

Redefining Hemorrhage in Diverticulitis: Complicated Diverticulitis or Exacerbation of Diverticular Bleeding?

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ABSTRACT

AIM: Lower gastrointestinal hemorrhage in a patient presenting with diverticulitis shifts the diagnosis from uncomplicated to complicated diverticulitis leading to more aggressive treatment measures. This study sought to determine the demographic characteristics of patients hospitalized with diverticular bleeding and diverticulitis with a focus on identifying factors that predispose to hemorrhage. We aim to use demographic information to elucidate whether hemorrhage in the setting of diverticulitis is more similar mechanistically to diverticular bleeding or diverticulitis.

MATERIALS AND METHODS: Inpatient data collected by the Pennsylvania Health Care Cost Containment Council was used to analyze 29,479 hospitalizations spanning from 2002 to 2018 at Philadelphia healthcare institutions where the primary diagnosis for admission was diverticulitis or diverticular bleeding. Age, race, and gender were collected for patients hospitalized with diverticular bleeding, di-

verticulitis, and diverticulitis complications. Demographic data from the 2010 US Census was used for comparison.

RESULTS: Diverticulitis ($n = 20,260$) disproportionately affects White individuals ($p < 0.0001$) while diverticular bleeding ($n = 9,219$) disproportionately affects Black individuals ($p < 0.0001$). Of all diverticulitis complications, hemorrhage ($n = 1,429$) had the highest proportion of Black individuals. Patients admitted for diverticular bleeding tend to be older (75.0 ± 12.1) than patients admitted for diverticulitis (60.2 ± 15.9 ; $p < 0.00001$). Among those with complicated diverticulitis, patients with hemorrhage are the oldest (70.2 ± 14.7).

CONCLUSION: Patients admitted with diverticulitis complicated by hemorrhage were more similar demographically to patients admitted with diverticular bleeding than those admitted with other forms of diverticulitis. Reframing diverticulitis complicated by hemorrhage as uncomplicated diverticulitis with diverticular bleeding could prompt more appropriate treatment with avoidance of potentially unnecessary antibiotics and imaging.

Synopsis: An epidemiological assessment of diverticular bleeding and diverticulitis found that patients admitted with diverticulitis complicated by hemorrhage were more similar demographically to patients admitted with diverticular bleeding than those admitted with other forms of diverticulitis. Because prior studies have suggested that demographic differences between diverticular bleeding and diverticulitis suggest distinct etiologies, we conclude that hemorrhage in the setting of diverticulitis should be treated as a diverticular bleed and not as a complication of diverticulitis itself.

Key words: Diverticular disease; Diverticulitis; Diverticular bleeding; Hemorrhage

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INTRODUCTION

Although diverticular bleeding is only the second most common

cause of hospitalization for diverticular disease^[1], it accounts for up to 40% of lower gastrointestinal bleeds requiring hospital admission^[2]. Unlike diverticulitis, diverticular bleeding is typically not associated with inflammation. Instead, diverticular bleeding is likely due to a combination of thinning of the colonic wall increasing the proximity of vessels to the colonic lumen as well as inherent segmental weakness in arteries supplying diverticula secondary to structural changes associated with the development of diverticulosis^[3]. This can lead to spontaneous rupture of arteries supplying a diverticulum producing a painless, often self-limiting hematochezia^[4]. Though bleeding resolves in 70-80% of patients without intervention^[5,6], bleeding which does not resolve may require endoscopic, endovascular, or surgical correction to prevent complications^[7,8]. Even for those for which bleeding resolves spontaneously, there is still up to a 40% chance of rebleeding^[6]. Other than recurrent bleeds and potential need for intervention during episodes, diverticular bleeding is typically not associated with long-term complications which often manifest in other forms of diverticular disease, such as diverticulitis.

