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RESEARCH ARTICLE

Cardiology

Predictors of new-onset atrial fibrillation in geriatric trauma patients

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Abstract

Introduction: Geriatric patients (age >65) comprise a growing segment of the trauma population. New-onset atrial fibrillation may occur after injury, complicating clinical management and resulting in significant morbidity and mortality. This study was undertaken to identify clinical and demographic factors associated with new-onset atrial fibrillation among geriatric trauma patients.

Methods: In this case control study, eligible participants included admitted trauma patients age 65 and older who developed new-onset atrial fibrillation during the hospitalization. Controls were admitted trauma patients who were matched for age and injury severity score, who did not develop atrial fibrillation. We evaluated the associations between new-onset atrial fibrillation and clinical characteristics, including patient demographics, health behaviors, chronic medical conditions, and course of care.

Results: Data were available for 63 cases and 25 controls. Patients who developed atrial fibrillation were more likely to be male, compared to controls (49% versus 24%; odds ratio 3.0[1.0, 8.9]). Other demographic and clinical factors were not associated with new-onset atrial fibrillation, including mechanism of injury, co-morbid medical conditions, drug or alcohol use, surgical procedures, and intravenous fluid administration.

Conclusions: Male geriatric trauma patients were at higher risk for developing new-onset atrial fibrillation. Other demographic and clinical factors were not associated with new-onset atrial fibrillation.

1 | INTRODUCTION

1.1 | Background

Geriatric patients (age >65) are the fastest growing trauma patient population. It is projected that by the year 2050, 40% of all trauma patients are expected to be geriatric. Trauma is the seventh leading cause of death among geriatric trauma patients.[1,2] Currently, geriatric trauma patients serve as 8%–14% of the entire trauma populace.[3–5] Furthermore, geriatric trauma patients account for 36% of all ambulance transports, >25% of trauma hospitalizations, and 25%–30% of total trauma costs. These trauma patients experience higher morbidity and mortality than younger trauma patients.[6–9] Many elderly patients have co-morbidities, including hypertension (>50%), heart disease (>30%), and others, which may contribute to increased morbidity and mortality.[10]

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Atrial fibrillation occurs when the atrial myocardium is continuously discharging and contracting and results in an irregular, narrow complex rhythm.[11] Risk factors for atrial fibrillation include advanced age, male sex, white race, congestive heart failure, valve disease, hypertension, dyslipidemia, diabetes, obesity, sleep-disorder breathing, tobacco use, excessive alcohol use, and critical illness.[12–14]

Atrial fibrillation accounts for ≥15% of all strokes in the United States, 36% of strokes for individuals aged >80, and up to 20% of cryptogenic strokes, which means >100,000–125,000 embolic strokes per year, of which >20% are fatal.[15] Atrial fibrillation is commonly diagnosed in the elderly population. In the Anticoagulation and Risk Factors in Atrial Fibrillation Study in 2001, in a population of 1.89 million people, the prevalence of atrial fibrillation was found to increase with older age, ranging from 0.1% among persons younger than 55 years to 9.0% among patients 80 years or older.[16] In the Framingham Heart Study, there was a 5-fold increase in strokes in patients when atrial fibrillation was present.[17]

1.2 | Importance

In older patients, new-onset atrial fibrillation is an important complication after injury. The pathophysiology of new-onset atrial fibrillation in the trauma setting is unclear. Postulated mechanisms include stress, high cortisol levels, intravenous fluid administration, or unrelated new-onset atrial fibrillation. In other settings, medications used to prevent atrial fibrillation may result in trauma. Dalgaard et al. demonstrated recently that geriatric patients on anti-arrhythmic drugs have a rate risk of associated fall-related injuries, with that risk being highest in the first 14 days.[18] Hadjizacharia et al found that trauma patients with new-onset atrial arrhythmias have higher mortality, and atrial arrhythmias are an independent risk factor for mortality after trauma.[19] The new-onset of atrial fibrillation can complicate management, because both anticoagulation and rate or rhythm control may be deleterious in the setting of trauma. However, only limited data describe the patients most vulnerable to new-onset atrial fibrillation after trauma.

1.3 | Goals of this study

This study was undertaken to identify clinical and demographic factors associated with new-onset atrial fibrillation among geriatric trauma patients.

2 | METHODS

2.1 | Design and setting

This study used a case control design. We used data from the trauma registry at Miami Valley Hospital, an urban Level 1 Trauma Center in Dayton, Ohio, with 95,000 annual emergency department (ED) visits. The center serves a population of 140,000 persons and responds to over 3000 trauma activations annually. Information on patients receiving care at the trauma center is recorded in the institution trauma registry. Inclusion in the trauma registry includes all trauma activations admitted to the hospital, including patients ultimately admitted to either trauma or medical service. Trained registrars abstract information for the trauma registry including patient demographics, out-of-hospital course, clinical presentation, diagnoses, course of care, interventions, complications, and outcomes.

