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Article

Do Patients with Liver Cirrhosis Have Worse Outcomes in Newly Diagnosed Atrial Fibrillation/Flutter?

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Abstract

Background/Objectives Atrial fibrillation/flutter (AF) and liver cirrhosis both present a large disease burden internationally, with millions of adults afflicted. There is evidence of a link between these two diseases; however, the prevalence and impact of liver cirrhosis in patients with and without AF have not been extensively detailed. With the utilization of a large national database, we examined the relationship between liver cirrhosis and AF and the effects on hospital outcomes. **Methods** We conducted a nationwide review from 2016 to 2020 utilizing the Nationwide Inpatient Sample (NIS) database. Patients ≥ 18 years old with newly diagnosed atrial fibrillation or atrial flutter were identified. They were then further stratified into patients with and without liver cirrhosis. Characteristics and comorbidities were identified, evaluating in-hospital mortality as the primary outcome. **Results** A total of 3,866,486 patients with a primary diagnosis of AF were included. Patients with liver cirrhosis were younger in age (mean age 68.32 vs 74.36 years old), the majority were White (74.1%), followed by Black (10.2%), and Hispanic (10.5%). They had more comorbidities, such as diabetes (45.1% vs 37.3%, $p<0.001$), hypertension (78.5% vs 83.6%, $p<0.01$), and chronic kidney disease (22.1% vs 19.5%, $p<0.001$) when compared to patients without liver cirrhosis. Patients with liver cirrhosis had a higher risk of in-hospital mortality (OR=1.84, $p<0.001$), hypovolemic shock (OR=2.17, $p<0.001$), gastrointestinal bleed (OR=2.42, $p<0.001$), requiring blood transfusions (OR=1.84, $p<0.001$), and requiring ICU-level of care with intubation (OR=1.214, $p<0.001$), central line (OR=1.33, $p<0.001$), arterial line (OR=1.32, $p<0.001$) and vasopressors (OR=1.61, $p<0.001$). Moreover, patients with liver cirrhosis had a lower risk of having an acute cerebrovascular accident (OR=0.431), transient ischemic attack (OR=0.475), or pulmonary embolism (OR=0.68) while hospitalized ($p<0.001$). **Conclusion** Our results have demonstrated a remarkable relationship between AF and liver cirrhosis, with significantly increased morbidity and mortality reported in individuals with both conditions compared to AF without liver cirrhosis.

Keywords: liver cirrhosis; atrial fibrillation; atrial flutter

1. Introduction

Atrial fibrillation/flutter (AF) is the most common cardiac arrhythmia affecting over 50 million adults worldwide. Similarly, liver cirrhosis has a large disease burden, affecting nearly 60 million individuals globally [1]. There is an extensive body of evidence linking both conditions. For instance, patients with liver cirrhosis appear to be at higher risk of developing AF, with higher proportions of new onset AF being reported in relation to liver disease severity [2]. Additionally, multiple large

cohort studies and meta-analyses show that the presence of AF in cirrhosis is associated with a substantial increase in all-cause mortality and morbidity [3,4].

Though there is a demonstrated association between AF and liver cirrhosis, the prevalence of liver cirrhosis in patients with and without AF, as well as their demographic profile and morbidity or mortality outcomes, has not been extensively described. The goal of this study is to utilize the National Inpatient Sample (NIS) database to investigate patients with new onset AF with and without concomitant liver cirrhosis to evaluate the primary outcome of in-hospital mortality as well as secondary outcomes of rates of thromboembolic disease, hemorrhage, and shock. In this study, it is hypothesized that the presence of liver cirrhosis leads to worsened outcomes in patients afflicted with AF, with increased morbidity and/or mortality.

2. Materials and Methods

Data Source and Variables of Interest

The NIS from the Healthcare Cost and Utilization Project is a US-based database managed by the Agency for Healthcare Research and Quality. The database compiles hospitalization records, including patient characteristics, medical conditions, procedures performed, and hospital characteristics. Every hospitalization is recorded individually in the NIS database, which may lead to multiple entries for the same patient.

To identify relevant conditions for this study, the International Classification of Diseases, 10th Edition (ICD-10) codes were utilized. Patients under 18 years old were excluded from the analysis. Due to the de-identified nature of the NIS database, this study was deemed exempt from Institutional Review Board review at Northwell Health.