Diverticulitis itself has many complications which make it the most severe and life-threatening form of diverticular disease^[9,10]. Acute diverticulitis is thought to be caused by microperforations in diverticula producing diverticular inflammation which presents as severe abdominal pain most commonly localized in the left lower quadrant^[10,11]. The most common complication of acute diverticulitis is abscess formation caused by the walling off of material which egressed from diverticular microperforations into adjacent pericolonic fat and mesentery^[12,13]. The inflammation of diverticula and pericolonic tissue can additionally produce partial obstruction through ileus and colonic narrowing as well as fistulas between the colon and adjacent organs^[14]. Lastly, while diverticular bleeding is a separate disease process from diverticulitis, complicated diverticulitis can present with hemorrhage due to irritation of surrounding microvasculature in the area of inflammation^[15].

Lower gastrointestinal hemorrhage in a patient presenting with diverticulitis is a defining symptom that shifts the diagnosis from uncomplicated diverticulitis to complicated diverticulitis^[15]. Because of higher mortality risks associated with complicated diverticulitis and the need for closer monitoring, this shift could mean the difference between conservative outpatient management with little to no antibiotics and inpatient admission with more aggressive treatment involving intravenous antibiotics and expensive imaging^[16]. The pathophysiological basis of diverticulitis and diverticular bleeding is not well understood and controversy remains regarding their etiology. This study sought to determine the demographic characteristics of patient populations hospitalized with diverticular bleeding and complicated diverticulitis with a focus on a distinction between hemorrhage in the setting of diverticulitis and diverticular bleeding.

METHODS

Design

A retrospective cross-sectional study was used to determine patterns of hospital admissions for diverticular disease, diverticulitis, and diverticulitis complications in Philadelphia between January 2002 and December 2018. Data was obtained from the Pennsylvania Health Care Cost Containment Council which collects more than 1.7 million inpatient discharge records each year from Pennsylvania hospitals. The dataset includes admission characteristics with one primary and up to eighteen secondary diagnosis codes as well as patient characteristics including age, gender, zip code, race, and ethnicity. Approval was obtained from the Institutional Review Board prior to data

extraction and analysis. Hospitalizations with diverticular bleeding or diverticulitis as the primary diagnosis were identified using International Classification of Disease (ICD) 9 and ICD 10 codes. From the admissions for diverticulitis, complications were identified from primary or secondary diagnosis fields containing ICD 9 and 10 codes for diverticular abscess, perforation, hemorrhage, obstruction, and fistula.

Patient Population

Inclusion criteria for this study were all patients 18 years or older with a Philadelphia zip code admitted to an acute care hospital in Philadelphia with primary diagnosis of diverticular bleeding or diverticulitis. Demographic parameters interrogated included patient age, gender, zip code, race, and ethnicity. Race and ethnicity categories included Asian, White (non-Hispanic), Black (non-Hispanic), Hispanic, and other (American Indian, Alaskan Native, Native Hawaiian/Pacific Islander, and two or more race groups). Patients with unknown race ($n = 933$) were excluded from statistical analysis of race composition. US Census data from 2010 was used for demographic comparison of patient data to the general Philadelphia population.

Statistical Analysis

Basic descriptive statistics and figures were used to summarize data. One-way analysis of variance with Tukey's test for post hoc analysis was used to determine differences between mean age of patients with diverticular bleeding, diverticulitis, and diverticulitis complications. Chi square tests with calculation of odds ratios were used to determine racial and gender differences between patients with diverticular bleeding, diverticulitis, or diverticular complications and the general Philadelphia population.

RESULTS

Between 2002 and 2018, there have been 20,260 recorded hospitalizations for diverticulitis and 9,219 hospitalizations for diverticular bleeding. Of the 20,260 diverticulitis admissions, nearly 30% ($n=5835$) were from complicated diverticulitis of which 1,429 were complicated by hemorrhage (Table 1).

