International Journal of Gerontology 19 (2025) 160–165
https://doi.org/10.6890/IJGE.202507_19(3).0006

International Journal of Gerontology

journal homepage: http://www.sgecm.org.tw/ijge/

Original Article

Old Age-Related Atherosclerotic Cardiovascular Disease and Atrial Fibrillation Predicts Mortality of Patients with Acute Ischemic Bowel Disease

Yao-Chung Tsai [a,b], Min-I Su [c,d,e], Kuang-Te Wang [c,e], Yu-Cheng Chang [f,g], Wei-Ru Chiou [c,e,h] *

[a] *Meiho University, Pingtung, Taiwan,* [b] *Department of General Surgery, Taitung MacKay Memorial Hospital, Taitung, Taiwan,* [c] *Division of Cardiology, Department of Internal Medicine, Taitung MacKay Memorial Hospital, Taitung, Taiwan,* [d] *Graduate Institute of Business Administration, National Dong Hwa University, Hualian, Taiwan,* [e] *Department of Medicine, MacKay Medical College, New Taipei City, Taiwan,* [f] *Department of Bioinformatics and Medical Engineering, Asia University, Taichung, Taiwan,* [g] *Department of Cardiology, Asia University Hospital, Taichung, Taiwan,* [h] *College of Science and Engineering, National Taitung University, Taitung, Taiwan*

ARTICLE INFO

Accepted 15 January 2025

Keywords:
acute ischemic bowel disease,
atherosclerotic cardiovascular disease (ASCVD),
atrial fibrillation,
elderly,
mortality

SUMMARY

Background: The morbidity and mortality in patients suffering from acute ischemic bowel disease can be markedly increased if the condition is not recognized and managed in a timely manner. There is a potential correlation between old age-related atherosclerotic cardiovascular disease (ASCVD)/atrial fibrillation and acute ischemic bowel disease. The present study aimed to further determine whether old age-related ASCVD/atrial fibrillation affects mortality of acute ischemic bowel disease.
Methods: The records of 709 patients with acute ischemic bowel disease were retrospectively reviewed. All data were extracted from the Medical Information Mart for Intensive Care IV (MIMIC-IV version 2.2) database 2008 to 2019.
Results: Patients with older age (≥ 65 years) had longer hospital stays, higher in-hospital mortality, and higher total mortality compared to those under 65. In the older age group, atrial fibrillation (hazard ratio [HR] = 2.307, 95% confidence interval [CI]: 1.290–4.128) and high baseline aspartate aminotransferase (AST) (HR = 1.001, 95% CI: 1.001–1.002) were independent predictors of higher in-hospital mortality. ASCVD (HR = 1.397, 95% CI: 1.024–1.904), male sex (HR = 1.469, 95% CI: 1.051–2.053), high baseline white blood cell (WBC) count (HR = 1.026, 95% CI: 1.002–1.051) and high baseline AST (HR = 1.001, 95% CI: 1.001–1.002) were independent predictors of higher total mortality, while high baseline hemoglobin (HR = 0.864, 95% CI: 0.758–0.985) was as an independent predictor of lower total mortality.
Conclusion: Old age-related ASCVD and atrial fibrillation are adverse prognostic factors for total and in-hospital mortality in patients with acute ischemic bowel disease, respectively.

1. Introduction

Acute ischemic bowel disease is the most common vascular disorder of the gastrointestinal tract.[1] It occurs due to insufficient oxygenated blood supply to any part of the bowel wall.[1] Acute ischemic bowel disease is a heterogenous group of disorders that can be divided into small intestinal ischemia, mesenteric ischemia,[2] large intestinal ischemia, colonic ischemia (CI), or ischemic colitis (IC).[3] Although ischemic bowel disease is very common, the morbidity and mortality can be high if it is not recognized and treated emergently.[4]

The risk factors for acute ischemic bowel disease include diabetes mellitus, hypertension, coronary artery disease, peripheral artery disease, atrial fibrillation, congestive heart failure, recent myocardial infarction, shock, chronic renal failure requiring hemodialysis, severe dehydration, chronic obstructive lung disease, irritable bowel syndrome, sickle cell crisis with microvascular occlusion, rheumatic autoimmune diseases, substance abuse like amphetamine abuse or cocaine abuse, long distance running, and hereditary and acquired thrombophilia.[5,6] Notably, acute ischemic bowel disease is commonly seen in the elderly population with mesenteric vascular atherosclerosis.[7] Study has suggested an association between atherosclerotic cardiovascular disease (ASCVD)/atrial fibrillation and acute ischemic bowel disease. Nevertheless, the role of ASCVD on the prognosis of elderly patients with ischemic bowel disease is not well studied. Therefore, the present study aimed to further determine the association between old age-related ASCVD/atrial fibrillation and mortality in patients with acute ischemic bowel disease.