Study Design

Data for hospitalized patients with liver cirrhosis were obtained from the NIS database from 2016 to 2020. Baseline risk factors were identified using ICD-10 codes. Inclusion criteria were a new diagnosis of atrial fibrillation or atrial flutter and age of 18 years or older. Exclusion criteria were chronic atrial fibrillation or flutter and age less than 18 years old. Patients were then stratified into two groups: patients with liver cirrhosis and patients without liver cirrhosis. Baseline characteristics such as age, sex, race, and sociodemographic factors such as hospital location, insurance, and median household income were collected. Multiple comorbidities were identified, such as diabetes mellitus (DM), hypertension (HTN), dyslipidemia (DLD), overweight (defined as a Body Mass Index (BMI) between 25 and 29.9), obesity (defined as a BMI > 30), alcohol use, tobacco use, chronic kidney disease (CKD) stages 3 to 5, end stage renal disease (ESRD), and coronary artery disease (CAD).

The primary outcome was in-hospital mortality. The secondary outcomes were length of stay (LOS), acute cerebrovascular accident (CVA), acute transient ischemic attack (TIA), hypovolemic shock, gastrointestinal bleeding, acute deep venous thrombosis (DVT), acute pulmonary embolism (PE), need for blood transfusions, and need for intensive care unit (ICU)-level of care (intubation, central line, arterial line, and vasopressors).

Statistical Analysis

The collected data were coded, tabulated, and statistically analyzed using IBM Statistical Package for Social Sciences Statistics Software Version 30.0, IBM Corp., Chicago, USA.

Qualitative data were described as frequencies and percentages and compared using Chi square test and Fisher's Exact test.

Multivariate binary logistic regression was done and allowed the assessment of whether liver cirrhosis was independently associated with the outcomes of interest. All regressions were adjusted to age, sex, race, primary expected payer, population setting, median household income, and

comorbidities. The results are presented as odds ratio (OR) estimates with 95% confidence intervals (CIs). The level of significance was taken at p-value < 0.05.

3. Results

3,866,486 patients with a primary diagnosis of AF were identified. 95,817 of these patients had concomitant liver cirrhosis (2.48%). Patients with concomitant liver cirrhosis were younger (mean age of 68.32 versus 74.36), less likely to be female (35.9% versus 47%), more likely to be Black and Hispanic, and had higher rates of comorbidities, including diabetes, ESRD, and alcohol use. The most common primary expected payer was Medicare at 69.3%. The most common median household income bracket was 0-25th percentile at 31.1%, higher compared to AF without liver cirrhosis, with a percentage of 27.1% in this same income bracket. Demographic analysis of this sample is outlined in Table 1.

Table 1. Demographic analysis of patients with AF without liver cirrhosis and those with liver cirrhosis.

Demographics	No Liver Cirrhosis	Liver Cirrhosis	p-value
Total n	3,770,669	95,817	
Age mean, Standard Deviation (SD)	74.36, 12.00	68.32, 11.14	< 0.001
Sex female (%)	1,772,256 (47)	34,410 (35.9)	< 0.001
Race			< 0.001
White	2,935,596 (79.9)	69,424 (74.1)	
Black	362,830 (9.9)	9,535 (10.2)	
Hispanic	210,400 (5.7)	9,820 (10.5)	
Asian	74,251 (2)	2,053 (2.2)	
Native American	13,457 (0.4)	740 (0.8)	
Other	75,533 (2.1)	2,152 (2.3)	
Primary expected payer			< 0.001
Medicare	2,968,630 (78.8)	66,329 (69.3)	
Medicaid	194,585 (5.2)	11,814 (12.3)	
Private	477,374 (12.7)	12,873 (13.4)	
Self-pay	49,800 (1.3)	2,063 (2.2)	
None	4,271 (0.1)	156 (0.2)	
Other	72,383 (1.9)	2,477 (2.6)	
Population Setting			< 0.001
>1 million in central city	967,565 (25.7)	28,058 (29.5)	
>1 million fringe of city	963,126 (25.6)	22,699 (23.9)	
250K-1 million population	789,998 (21)	20,151 (21.2)	
50K-250K population	375,493 (10)	9,248 (9.7)	
<50K Metropolitan counties	374,163 (10)	8,625 (9.1)	
<50K Not metropolitan counties	289,937 (7.7)	6,390 (6.7)	
Median Household Income			< 0.001
0-25th percentile	1,006,371 (27.1)	29,158 (31.1)	
26-50th percentile	1,001,042 (27)	25,202 (26.9)	
51-75th percentile	913,899 (24.6)	22,280 (23.7)	
76-100th percentile	792,650 (21.3)	17,185 (18.3)	
DM	1,406,324 (37.3)	43,194 (45.1)	< 0.001
HTN	3,153,218 (83.6)	75,247 (78.5)	< 0.001
DLD	1,445,600 (38.3)	28,067 (29.3)	< 0.001
Overweight BMI 25 to 29.9	93,561 (2.5)	2,916 (3)	< 0.001
Obesity BMI 30 +	739,889 (19.6)	20,944 (21.9)	< 0.001
Alcohol	130,997 (3.5)	21,727 (22.7)	< 0.001

