy in 1898.[1] Although relatively rare, they carry a high risk of gastrointestinal bleeds.[2] Unfortunately, data regarding Dieulafoy's lesions are limited to case reports. Due to poor understanding of the disease, patients with Dieulafoy's lesions often pose a diagnostic challenge. Many of these lesions are in the stomach or duodenum and are described as small arteries with an abnormally dilated caliber that runs a tortuous course in the submucosa of the gut or nongut tissue.[3] The submucosal arteries can experience pressure necrosis of overlying mucosa and submucosa, frequently mimicking an ulcer, often resulting in bleeding. Massive bleeding on presentation often leads to poor outcomes. Prior research supports the association of Dieulafoy's lesions with increasing age, male gender, anticoagulant use, antiplatelets/nonsteroidal anti-inflammatory drugs, and comorbidities related to coagulopathies such as chronic kidney disease or liver cirrhosis.[1] However, no prior large database studies exist regarding the association of Dieulafoy's lesions with inpatient outcomes, mortality, and comorbidities. We describe the magnitude of Dieulafoy's lesions in the US healthcare system by focusing on healthcare costs and length of stay along with the various complications and predictors of inpatient mortality. To our knowledge, this study is the first to report associations of various common comorbidities with Dieulafoy's lesions.

METHODS

This is a retrospective study conducted using the National Inpatient Sample (NIS) database evaluating adults (≥18 years) hospitalized for Dieulafoy's lesions in the US from January 1, 2016, to December 31, 2019.[4] NIS is the largest publicly available all-payer inpatient database in the US. For the designated study period, the International Classification of Diseases–10 coding system was used by the NIS. Detailed information on the design and sampling methods of NIS is available at https://www.hcup-us.ahrq.gov. The 10 most common principal diagnoses at admission among patients with Dieulafoy's lesions were identified. The outcomes of interest included demographic characteristics, mean length of stay (LOS), mean inpatient cost, and association with common comorbidities. We also identified predictors of inpatient mortality for patients with Dieulafoy's lesions.

Analyses were performed using STATA version 16.0. Hierarchical multivariate linear and logistic regression models were built based on univariate analysis to adjust for confounding variables. Only variables associated with the outcome of interest on univariable regression analysis at $P < 0.2$ or known potential confounders despite a P value indicating no significance were used in multivariate regression. Categorical variables were compared using the chi-square test. Our analysis used 0.05 as the threshold for statistical significance, and all P values were two-sided. All outcomes were adjusted for patient- and hospital-level characteristics, including age, race, sex, insurance type, residential region, Elixhauser Comorbidity Index score, hospital teaching status, hospital bed size, and confounders in outcomes such as LOS and mean inpatient cost.[5–7] Dichotomous variables were reported as adjusted odds ratios with 95% confidence intervals (CI) and P value. Standard errors were reported as ± SE for continuous outcomes. NIS contains deidentified patient data; therefore, the study was deemed exempt from review based on guidelines from the institutional review board. Patient consent was also waived due to the public availability of data.

RESULTS

On admission, an initial diagnosis of Dieulafoy's lesions of the stomach and duodenum was established for 53.85% of the patients (Table 1). Additionally, common diagnoses at initial presentation included Dieulafoy's lesion of the intestine (13.67%), sepsis (3.98%), gastrointestinal hemorrhage due to unspecified cause (2.2%), acute posthemorrhagic anemia (1.58%), and melena (1.18%) (Table 1).

We identified 30,015 weighted hospitalizations for Dieulafoy's lesions from 2016 to 2019 (Table 2). The mean age was 68.7 ± 0.04 years, with male (56%) and white race predominance (70%). This was followed by blacks (15%), Hispanics (8%), and other races (7%). Additionally, most hospitalizations for Dieulafoy's lesions were reported at large (54%) and urban teaching hospitals (74%). From an

Table 1. Top 10 admission diagnoses for patients with Dieulafoy's lesions

Initial diagnosis	n	%
Dieulafoy's lesion (hemorrhagic) of stomach and duodenum	16,165	53.85%
Dieulafoy's lesion of intestine	3,349	13.67
Sepsis due to unspecified organism	930	3.98%
Gastrointestinal hemorrhage (unspecified whether upper or lower)	690	2.2%
Acute posthemorrhagic anemia	475	1.58%
Angiodysplasia of stomach and duodenum with bleeding	385	1.28%
Angiodysplasia of colon with hemorrhage	385	1.28%
Melena	354	1.18%
Hypertensive heart and chronic kidney disease	240	0.8%
Non-ST elevation myocardial infarction	239	0.79%

insurance perspective, Medicare was the largest payer (71%), followed by private insurance (17%) and Medicaid (9%) (Table 2).