2. Materials and methods

2.1. Data source

This study used data from the Medical Information Mart for Intensive Care IV (MIMIC-IV version 2.2) database, which was collected between 2008 and 2019.[8] The MIMIC-IV database is a publicly accessible clinical database containing real-world data, and is managed by the Beth Israel Deaconess Medical Center. It includes information on more than 200,000 emergency department admissions and over 60,000 intensive care unit stays (ICU) stays. One author, Min-I Su, has finished the Collaborative Institutional Training Initia-

* Corresponding author. Division of Cardiology, Department of Internal Medicine, Taitung MacKay Memorial Hospital, No. 1, Ln. 303, Changsha St., Taitung City, Taitung County 950, Taiwan.
E-mail address: clementchiou@gmail.com (W.-R. Chiou)

tive examination (certification number: 42188048) and achieved access to the database for data extraction. The code for extracting data can be found on GitHub (https://github.com/MIT-LCP/mimic-iv). The accumulation of patient data and the establishment of the research asset was reviewed by the Institutional Review Board at the Beth Israel Deaconess Medical Center, who granted a waiver of informed consent and approved the data sharing initiative.[9]

2.2. Study design and patients

This retrospective study included patients with acute ischemic bowel disease (ICD-9-CM 557.0; ICD-10-CM K55.0). Exclusion criteria were: 1) Age < 18 years; 2) Malignancy; 3) AIDS; 4) Death time < 24 hours (from onset to death); 5) Hospitalized < 6 hours; 6) Repeated hospitalization; and 7) Missing hospitalization records. After exclusion, 709 patients were included in the analysis (Figure 1). Patients were divided into 2 age groups: < 65 years old and ≥ 65 years old.

2.3. Main outcome measures

Primary outcomes included in-hospital mortality and total mortality. Data extracted within first 24 hours after ICU admission from the database included age, sex, body mass index (BMI), history of ASCVD, atrial fibrillation, diabetes mellitus, hypertension, dyslipidemia, coronary arterial disease (CAD), peripheral arterial occlusive disease (PAOD) or stroke, serum red blood cell (RBC) count, hemoglobin level, white blood cell (WBC) count, platelet count, aspartate aminotransferase (AST), creatinine, chloride or potassium levels, length of hospital stay (LOS), and follow-up duration.

2.4. Statistical analysis

Continuous variables were expressed as mean and standard deviation (SD), and compared using the t-test. Categorical variables were expressed as number and percentage, and compared using the chi-squared test or Fisher's exact test. The Kaplan-Meier method was used to compare survival times between the 2 age groups, and survival curves were compared using the log-rank test. Univariate and multivariate Cox regression analysis was performed to determine associations between demographic and clinical variables and in-hospital mortality and total mortality. Time-to-event of total mortality was defined as "the follow-up period of event occurrence". Significant parameters in univariate Cox regression analysis (*p*-value < 0.05) and well-known risk factors were entered into multivariate Cox regression analysis to determine the predictors of in-hospital/total mortality. A 2-sided value of $p < 0.05$ was considered statistical significance. All statistical analyses were performed using R (version 4.2.3) and SPSS (version 20) software.

3. Results

3.1. Patients characteristics

The baseline demographic and clinical characteristics of the 709 patients (304 < 65 years old and 405 ≥ 65 years old) were shown in Table 1. Most demographic and clinical characteristics, including age, sex, history of ASCVD, atrial fibrillation, diabetes mellitus, hypertension, dyslipidemia, CAD, POAD or stroke, and baseline AST were significantly different between the 2 age groups (all, $p < 0.05$). However, baseline creatinine, chloride, and potassium levels, hemoglobin level, platelet, WBC, and RBC counts were not significantly different between the 2 age groups (all, $p > 0.05$).

3.2. Outcomes

The follow-up duration of the 2 groups was similar: < 65 years old, 692.4 ± 993.9 days; ≥ 65 years old, 623.2 ± 909.1 days ($p > 0.05$, Table 1). During follow-up, patients ≥ 65 years old had a shorter LOS, higher in-hospital mortality, and higher total mortality compared those < 65 years old (all, $p < 0.05$, Table 1).

In particular, we have analyzed the association between old age-related ASCVD/atrial fibrillation and mortality in the age ≥ 65 years old group. As shown in Supplemental Table 1 and Supplemental Table 2, in the age ≥ 65 years old group, patients with ASCVD or atrial fibrillation had higher proportion of in-hospital mortality and total mortality (all, $p < 0.05$).