Smoking	1,108,977 (29.4)	26,317 (27.5)	< 0.001
CKD 3-5	736,738 (19.5)	21,198 (22.1)	< 0.001
ESRD	197,040 (5.2)	10,479 (10.9)	< 0.001
CAD	1,509,611 (40)	33,454 (34.9)	

New onset AF patients with liver cirrhosis had 1.84 times the odds of in-hospital mortality (95% CI 1.796-1.885) (Table 2). When the sample was further stratified, patients with new onset AF and ESRD who also had liver cirrhosis had 1.985 times the odds of in-hospital mortality when compared to those without cirrhosis (95% CI 1.95-2.021) (Table A1). AF with liver cirrhosis also had a longer average hospital stay (mean 7.1 days versus 5.94 days).

Table 2. Multivariate binary logistic regressions evaluating the association of liver cirrhosis with outcomes of interest.

	OR	Lower CI 95%	Higher CI 95%	p-value
In-hospital mortality	1.84	1.796	1.885	<.001
Acute CVA	0.431	0.409	0.455	<.001
TIA	0.475	0.419	0.538	<.001
Hypovolemic shock	2.169	2.039	2.308	<.001
GI Bleed	2.42	2.358	2.485	<.001
Acute DVT	0.989	0.946	1.035	0.639
Acute PE	0.684	0.641	0.731	<.001
Intubation	1.214	1.187	1.243	<.001
Arterial line	1.322	1.238	1.41	<.001
Central line	1.326	1.273	1.38	<.001
Vasopressors	1.607	1.542	1.675	<.001
Blood Transfusion	1.837	1.796	1.878	<.001

Participants with new-onset AF and liver cirrhosis had significantly lower odds of CVA (OR 0.431, 95% CI 0.409-0.455), TIA (OR 0.475, 95% CI 0.419-0.538), and acute PE (OR 0.684, 95% CI 0.641-0.731) (Table 2).

Odds of hypovolemic shock, gastrointestinal bleed, and blood transfusion were significantly higher in patients with new-onset AF and liver cirrhosis (OR 2.169 95% CI 2.039-2.308, OR 2.42 95% CI 2.358-2.485, OR 1.837 95% CI 1.796-1.878 respectively). When the sample was stratified further to only those with ESRD, the odds were still significantly higher in those with AF and liver cirrhosis (OR 1.721 95% CI 1.631-1.816 for hypovolemic shock, OR 1.667 95% CI 1.63-1.704 for gastrointestinal bleed, and OR 2.167 95% CI 2.133-2.201 for those who received blood transfusions).

The measures for those requiring a critical level of care were intubation, arterial line placement, central line placement, and/or vasopressor support. Odds of intubation in those with AF and liver cirrhosis were 1.214 times that of AF without liver cirrhosis (95% CI 1.187-1.243). The odds of intubation increased to 1.627 times when the data was stratified to include Asian participants only (95% CI 1.587-1.669). Odds of arterial line placement in those with AF and liver cirrhosis were 1.322 times that of AF without liver cirrhosis (95% CI 1.238-1.41). Odds of central line placement in those with AF and liver cirrhosis were 1.326 times that of AF without liver cirrhosis (95% CI 1.273-1.38), increasing to 3.771 times the odds when stratified for ESRD patients (95% CI 3.685-3.859). Odds of vasopressor support in those with AF and liver cirrhosis were 1.607 times that of AF without liver cirrhosis (95% CI 1.542-1.675).

4. Discussion

There are multiple causes of liver cirrhosis with metabolic dysfunction-associated steatotic liver disease (MASLD) serving as a major inciting factor being associated with increased long-term risk of atrial fibrillation [5]. MASLD is a broader umbrella term with characteristics of metabolic syndrome

involvement that includes the role of obesity, diabetes, hypertension, chronic kidney disease, and hyperlipidemia with demonstrated increased cardiovascular disease risk [6].