Race

Diverticulitis disproportionately affects White individuals whom comprise 55.7% of admissions compared to 35.3% of the Philadelphia population (OR = 2.30; 95% CI = 2.24-2.37; $p < 0.0001$). However, diverticular bleeding ($n=9219$) disproportionately affects Black individuals whom account for 64.6% of admissions compared to 42.9% of the general population of Philadelphia (OR = 2.43; 95% CI = 2.33-2.54; $p < 0.0001$) (Figure 1) (Table 2). Although all complications of diverticulitis appear to preferentially affect White individuals more than Black individuals, this trend is least pronounced with hemorrhage in the setting of diverticulitis (Figure 2) (Table 2). In other words, hemorrhage had the highest proportion of Black individuals of all diverticulitis complications at 46.4% which is significantly higher than the general population of Philadelphia (OR = 1.15; 95% CI = 1.04-1.28; $p < 0.01$).

Age and Gender

Patients admitted for diverticular bleeding tend to be older (75.0 ± 12.1) than patients admitted for diverticulitis (60.2 ± 15.9 ; $p < 0.00001$). Among those with complicated diverticulitis, patients with hemorrhage are the oldest (70.2 ± 14.7) by at least 4 years (average age of 66.0 ± 14.9 years for obstruction) and at most 12 years (average

age of 58.5 ± 15.1 years for abscess). There was no significant difference in gender distribution between diverticular bleeding and diverticulitis or any of its complications, all of which showed a female predominance (Table 1).

DISCUSSION

It is well documented that of the manifestations of diverticular disease, those presenting with diverticular bleeding tend to be older than those with diverticulitis^[17,18]. While the peak age for diverticulitis in our data is around 50 years of age, there are almost no cases of diver-

ticular bleeding in patients 50 years or younger (Figure 3).

Not only is age vastly different between diverticulitis and diverticular bleeding, racial composition also was distinctly different for the two forms of disease. The difference between diverticulitis and diverticular bleeding in terms of patient demographics further cements the idea that these two manifestations of diverticular disease have vastly different mechanisms of development and are discreet entities within the realm of diverticular disease. However, bleeding can occur as a complication of diverticulitis. Hemorrhage in complicated diverticulitis has unique features compared to all other complications including an older age and tendency to occur in Black individuals.

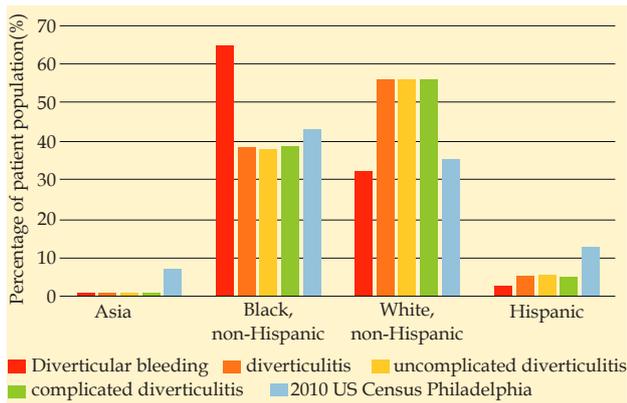


Figure 1 Percent race composition of hospitalizations with diverticular disease, diverticular bleeding, diverticulitis, uncomplicated diverticulitis, and complicated diverticulitis in Philadelphia from 2002-2018 compared to 2010 Philadelphia Census data.

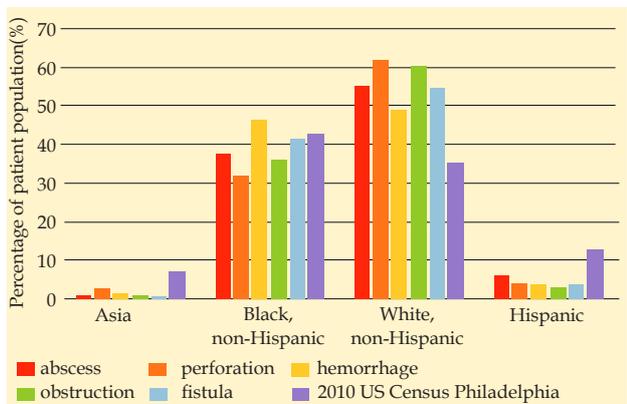


Figure 2 Percent race composition of hospitalizations with diverticulitis complicated by abscess, perforation, hemorrhage, obstruction, and fistula in Philadelphia from 2002-2018 compared to 2010 Philadelphia Census data.