3.3. Age-related factors associated with in-hospital mortality and total mortality

In the age ≥ 65 years group, multivariate Cox regression analysis showed that atrial fibrillation (hazard ratio [HR] = 2.307, 95% confidence interval [CI]: 1.290–4.128; p = 0.005) and high baseline AST (HR = 1.001, 95% CI: 1.001–1.002; $p < 0.001$) were independent predictors of higher in-hospital mortality (Table 2). ASCVD (HR = 1.397, 95% CI: 1.024–1.904; p = 0.035), male sex (HR = 1.469, 95% CI: 1.051–2.053; p = 0.024), high baseline WBC count (HR = 1.026, 95% CI: 1.002–1.051; p = 0.037), and high baseline AST (HR = 1.001, 95% CI: 1.001–1.002; $p < 0.001$) were independent predictors of higher total mortality, while high baseline hemoglobin level (HR = 0.864, 95% CI: 0.758–0.985; p = 0.029) was an independent predictor of lower total mortality (Table 3). However, these associations were not observed in the age < 65 years old group (all, $p > 0.05$, Table 2 and Table 3).

Kaplan-Meier analysis showed that atrial fibrillation was associated with a higher cumulative probability of in-hospital mortality in patients ≥ 65 years old compared to those without atrial fibrillation ($p < 0.05$, Figure 2). ASCVD also associated with a higher cumulative probability of total mortality in patients ≥ 65 years old as compared to those without ASCVD ($p < 0.05$, Figure 3).

4. Discussion

The current study of ASCVD and its association with the prog-

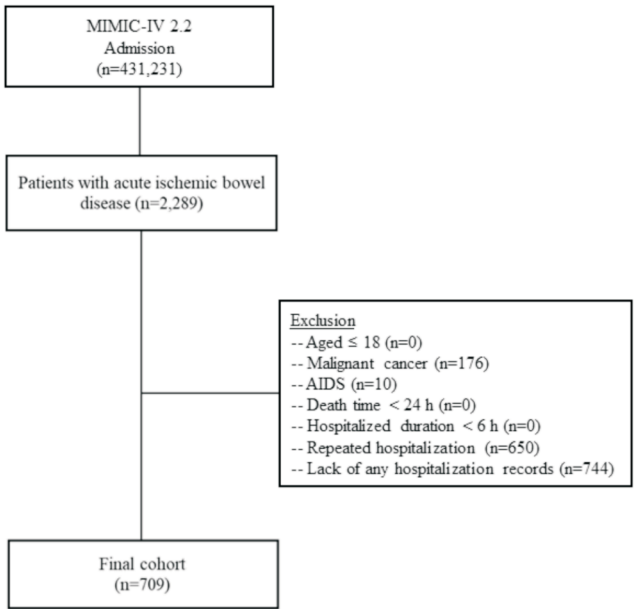

Figure 1. Patient flow diagram.

Table 1
Patient characteristics.

Variable	Total (n = 709)	Age < 65 years (n = 304)	Age ≥ 65 years (n = 405)	p-value
Male sex	279 (39.4)	149 (49.0)	130 (32.1)	< 0.001*
Age (years)	66.8 ± 16.4	51.4 ± 11.3	78.3 ± 8.1	< 0.001*
BMI (Kg/m^2)	26.8 ± 6.8	27.6 ± 7.5	26.2 ± 6.1	0.010*
History of disease				
ASCVD	259 (36.5)	63 (20.7)	196 (48.4)	< 0.001*
Atrial fibrillation	202 (28.5)	37 (12.2)	165 (40.7)	< 0.001*
Diabetes mellitus	213 (30.0)	74 (24.3)	139 (34.3)	0.005*
Hypertension	465 (65.6)	135 (44.4)	330 (81.5)	< 0.001*
Dyslipidemia	456 (64.3)	136 (44.7)	320 (79.0)	< 0.001*
CAD	208 (29.3)	51 (16.8)	157 (38.8)	< 0.001*
PAOD	104 (14.7)	23 (7.6)	81 (20.0)	< 0.001*
Stroke	10 (1.4)	5 (1.6)	5 (1.2)	0.752
Serum examination				
Creatinine (mg/dL)	1.4 ± 1.5	1.4 ± 1.6	1.5 ± 1.4	0.960
Chloride (mEq/L)	101.7 ± 6.1	101.3 ± 5.6	102.0 ± 6.4	0.107
Potassium (mEq/L)	4.2 ± 0.9	4.2 ± 0.9	4.2 ± 0.9	0.607
Hemoglobin (g/dL)	11.8 ± 2.4	11.9 ± 2.6	11.6 ± 2.3	0.106
Platelet (10^3/μL)	246.0 ± 128.1	244.0 ± 143.6	248.0 ± 115.3	0.684
WBC (10^3/μL)	11.5 ± 6.2	11.0 ± 6.6	11.8 ± 6.0	0.080
RBC (10^6/μL)	3.9 ± 0.8	4.0 ± 0.8	3.9 ± 0.8	0.188
AST (IU/L)	128.3 ± 1093.8	213.9 ± 1648.1	64.0 ± 223.6	0.014*
Length of hospital stay (days)	11.7 ± 13.4	13.0 ± 15.0	10.7 ± 12.0	0.030*
In-hospital mortality	80 (11.3)	22 (7.2)	58 (14.3)	0.004*
Total mortality	264 (37.2)	74 (24.3)	190 (46.9)	< 0.001*
Followed up (days)	652.9 ± 946.3	692.4 ± 993.9	623.2 ± 909.1	0.336

Data are presented as mean ± standard deviation (SD), or count (percentage).
ASCVD, atherosclerotic cardiovascular disease; AST, aspartate aminotransferase; BMI, body mass index; CAD, coronary arterial disease; POAD, peripheral arterial occlusive disease; RBC, red blood cell; WBC, white blood cell. * p < 0.05.