The inpatient mortality for Dieulafoy's lesions was 4.65% (Table 3). The mean LOS was 7.87 days (95% CI 7.63–8.23; $P < 0.001$), and the mean inpatient cost was $111,914 (95% CI $106,430–$120,229; $P < 0.001$). During hospitalization for Dieulafoy's lesions, 78% of patients underwent upper endoscopy and 11% underwent colonoscopy. The common comorbidities in cases of Dieulafoy's lesions included heart failure (34%), cardiac arrhythmias (41%), uncomplicated hypertension (32%), chronic obstructive pulmonary disorders (25%), complicated diabetes (24%), chronic renal disease (37%), coagulopathic disorders (22%), electrolyte abnormalities (42%), complicated hypertension (43%), and alcohol abuse (12%). Additional comorbidities are listed in Table 3. Some comorbidities had stronger associations with Dieulafoy's lesions, including peptic ulcer disease, coagulopathy, liver disease, blood loss anemia, and alcohol abuse ($P < 0.001$) (Figure 1). Analysis revealed that heart failure, cardiac arrhythmias, chronic liver disease, coagulopathy, protein-calorie malnutrition, fluid and electrolyte disorder, and alcohol abuse were significantly associated with an increased odds of inpatient mortality among Dieulafoy's lesions hospitalizations ($P < 0.05$) (Table 4).

DISCUSSION

Dieulafoy's lesions have become a significant healthcare problem due to their difficult diagnosis and high healthcare costs.[8] As the rate of hospitalizations with Dieulafoy's lesions increases, physicians are more likely to encounter these

Table 2. Demographic and hospitalization characteristics of patients with Dieulafoy's lesions

Characteristics	Value (%)
Patient characteristics	
Total hospitalizations	30,015
Male	16,795 (56%)
Female	13,220 (44%)
Mean age (years) ± SE	68.7 ± 0.04
Male	67.8 ± 0.06
Female	70.6 ± 0.07
Race/ethnicity	
White	20,380 (70%)
Black	4,365 (15%)
Hispanic	2,360 (8%)
Asian or Pacific Islander	920 (3%)
Native American	210 (1%)
Other	785 (3%)
Elixhauser Comorbidity Index score	
0	630 (2%)
1	1415 (5%)
2	2695 (9%)
≥3	25,275 (84%)
Median annual income in patient's zip code	
$1–$24,999	8,400 (28%)
$25,000–$34,999	7,945 (27%)
$35,000–$44,999	6,975 (24%)
≥$45,000	6,220 (21%)
Insurance type	
Medicare	20,910 (71%)
Medicaid	2,540 (9%)
Private	5,115 (17%)
Uninsured	765 (3%)
Hospital characteristics	
Hospital region	
Northeast	5,465 (18%)
Midwest	6,930 (23%)
South	11,280 (38%)
West	6,340 (21%)
Hospital bed size	
Small	4,880 (16%)
Medium	8,984 (30%)
Large	16,150 (54%)
Hospital status	
Rural	1,615 (5%)
Urban nonteaching	6,185 (21%)
Urban teaching	22,215 (74%)

SE indicates standard error.

Table 3. Inpatient outcomes and comorbidities for hospitalizations for Dieulafoy's lesions