The prevalence of liver cirrhosis in patients with AF has not been specifically reported in the literature, as most studies describe the incidence of AF in liver cirrhosis patients. In this data set, the proportion of individuals with liver cirrhosis among AF patients was 2.5%. This is similar to the reported prevalence of liver cirrhosis in the general US population of 2.6% [7], suggesting that liver cirrhosis may pose a similar disease burden in the AF population as in the general population.

It has been described that the incidence of individuals having both AF and liver cirrhosis appears to increase in specific subgroups, such as those with advanced age and metabolic risk factors [8]. In this sample, those with alcohol use disorder, DM, and ESRD were significantly over-represented in the category of AF patients with liver cirrhosis (Table 1).

Anticoagulation is indicated in some patients with AF and has been shown to reduce mortality and stroke risk. However, AF patients who also have liver cirrhosis are at increased risk of bleeding. A large US study investigated the use of warfarin versus direct oral anticoagulants in this population and saw reduced mortality and CVA risk; however, the use of anticoagulant therapies increased bleeding risk [9]. As the NIS database was utilized in this study, granular information including use of anticoagulation was not specified; however, overall, there was a significantly increased incidence of hypovolemic shock, GI bleed, and blood transfusions in patients with AF and liver cirrhosis. Those with new-onset AF and liver cirrhosis also had significantly lower odds of CVA, TIA, and acute PE. Taken together, it can be assumed that a certain proportion of patients with AF and cirrhosis were on anticoagulation and this reduced the odds of thromboembolic disease. The risk of hemorrhage in this population may be in part due to the impaired clotting in cirrhosis and the additional risk of hemorrhage with anticoagulant use.

Multiple large studies have demonstrated that higher morbidity and mortality is present in populations with concomitant AF and liver cirrhosis [3,4]. As outlined in Table 2 in this study, the group with AF and liver cirrhosis had reported higher rates of in-hospital mortality, hypovolemic shock, vasopressor support, GI bleed, intubation, arterial line placement, central line placement, and blood transfusion, similar to the other studies mentioned.

Utilizing the NIS database in this study allowed for the analysis of many hospitalized patients that allows us to access nationally representative data, achieve greater statistical power and reduce sampling error.

While there are benefits to utilizing the NIS database, there are significant limitations as well. There is a reliance on ICD-10 codes to sort the data which imparts an inherent risk of documentation errors. Each hospitalization is counted separately, meaning one patient could be represented multiple times in the sample. Due to the large sample size, the effects these factors have on the results is estimated to be minimal, though are important to consider. Additionally, there is an inability to access more patient-specific information including use of anticoagulants as well as the severity of liver cirrhosis.

The risk and benefits of stroke prevention with anticoagulants versus the risk of hemorrhage and hypovolemic shock in these patients have not been fully studied. Future prospective longitudinal studies are needed to outline the long-term outcomes of patients with AF and cirrhosis.

5. Conclusions

In this national cohort of patients with AF, those with coexistent liver cirrhosis represented a small but unique subgroup of patients that were younger, more often male, disproportionately Black and Hispanic, and burdened with greater comorbidity and socioeconomic disadvantage. New-onset AF in the setting of liver cirrhosis was associated with significantly higher in-hospital mortality, longer length of stay, and significantly increased risks of hypovolemic shock, gastrointestinal bleeding, and need for blood transfusion, with these risks persisting or worsening in ESRD patients. Patients with AF and liver cirrhosis also required higher levels of critical care. Overall, these findings

highlight that patients with liver cirrhosis and AF are an especially vulnerable population with significantly worse inpatient outcomes and resource utilization.

Supplementary Materials: The supplemental table provides a list of ICD-10 codes use for the analysis of this manuscript.

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Data Availability Statement: The data that support the findings of this study are available from HCUP. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from the author(s) with the permission of HCUP.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

AF	Atrial fibrillation/flutter
NIS	Nationwide Inpatient Sample
OR	Odds Ratio
CI	Confidence Intervals
SD	Standard Deviation
ICD-10	International Classification of Diseases, 10th Edition
DM	Diabetes Mellitus
HTN	Hypertension
DLD	Dyslipidemia
BMI	Body Mass Index
CKD	Chronic Kidney Disease
ESRD	End Stage Renal Disease
CAD	Coronary Artery Disease
LOS	Length of Stay
CVA	Cerebrovascular Accident
TIA	Transient Ischemic Attack
DVT	Deep Vein Thrombosis
PE	Pulmonary Embolism
ICU	Intensive Care Unit

Appendix A

Table A1. Multivariate regression for AF risk in cirrhosis. Adjusted for age, sex, race, and comorbidities (DM, HTN, DLD, overweight, obesity, CKD stage 3-5, ESRD, smoking, alcohol and CAD).