Table 2
Cox regression analysis of in-hospital mortality.

Variable	Age ≥ 65 years				Age < 65 years			
	Univariate analysis		Multivariate analysis		Univariate analysis		Multivariate analysis	
	HR (95% CI)	p-value	HR (95% CI)	p-value	HR (95% CI)	p-value	HR (95% CI)	p-value
Male sex	1.338 (0.810, 2.211)	0.255	1.096 (0.613, 1.958)	0.758	0.815 (0.352, 1.888)	0.634	0.731 (0.288, 1.856)	0.510
Age (years)	1.021 (0.991, 1.052)	0.164	1.001 (0.968, 1.036)	0.934	1.053 (0.998, 1.111)	0.061	1.034 (0.976, 1.095)	0.257
BMI (kg/m^2)	1.017 (0.978, 1.057)	0.398	1.028 (0.984, 1.074)	0.217	1.005 (0.951, 1.061)	0.869	0.987 (0.936, 1.040)	0.623
ASCVD	2.012 (1.201, 3.370)	0.008*	1.471 (0.831, 2.605)	0.185	1.516 (0.618, 3.721)	0.364		
Atrial fibrillation	2.323 (1.400, 3.853)	0.001*	2.307 (1.290, 4.128)	0.005*	3.146 (1.282, 7.719)	0.012*	1.892 (0.702, 5.100)	0.207
Diabetes mellitus	1.050 (0.630, 1.750)	0.850			1.282 (0.522, 3.147)	0.587		
Hypertension	0.953 (0.518, 1.751)	0.876			0.509 (0.208, 1.250)	0.141		
Dyslipidemia	1.477 (0.752, 2.901)	0.257			1.113 (0.482, 2.569)	0.801		
Creatinine (mg/dL)	1.144 (1.015, 1.290)	0.027*	1.055 (0.913, 1.219)	0.467	1.147 (0.985, 1.336)	0.078		
Chloride (mEq/L)	0.961 (0.926, 0.997)	0.033*	0.979 (0.940, 1.020)	0.310	0.933 (0.880, 0.990)	0.021*	0.965 (0.901, 1.035)	0.319
Potassium (mEq/L)	1.112 (0.886, 1.397)	0.359			1.866 (1.293, 2.692)	0.001*	1.778 (1.131, 2.794)	0.013
Hemoglobin (gm/dl)	0.922 (0.831, 1.022)	0.122			0.891 (0.758, 1.046)	0.159		
Platelet (k/uL)	0.998 (0.996, 1.001)	0.212			0.996 (0.992, 1.000)	0.047*	0.997 (0.993, 1.001)	0.129
WBC (K/uL)	1.032 (0.997, 1.069)	0.077			1.043 (0.991, 1.096)	0.104		
RBC (m/uL)	0.758 (0.554, 1.037)	0.083			0.540 (0.339, 0.860)	0.009*	0.670 (0.407, 1.103)	0.116
AST (IU/L)	1.002 (1.001, 1.002)	< 0.001*	1.001 (1.001, 1.002)	< 0.001*	1.000 (1.000, 1.000)	0.334	1.000 (1.000, 1.000)	0.917

ASCVD, atherosclerotic cardiovascular disease; AST, aspartate aminotransferase; BMI, body mass index; RBC, red blood cell; WBC, white blood cell.
* p < 0.05.

nosis of elderly patients with acute ischemic bowel disease revealed 3 important results. 1) Patients ≥ 65 years old had higher in-hospital mortality and total mortality as compared to patients < 65 years old. 2) In patients ≥ 65 years old, atrial fibrillation or high baseline AST were independent predictors of higher in-hospital mortality. 3) In patients ≥ 65 years old, ASCVD, atrial fibrillation, higher age, male sex, high baseline WBC count, and high baseline AST were independent predictors of higher total mortality, while high baseline hemoglobin was an independent predictor of lower total mortality.