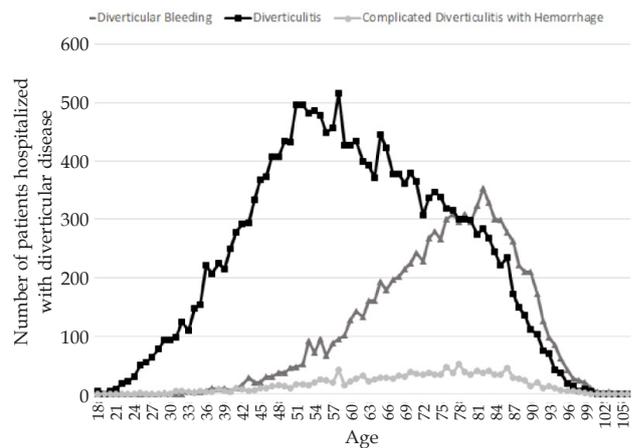


Figure 3 Number of patients hospitalized with diverticular bleeding, diverticulitis, and diverticulitis complicated by hemorrhage in Philadelphia from 2002-2018, categorized by age.

Table 1 Total number, average age (+/- S.D.), and number/percentage female gender of hospitalizations with diverticular bleeding, diverticulitis, and diverticulitis complications in Philadelphia from 2002-2018.

Admission Diagnosis	n	Average Age	Female Gender (n [%])
Diverticular Bleeding	9219	75.0 ± 12.1	5561 (60.3%)
Diverticulitis	20260	60.2 ± 15.9	12559 (62.0%)
Uncomplicated Diverticulitis	14425	59.5 ± 15.8	9122 (63.2%)
Complicated Diverticulitis	5835	62.0 ± 15.8	3437 (58.9%)
Abscess	3575	58.5 ± 15.1	2044 (57.2%)
Perforation	253	61.2 ± 16.5	131 (51.2%)
Hemorrhage	1429	70.2 ± 14.7	917 (64.2%)
Obstruction	1338	66.0 ± 14.9	785 (58.7%)
Fistula	221	61.6 ± 14.2	135 (61.1%)

Table 2 Total number and race composition (n, %) of hospitalizations with diverticular bleeding, diverticulitis, and diverticulitis complications in Philadelphia from 2002-2018 compared to 2010 Philadelphia Census data. Patients with unknown race were excluded.

Admission Diagnosis	n	Asian (n [%])	Black, Non-Hispanic (n [%])	White, Non-Hispanic (n [%])	Hispanic (n [%])	Other (n [%])	Excluded (n)
Diverticular Bleeding	8994	70 (0.8%)	5808 (64.6%)	2889 (32.1%)	221 (2.5%)	6 (0.1%)	225
Diverticulitis	19552	176 (0.9%)	7436 (38.0%)	10884 (55.7%)	1037 (5.3%)	19 (0.1%)	708
Uncomplicated Diverticulitis	13911	130 (0.9%)	5258 (37.8%)	7754 (55.7%)	755 (5.4%)	14 (0.1%)	514
Complicated Diverticulitis:	5641	46 (0.8%)	2178 (38.6%)	3130 (55.5%)	282 (5.0%)	5 (0.1%)	194
Abscess	3448	27 (0.8%)	1298 (37.6%)	1906 (55.3%)	212 (6.1%)	5 (0.1%)	127
Perforation	242	6 (2.5%)	77 (31.8%)	150 (62.0%)	9 (3.7%)	0 (0.0%)	11
Hemorrhage	1386	16 (1.2%)	643 (46.4%)	680 (49.1%)	47 (3.4%)	0 (0.0%)	43
Obstruction	1308	9 (0.7%)	469 (35.9%)	795 (60.8%)	35 (2.7%)	0 (0.0%)	30
Fistula	207	1 (0.5%)	86 (41.5%)	113 (54.6%)	7 (3.4%)	0 (0.0%)	14
2010 Census Data, Philadelphia	1526006	105327 (6.9%)	654030 (42.9%)	538190 (35.3%)	189151 (12.4%)	39308 (2.6%)	0