In-hospital mortality				
	OR	Lower CI 95%	Higher CI 95%	p-value
Cirrhosis	1.84	1.796	1.885	<.001
Age mean (SD)	1.024	1.023	1.024	<.001
Sex female (mean)	0.851	0.843	0.86	<.001
Race				

White = REFERENCE				
Black	1.195	1.176	1.214	<.001
Hispanic	1.215	1.192	1.238	<.001
Asian	1.391	1.352	1.43	<.001
Native American	1.25	1.164	1.342	<.001
Other	1.285	1.248	1.324	<.001
DM	1.009	0.999	1.02	0.073
HTN	0.614	0.607	0.621	<.001
Dyslipidemia	0.874	0.866	0.883	<.001
Overweight BMI 25 to 29.9	0.916	0.888	0.946	<.001
Obesity BMI 30 +	0.82	0.809	0.831	<.001
CKD3-5	1.109	1.095	1.122	<.001
ESRD	1.985	1.95	2.021	<.001
Smoking	0.714	0.707	0.722	<.001
Alcohol	0.923	0.899	0.948	<.001
CAD	0.871	0.863	0.88	<.001

References

1. Global burden of disease study 2021 (GBD 2021) Data Resources. GHDx. (2025, March 4). <https://ghdx.healthdata.org/gbd-2021>

2. Cho, E. J., Chung, G. E., Yoo, J. J., Cho, Y., Lee, K. N., Shin, D. W., Kim, Y. J., Yoon, J. H., Han, K., & Yu, S. J. (2024). Association of nonalcoholic fatty liver disease with new-onset atrial fibrillation stratified by age groups. *Cardiovascular Diabetology*, 23(1). <https://doi.org/10.1186/s12933-024-02408-7>

3. Chokesuwattanaskul, R., Thongprayoon, C., Bathini, T., O’Corragain, O. A., Sharma, K., Preechawat, S., Wijarnpreecha, K., Kröner, P. T., Ungprasert, P., & Cheungpasitporn, W. (2019). Epidemiology of atrial fibrillation in patients with cirrhosis and clinical significance: A meta-analysis. *European Journal of Gastroenterology & Hepatology*, 31(4), 514–519. <https://doi.org/10.1097/meg.0000000000001315>

4. Han, H., Qin, Y., Yu, Y., Wei, X., Guo, H., Ruan, Y., Cao, Y., & He, J. (2019). Atrial fibrillation in hospitalized patients with end-stage liver disease: Temporal trends in prevalence and outcomes. *Liver International*, 40(3), 674–684. <https://doi.org/10.1111/liv.14291>

5. Mantovani, A., Morandin, R., Sani, E., Fiorio, V., Shtembari, E., Bonapace, S., Petta, S., Polyzos, S. A., Byrne, C. D., & Targher, G. (2024). MASLD is associated with an increased long-term risk of atrial fibrillation: An updated systematic review and meta-analysis. *Liver International*, 45(1). <https://doi.org/10.1111/liv.16218>

6. Targher, G., Byrne, C. D., & Tilg, H. (2024). MASLD: A systemic metabolic disorder with cardiovascular and malignant complications. *Gut*, 73(4), 691–702. <https://doi.org/10.1136/gutjnl-2023-330595>

7. Younossi, Z. M., De Avila, L., Racila, A., Nader, F., Paik, J., Henry, L., & Stepanova, M. (2025). Prevalence and predictors of cirrhosis and portal hypertension in the United States. *Hepatology*, 82(5), 1229–1240. <https://doi.org/10.1097/hep.0000000000001243>

8. Kang, M. K., Park, J. G., & Kim, M. C. (2020). Association between atrial fibrillation and advanced liver fibrosis in patients with non-alcoholic fatty liver disease. *Yonsei Medical Journal*, 61(10), 860. <https://doi.org/10.3349/ymj.2020.61.10.860>

9. Serper, M., Weinberg, E. M., Cohen, J. B., Reese, P. P., Taddei, T. H., & Kaplan, D. E. (2020). Mortality and hepatic decompensation in patients with cirrhosis and atrial fibrillation treated with anticoagulation. *Hepatology*, 73(1), 219–232. <https://doi.org/10.1002/hep.31264>

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