Acute ischemic bowel disease may be associated with high mortality due to inadequate arterial or venous blood flow resulting from embolism, thrombosis, or a non-occlusive low-flow state in the splanchnic circulation.[1,10] The mortality ranges from 60% to 80% depending on etiology, patient age, and time from symptom onset to diagnosis and treatment.[11, 12] Our results showed that patients ≥ 65 years old had a significantly higher in-hospital mortality and total mortality as compared to patients < 65 years old. Accordingly, we recommend that patients at high-risk (age ≥ 65 years old) should be regularly monitored. Early diagnosis based on radiographic examina-

Table 3
Cox regression analysis of total mortality.

Variable	Age ≥ 65 years				Age < 65 years			
	Univariate analysis		Multivariate analysis		Univariate analysis		Multivariate analysis	
	HR (95% CI)	p-value	HR (95% CI)	p-value	HR (95% CI)	p-value	HR (95% CI)	p-value
Male sex	1.468 (1.087, 1.981)	0.012*	1.469 (1.051, 2.053)	0.024*	1.842 (1.149, 2.951)	0.011*	1.634 (0.977, 2.731)	0.061
Age (years)	1.029 (1.011, 1.047)	0.002*	1.037 (1.017, 1.058)	< 0.001*	1.064 (1.031, 1.098)	< 0.001*	1.059 (1.021, 1.099)	0.002*
BMI (kg/m^2)	0.994 (0.973, 1.017)	0.618	0.998 (0.974, 1.023)	0.884	0.987 (0.955, 1.019)	0.416	0.975 (0.944, 1.008)	0.135
ASCVD	1.849 (1.383, 2.474)	< 0.001*	1.397 (1.024, 1.904)	0.035*	1.741 (1.061, 2.859)	0.028*	0.656 (0.351, 1.226)	0.186
Atrial fibrillation	2.030 (1.522, 2.707)	< 0.001*	1.473 (1.080, 2.009)	0.014*	3.103 (1.828, 5.266)	< 0.001*	2.053 (1.053, 4.003)	0.035*
Diabetes mellitus	1.386 (1.036, 1.854)	0.028*	1.186 (0.861, 1.635)	0.297	1.623 (1.005, 2.620)	0.048	1.019 (0.569, 1.825)	0.950
Hypertension	1.160 (0.804, 1.675)	0.428			1.504 (0.944, 2.394)	0.086		
Dyslipidemia	1.108 (0.771, 1.595)	0.579			2.307 (1.424, 3.737)	0.001*	1.776 (1.012, 3.115)	0.045*
Creatinine (mg/dL)	1.205 (1.115, 1.302)	< 0.001*	1.110 (0.995, 1.238)	0.063	1.180 (1.090, 1.278)	< 0.001*	0.918 (0.804, 1.049)	0.209
Chloride (mEq/L)	0.980 (0.957, 1.003)	0.081			0.926 (0.897, 0.955)	< 0.001*	0.933 (0.899, 0.969)	< 0.001*
Potassium (mEq/L)	1.224 (1.075, 1.394)	0.002*	1.046 (0.888, 1.233)	0.587	1.674 (1.326, 2.115)	< 0.001*	1.438 (1.080, 1.915)	0.013
Hemoglobin (g/dl)	0.893 (0.843, 0.946)	< 0.001*	0.864 (0.758, 0.985)	0.029*	0.911 (0.834, 0.996)	0.040*	0.922 (0.734, 1.157)	0.481
Platelet (10^3/μL)	0.999 (0.997, 1.000)	0.061			0.997 (0.995, 0.999)	0.001*	0.997 (0.995, 0.999)	0.002*
WBC (10^3/μL)	1.030 (1.007, 1.054)	0.011*	1.026 (1.002, 1.051)	0.037*	1.003 (0.972, 1.035)	0.854		
RBC (10^6/μL)	0.743 (0.618, 0.892)	0.001*	1.243 (0.832, 1.857)	0.287	0.688 (0.528, 0.896)	0.006*	0.880 (0.441, 1.757)	0.718
AST (IU/L)	1.002 (1.001, 1.002)	< 0.001*	1.001 (1.001, 1.002)	< 0.001*	1.000 (1.000, 1.000)	0.020*	1.000 (1.000, 1.000)	0.125

ASCVD, atherosclerotic cardiovascular disease; AST, aspartate aminotransferase; BMI, body mass index; RBC, red blood cell; WBC, white blood cell.
* p < 0.05.

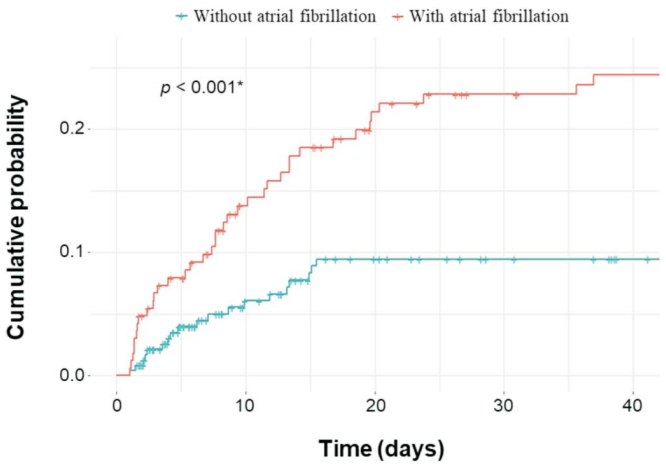

Figure 2. Kaplan-Meier survival curves of in-hospital mortality for elderly patients with acute ischemic bowel disease. Patients age ≥ 65 years stratified by atrial fibrillation. * p < 0.05.