Outcomes	Proportion (N = 30,015)
Inpatient mortality (%)	4.65%
Mean length of stay (days)	7.87 ± 0.14
Mean total hospital charges	$111,914 ± $3230
Endoscopy during hospitalization	78%
Colonoscopy during hospitalization	11%
Acute renal failure	29%
Heart failure	34%
Cardiac arrhythmias	41%
Valvular disease	16%
Pulmonary circulation	8%
Peripheral vascular disease	15%
Uncomplicated hypertension	32%
Paralysis	1%
Other neurological disorders	11%
Chronic obstructive pulmonary disorders	25%
Uncomplicated diabetes mellitus	12%
Complicated diabetes	24%
Hypothyroidism	16%
Chronic renal disease	37%
Liver disease	17%
Peptic ulcer disease excluding bleeding	8%
AIDS/HIV	< 1%
Lymphoma	1%
Metastatic cancer	3%
Solid tumor without metastasis	5%
Rheumatoid arthritis/collagen vascular disorder	4%
Coagulopathy	22%
Obesity	14%
Weight loss	12%
Fluid and electrolyte disorder	42%
Blood loss anemia	8%
Deficiency anemia	8%
Alcohol abuse	12%
Drug abuse	3%
Psychoses	1%
Depression	12%
Complicated hypertension	43%
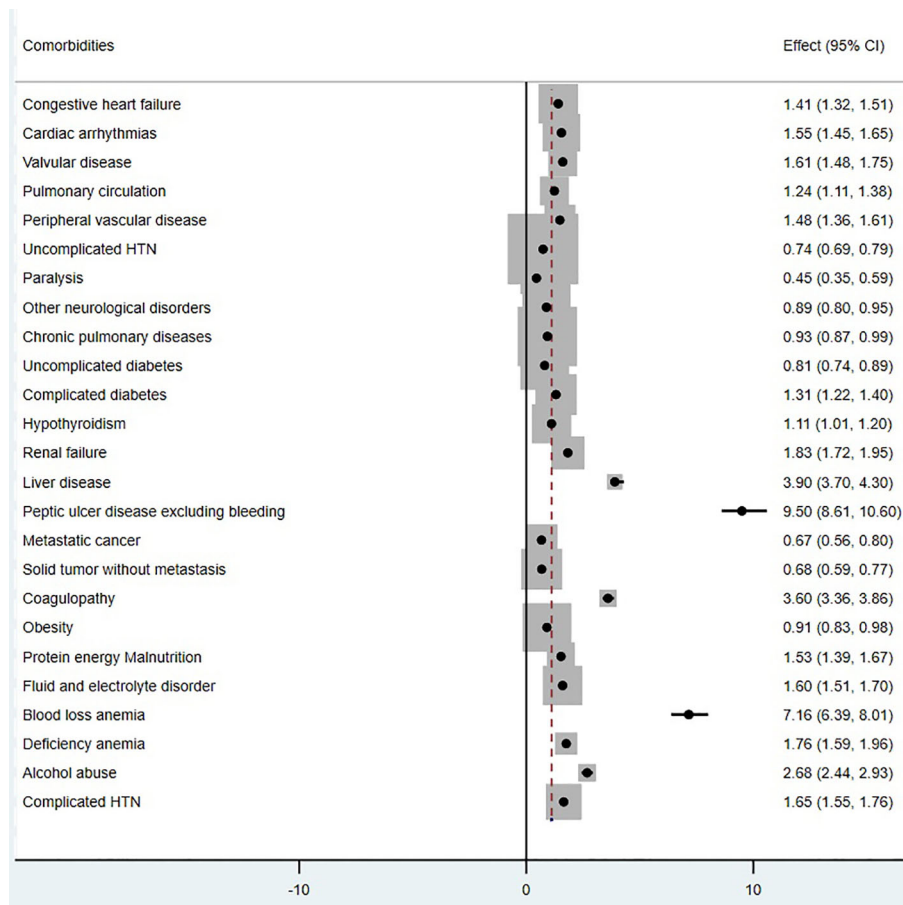
Figure 1. Adjusted multivariate regression showing associations of different comorbidities with Dieulafoy's lesions. CI indicates confidence interval; HTN, hypertension.

Table 4. Predictors of inpatient mortality for hospitalizations for Dieulafoy's lesions

Predictors	Adjusted odds ratio	95% confidence interval	P value
Dieulafoy's lesions	1.34	1.17–1.52	<0.001
Hispanic compared to white	1.02	1.002–1.04	<0.01
>3 comorbidities	1.26	1.19–1.33	<0.001
Congestive heart failure	1.71	1.35–2.36	<0.001
Cardiac arrhythmias	1.61	1.21–2.14	<0.01
Pulmonary embolisms	1.73	1.15–2.56	<0.01
Uncomplicated hypertension	0.46	0.33–0.65	<0.001
Uncomplicated diabetes	0.53	0.31–0.91	<0.03
Chronic liver disease	4.27	3.25–5.62	<0.001
Peptic ulcer disease excluding bleeding	0.36	0.17–0.78	<0.03
Coagulopathy	3.1	2.35–4.01	<0.001
Protein-calorie malnutrition	3.7	2.78–4.98	<0.001
Fluid and electrolyte disorder	4.2	3.1–5.7	<0.001
Alcohol abuse	1.9	1.34–2.7	<0.01

patients. Therefore, it becomes essential to identify and report the US healthcare system's burden, inpatient outcomes, and mortality predictors. The present study evaluates the clinical presentation and burden of Dieulafoy's lesions using the largest US healthcare inpatient database available. Based on a literature review, this is the only study that reports current data on Dieulafoy's lesions hospitalizations.