The demographics associated with diverticulitis complicated by hemorrhage more closely mirror those found in diverticular bleeding than other forms of diverticulitis suggesting that hemorrhage in the setting of diverticulitis is more similar mechanistically to diverticular bleeding than diverticulitis. In fact, this may suggest that rather than a complication of diverticulitis, hemorrhage during acute diverticulitis may be an exacerbation of diverticular bleeding. In other words, the strong overlap in patients susceptible to hemorrhage in the setting of diverticulitis and diverticular bleeding indicates that the etiology of these two manifestations of bleeding are the same or at least similar. This is also important because identifying susceptible populations aids physicians in recognizing patients that may be at higher risk for hemorrhage during an episode of acute diverticulitis.

One explanation for the elevated risk of hemorrhage in Black and older individuals may be the increased usage of anticoagulant and antiplatelet medications in these populations which have been shown to predispose to diverticular bleeding^[19-21]. Especially in Philadelphia where profound racial healthcare inequality exists, Black individuals are more likely to be on long-term anticoagulation or aspirin due to the increased disease burden including hypertension, DVTs/PEs, and diabetes disproportionately affecting this segment of the population^[22-25]. Similarly, patients > 65 years old are more likely to be using antithrombotic medication as older age is a risk factor for almost all vascular disease manifestations^[26,27]. This consideration is important for a physician to bear in mind when treating patients with concurrent coagulopathies and diverticular disease so as to minimize the risk of hemorrhage while maximizing the anticoagulation effects.

With shifts towards conservative outpatient management of uncomplicated diverticulitis, there is a widening gap between the level of treatment administered for uncomplicated and complicated diverticulitis cases^[28]. Many uncomplicated diverticulitis episodes are treated outpatient with physicians forgoing antibiotics and imaging in favor of reducing the cost burden associated with this disease^[29-33]. By classifying hemorrhage as a complication of diverticulitis, patients are exposed to potentially unnecessary antibiotics and imaging that they otherwise might not receive. The results of our study suggest hemorrhage in the setting of diverticulitis is more likely to be closer in etiology to diverticular bleeding than diverticulitis based on patient demographics and therefore should prompt changes in treatment paradigms surrounding this clinical presentation. By prioritizing treatment protocols for diverticular bleeding rather than complicated diverticulitis, patients may receive more appropriate treatment while avoiding extraneous tests and medications for what would otherwise be considered uncomplicated diverticulitis. In this way, a reclassification of diverticulitis complicated by hemorrhage as uncomplicated diverticulitis with superimposed diverticular bleeding may reduce the cost burden associated with this disease as well as prevent potentially harmful effects of unnecessary broad-spectrum antibiotics and imaging.

Overall, patients admitted with diverticulitis complicated by hemorrhage are more similar demographically to patients admitted with diverticular bleeding than those admitted with other forms of diverticulitis. Because prior studies have suggested that demographic differences between diverticular bleeding and diverticulitis suggest distinct etiologies, we conclude that hemorrhage in the setting of diverticulitis should be treated as a diverticular bleed and not as a complication of diverticulitis itself. If these patients were diagnosed with uncomplicated diverticulitis with diverticular bleeding instead, this could lead to a reduction in length of stay and prompt more appropriate treatment with greater focus on hemodynamic stability, a higher threshold for administering antibiotics, and avoidance of unnecessary imaging.

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