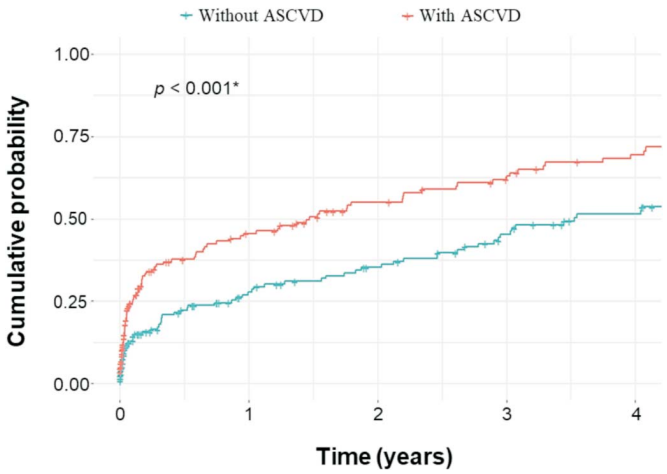

Figure 3. Kaplan-Meier survival curves of total mortality for elderly patients with acute ischemic bowel disease. Patients age ≥ 65 years stratified by ASCVD. * p < 0.05. ASCVD, atherosclerotic cardiovascular disease.

tions may improve outcomes because a delay in diagnosis is associated with higher mortality.[6,13]

Early diagnosis of acute ischemic bowel disease requires a high degree of suspicion in patients with any abdominal pain, especially when the pain is of sudden onset or rapidly worsening, unusual, and requires opioids for relief. Additional clinical and laboratory indicators such as hyperleukocytosis, gastrointestinal bleeding, lactic acidosis, vomiting, and diarrhea may not consistently manifest, or may only appear late in the disease progression, and thus are of limited diagnostic value.[1] In a retrospective study of 221 patients, peritoneal signs, organ failure, and serum lactate elevation were initially lacking in 85%, 77%, and 57% of the cases, respectively.[14] When diagnosis is delayed such that necrosis of the bowel has occurred, 83% of the patients require intestinal resection that results in short bowel syndrome in 80% of patients,[14] and the mortality rate is very high.[1] As such, there is an unmet need for markers for diagnosis and prognosis.

Atherosclerosis, thromboembolism, and hypoperfusion due to various cardiovascular conditions, a hypercoagulable state, vasculitis, venous occlusion, or mechanical obstruction of mesenteric blood vessels can cause acute ischemic bowel disease.[15] Most cases of superior mesenteric artery (SMA) embolism are due to emboli lodging in the SMA possibly facilitated by its larger diameter and acute angle of origin from the aorta.[16] Moreover, SMA thrombosis commonly develops at the origin of the SMA with severe atherosclerotic narrowing,[17] indicating a potential link between ASCVD and acute ischemic bowel disease. Golabi et al.[18] reported that increased risk of overall mortality is independently associated with having a high risk for ASCVD. In particular, the present study expanded these findings and further showed that ASCVD was as an independent predictor of higher total mortality in elderly patients with acute ischemic bowel disease. We speculate a possible explanation is that physiological changes associated with aging increase susceptibility to ASCVD processes,[19] resulting in an increased risk of total mortality.

Atrial fibrillation increases the risk of systemic embolism.[20] In addition, atrial fibrillation-related irregular heart rhythm may predispose to hypoperfusion and ischemia of the bowel walls.[6] Consequently, the relation between atrial fibrillation and ischemic bowel disease is well recognized. A recent retrospective study reviewed the outcomes of treatment with an open or endovascular approach in patients with acute mesenteric ischemia, and reported that atrial fibrillation is related to higher in-hospital mortality.[21] Of note, the

present study further identified that atrial fibrillation was as an independent predictor of in-hospital mortality in elderly patients with acute ischemic bowel disease. To our knowledge, this is the first study to examine the association between old age-related atrial fibrillation and in-hospital mortality in patients with acute ischemic bowel disease. A possible explanation is that age is a risk factor associated with developing atrial fibrillation,[22,23] thereby increasing in-hospital mortality in these patients.