Of the 30,015 adult hospitalizations for Dieulafoy's lesions in the study, 53.85% were identified as Dieulafoy's lesions of the stomach or duodenum and 13.67% as Dieulafoy's lesions of the intestine. All other Dieulafoy's lesions cases were identified as Dieulafoy's lesions of the intestine and had a different diagnosis on presentation (Table 1). This may be due to patients presenting with complications of Dieulafoy's lesions or Dieulafoy's lesions subsequently being diagnosed during hospitalization. Most admission diagnoses reflected complications of Dieulafoy's lesions. Dieulafoy's lesions are most common in patients >60 years of age.[1,9,10] Our study also supported that Dieulafoy's lesions hospitalizations were more common in elderly patients (mean age 68.7 years), with a male and white race predominance.

White patients were the dominant race in the cohort, followed by blacks and Hispanics. Lipka et al reported in their single-center study that 87.5% of patients with Dieulafoy's lesions were white.[11] This could be secondary to a higher prevalence of associated risk factors such as heart failure and alcohol consumption in white patients.[8,12] A greater proportion of patients with Dieulafoy's lesions had a higher Elixhauser Comorbidity Index score. Studies have reported that the presence of chronic medical conditions worsens the prognosis and disease severity of Dieulafoy's lesions.[13] Additionally, there has been a rise in hospitalizations among patients who have comorbidities such as diabetes, coronary heart disease, and chronic obstructive pulmonary disease.[14] Dieulafoy's lesions place a significant burden on the US healthcare system, as the mean LOS was 7.8 days and the inpatient cost per patient was $111,914 for the study period. This has not been reported previously.

The prognosis of Dieulafoy's lesions depends on a patient's comorbidity burden and disease severity during the hospital course.[13] Gastrointestinal bleeding has a 30-day mortality rate that ranges from 9% to 13%.[15,16] The 30-day mortality rate for Dieulafoy's lesions has not been reported previously using a large population-based sample. In the present study, the inpatient mortality for Dieulafoy's lesions hospitalizations was 4.65% (Table 3). Per our analysis, heart failure and arrhythmias had higher rates of inpatient mortality. It is well known that improper heart functionality can result in increased von Willebrand factor proteolysis leading to gastrointestinal bleeds and has a higher association with angiodysplasias.[17,18]

Chronic liver disease was also a risk factor for mortality in hospitalizations for Dieulafoy's lesions. The liver is essential for the body's clotting function, and chronic liver disease results in platelet disorders, reduced synthesis of clotting factors, and impairment of intravascular coagulation.[19] Despite medical interventions, patients with chronic liver diseases likely already have impaired hemostasis, supporting the poor outcomes seen in patients with Dieulafoy's lesions. Alcoholic patients had a higher mortality rate, presumably because of chronic liver damage and impaired clotting.[20]

There are several limitations within our study. The database does not report subjective symptoms, the severity of disease, hospital course, or treatments. Also, our study identified cohorts retrospectively and cannot determine causality. Additionally, the study did not have randomization and blinding, impacting the interpretation of results.

In conclusion, Dieulafoy's lesions are an underreported cause of upper gastrointestinal bleeding with a white and male predominance. Significant predictors of inpatient mortality included heart failure, cardiac arrhythmias, coagulopathy, protein-calorie malnutrition, and alcoholism. There is a significant discord between the number of colonoscopies vs endoscopies done for Dieulafoy's lesions during an inpatient stay, indicating upper gastrointestinal bleeding as a common presentation. Several comorbidities increase mortality during hospitalizations for Dieulafoy's lesions, mainly factors that worsen coagulopathy such as liver disease and alcoholism. Recognition of factors affecting mortality in these patients can make gastroenterologists aware of high-risk patients and help prevent inpatient mortality.

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Avocations

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