The results of the present study may have significant clinical relevance and public health implications for the prevention and management of ASCVD/atrial fibrillation-associated acute ischemic bowel. The potential benefits of lipid-lowering treatment in reducing ASCVD risk in elderly populations has been shown. The MRC/BHF Heart Protection Study (HPS) examined over 20,000 individuals across different age decades (< 65, 65–69, and ≥ 70 years old), and showed a significant relative risk reduction (RRR) with simvastatin compared to a placebo in terms of all-cause mortality.[24] Notably, the HPS study revealed that participants had relatively low levels of LDL-C before treatment, suggesting the potential benefits of more aggressive LDL lipid-lowering therapy for prevention of ASCVD compared to what is recommended in the ATP III Guidelines.[25] Additionally, the first randomized controlled trial (RCT) specifically focusing on the efficacy and safety of statins for ASCVD prevention in elderly patients (aged 70–82 years) demonstrated a substantial 22% pravastatin-associated RRR.[26] On the other hand, Chiou et al.[27] pointed out that rhythm control may have the benefit of mortality prevention in patients with non-permanent atrial fibrillation. Additionally, the Atrial Fibrillation Network (AFNET) trial recommended early rhythm control for individuals aged 75 and older with known atrial fibrillation, and showed a significant decreased risk of mortality during a median follow-up period of 5.1 years.[28] Considering these relevant benefits observed in preventing ASCVD and atrial fibrillation in older populations, it is recommended to expand the use of established preventive therapies to elderly patients with a history of ASCVD or atrial fibrillation who are experiencing acute ischemic bowel disease.

This study does have several limitations. First, it is difficult to yield a firm conclusion regarding causation in a retrospective study. A prospective randomized study is still needed to verify the effects of specific medications. Second, the diagnosis of acute ischemic bowel disease remains a challenge, particularly in patients with early-stage and mild disease. Therefore, some patients with mild acute ischemic bowel disease may not be included in our database. If this were the case, it would dilute the statistical association. However, we estimate this effect to be modest because acute ischemic bowel disease is rare.

5. Conclusion

Elderly patients with acute ischemic bowel disease have a higher in-hospital mortality and total mortality. Old age-related ASCVD is a predictor of total mortality, while old age-related atrial fibrillation is a predictor for in-hospital mortality in patients with acute ischemic bowel disease.

Acknowledgments

None.

Funding

None.

Conflicts of interest

Not applicable.

Supplementary materials

Supplementary materials for this article can be found at http://www.sgecm.org.tw/ijge/journal/view.asp?id=34.

References

1. Corcos O, Nuzzo A. Gastro-intestinal vascular emergencies. *Best Pract Res Clin Gastroenterol.* 2013;27:709–725. doi:10.1016/j.bpg.2013.08.006
2. Patel A, Kaleya RN, Sammartano RJ. Pathophysiology of mesenteric ischemia. *Surg Clin North Am.* 1992;72:31–41. doi:10.1016/s0039-6109(16)45626-4
3. Washington C, Carmichael JC. Management of ischemic colitis. *Clin Colon Rectal Surg.* 2012;25:228–235. doi:10.1055/s-0032-1329534
4. Roussel A, Castier Y, Nuzzo A, et al. Revascularization of acute mesenteric ischemia after creation of a dedicated multidisciplinary center. *J Vasc Surg.* 2015;62:1251–1256. doi:10.1016/j.jvs.2015.06.204
5. Acosta S, Alhadad A, Svensson P, Ekberg O. Epidemiology, risk and prognostic factors in mesenteric venous thrombosis. *Br J Surg.* 2008;95:1245–1251. doi:10.1002/bjs.6319
6. Ahmed M. Ischemic bowel disease in 2021. *World J Gastroenterol.* 2021;27:4746–4762. doi:10.3748/wjg.v27.i29.4746
7. Greenwald DA, Brandt LJ, Reinus JF. Ischemic bowel disease in the elderly. *Gastroenterol Clin North Am.* 2001;30:445–473. doi:S0889-8553(05)70190-4
8. Johnson AEW, Bulgarelli L, Shen L, et al. MIMIC-IV, a freely accessible electronic health record dataset [published correction appears in Sci Data. 2023 Jan 16;10(1):31. doi: 10.1038/s41597-023-01945-2.] [published correction appears in Sci Data. 2023 Apr 18;10(1):219. doi: 10.1038/s41597-023-02136-9.]. *Sci Data.* 2023;10:1. doi:10.1038/s41597-022-01899-x
9. Johnson AE, Stone DJ, Celi LA, Pollard TJ. The MIMIC Code Repository: enabling reproducibility in critical care research. *J Am Med Inform Assoc.* 2018;25:32–39. doi:10.1093/jamia/ocx084
10. Oldenburg WA, Lau LL, Rodenberg TJ, Edmonds HJ, Burger CD. Acute mesenteric ischemia: a clinical review. *Arch Intern Med.* 2004;164:1054–1062. doi:10.1001/archinte.164.10.1054
11. Acosta-Merida MA, Marchena-Gomez J, Hemmersbach-Miller M, Roque-Castellano C, Hernandez-Romero JM. Identification of risk factors for perioperative mortality in acute mesenteric ischemia. *World J Surg.* 2006;30:1579–1585. doi:10.1007/s00268-005-0560-5
12. Schoots IG, Koffeman GI, Legemate DA, Levi M, van Gulik TM. Systematic review of survival after acute mesenteric ischaemia according to disease aetiology. *Br J Surg.* 2004;91:17–27. doi:10.1002/bjs.4459
13. Mitsuyoshi A, Obama K, Shinkura N, Ito T, Zaima M. Survival in non-occlusive mesenteric ischemia: early diagnosis by multidetector row computed tomography and early treatment with continuous intravenous high-dose prostaglandin E(1). *Ann Surg.* 2007;246:229–235. doi:10.1097/01.sla.0000263157.59422.76
14. Nuzzo A, Maggiori L, Ronot M, et al. Intestinal resection un acute mesenteric ischemia: Predictive factors in 221 consecutive patients followed in an intestinal stroke center. *Gastroenterology.* 2016;150:S692. doi:10.1016/s0016-5085(16)32358-7
15. Paterno F, Longo WE. The etiology and pathogenesis of vascular disorders of the intestine. *Radiol Clin North Am.* 2008;46:877–885. doi:10.1016/j.rcl.2008.06.005
16. Cappell MS. Intestinal (mesenteric) vasculopathy. I. Acute superior mesenteric arteriopathy and venopathy. *Gastroenterol Clin North Am.* 1998;27:783–825. doi:10.1016/s0889-8553(05)70033-9
17. Franca E, Shaydakov ME, Kosove J. Mesenteric Artery Thrombosis. In: *StatPearls*. Treasure Island (FL): StatPearls Publishing; 2023.
18. Golabi P, Fukui N, Paik J, Sayiner M, Mishra A, Younossi ZM. Mortality risk detected by atherosclerotic cardiovascular disease score in patients with nonalcoholic fatty liver disease. *Hepatol Commun.* 2019;3:1050–1060. doi:10.1002/hep4.1387
19. Lakatta EG, Levy D. Arterial and cardiac aging: major shareholders in cardiovascular disease enterprises: Part II: the aging heart in health: links to

heart disease. *Circulation.* 2003;107:346–354. doi:10.1161/01.cir.0000048893.62841.f7
20. Friberg L, Rosenqvist M, Lindgren A, Terént A, Norrving B, Asplund K. High prevalence of atrial fibrillation among patients with ischemic stroke. *Stroke.* 2014;45:2599–2605. doi:10.1161/STROKEAHA.114.006070
21. Kapalla M, Choubey R, Weitz J, Reeps C, Wolk S. Results after intraoperative open and endovascular revascularization of acute mesenteric ischemia requiring a laparotomy. *Langenbecks Arch Surg.* 2023;408:303. doi:10.1007/s00423-023-03035-8
22. Ohlmeier C, Mikolajczyk R, Haverkamp W, Garbe E. Incidence, prevalence, and antithrombotic management of atrial fibrillation in elderly Germans. *Europace.* 2013;15:1436–1444. doi:10.1093/europace/eut048
23. Wilke T, Groth A, Mueller S, et al. Incidence and prevalence of atrial fibrillation: an analysis based on 8.3 million patients. *Europace.* 2013;15:486–493. doi:10.1093/europace/eus333
24. Heart Protection Study Collaborative Group. MRC/BHF Heart Protection Study of cholesterol lowering with simvastatin in 20,536 high-risk individuals: a randomised placebo-controlled trial. *Lancet.* 2002;360:7–22. doi:10.1016/S0140-6736(02)09327-3
25. Grundy SM, Cleeman JI, Merz CN, et al. Implications of recent clinical trials for the National Cholesterol Education Program Adult Treatment Panel III guidelines [published correction appears in Circulation. 2004 Aug 10; 110(6):763]. *Circulation.* 2004;110:227–239. doi:10.1161/01.CIR.0000133317.49796.0E
26. Shepherd J, Blauw GJ, Murphy MB, et al. Pravastatin in elderly individuals at risk of vascular disease (PROSPER): a randomised controlled trial. *Lancet.* 2002;360:1623–1630. doi:10.1016/s0140-6736(02)11600-x
27. Chiou WR, Lin PL, Huang CC, et al. Rhythm control without catheter ablation may have benefits beyond stroke prevention in rivaroxaban-treated non-permanent atrial fibrillation. *Sci Rep.* 2022;12:3745. doi:10.1038/s41598-022-07466-z
28. Kirchhof P, Camm AJ, Goette A, et al. Early rhythm-control therapy in patients with atrial fibrillation. *N Engl J Med.* 2020;383:1305–1316. doi:10.1056/NEJMoa2019422