This study was approved by the Wright State University Institutional Review Board and conducted within the approved guidelines.

2.2 | Selection of subjects—outcomes

Criteria for patient inclusion in this study was age over 65 years old, admission to the hospital following a traumatic injury, and the diagnosis of new-onset atrial fibrillation during the hospital stay during the time period 2008 to 2017. The diagnosis of new-onset atrial fibrillation was ascertained from discharge diagnoses recorded in the trauma registry. We did not use electrocardiographic or clinical data to identify new-onset atrial fibrillation. All cases that met inclusion criterion were included in the study. Exclusion criteria included previous history of atrial fibrillation or age under 65.

For the control population, we chose patients during the study period without new-onset atrial fibrillation, but with similar age (within 5 years of age) and injury severity score (within 5 points injury severity score) as cases. Controls were matched with individual cases. Some controls were eliminated after chart review due to ineligibility.

2.3 | Exposures

Data collected on these subjects and controls included information regarding their length of stay, time in the ICU, surgical dates, age, and sex. Information that was specific to the patient's injury and intervention was also collected and included injury severity score, mechanism of injury, the total amount of intravenous fluids patients received, administration of packed red blood cells, platelets, or plasma. We also identified factors in the patient's medical history, including heart disease, hypertension, sleep apnea, thyroid disease, diabetes, family history of atrial fibrillation, drug abuse, and alcohol abuse.

2.4 | Analysis

All data were analyzed using SAS v9.4. For binary and categorical variables, we determined association with new-onset atrial fibrillation using univariable odds ratio (OR) with 95% Wald confidence interval (CI). For continuous variables we determined associations with new-onset atrial fibrillation using Student's *t* tests or the Wilcoxon rank-sum test. With 63 cases and 25 controls, we estimated that we would have 92% power to detect large effect sizes of standardized differences of the mean of 0.8 or more, with 5% type I error using a two-sided test.

TABLE 1 Factors associated with new-onset atrial fibrillation among geriatric trauma patients

	Case	Control	OR for new-onset AFIB [CI]
No. subjects	63 N (%) [IQR]	25 N (%) [IQR]	
Age (mean, SD)	82 (7) [80, 84]	80 (7) [77, 83]	1.0 [1.0, 1.1]
Sex			
Male	25 (49%) [35, 63]	6 (24%) [7, 41]	3.0 [1.0, 8.9]
Female	26 (51%) [37, 65]	19 (76%) [59, 93]	Reference
Mechanism of injury			
Fall	38 (75%) [63%, 86%]	15 (60%) [41%, 79%]	1.9 [0.4, 9.5]
Motor vehicle accident	9 (18%) [7, 28]	7 (28%) [10, 46]	1.0 [0.2, 5.8]
Other	4 (8%) [0, 15]	3 (12%) [1, 25]	Reference
Injury severity score (median, IQR)	10 {6, 13}	9 {5, 13}	1.01 [0.94, 1.09]
History of drug abuse	0 (0%)	0 (0%)	Sample size too small to estimate OR
History of alcohol abuse	2 (4%) [0, 10]	1 (4%) [0, 12]	1.0 [0.1, 11.8]
Heart disease	27 (53%) [39, 67]	13 (52%) [32, 72]	1.0 [0.4, 2.7]
Hypertension	40 (78%) [67, 90]	23 (92%) [81, 100]	0.3 [0.1, 1.6]
Sleep apnea	3 (6%) [1, 12]	1 (4%) [0, 12]	1.5 [0.1, 15.2]
Thyroid	10 (20%) [9, 31]	6 (24%) [7, 41]	0.8 [0.2, 2.4]
Diabetes	15 (29%) [17, 42]	8 (32%) [14, 50]	0.9 [0.3, 2.5]
Family history	1 (2%) [0, 6]	0 (0%)	N/A
Received packed red blood cells	8 (13%) [4, 21]	4 (16%) [2, 30]	0.8 [0.2, 2.8]
Received platelets	14 (22%) [12, 32]	5 (20%) [4, 36]	1.1 [0.4, 3.6]
Received plasma	6 (10%) [2, 17]	2 (8%) [0, 19]	1.2 [0.2, 6.4]
Underwent surgical procedure	11 (17%) [8, 27]	2 (8%) [0, 19]	2.4 [0.5, 11.9]
Total IVF (median, IQR)	0 {0, 6814}	2035 {0, 6217}	$P = 0.38^*$
Fluids day 1 (median, IQR)	1128 {570, 1920}	889 {0, 1964}	$P = 0.16^*$
Fluids day 2 (median, IQR)	1801 {997, 2789}	1512 {809, 1949}	$P = 0.41^*$
Fluids day 3 (median, IQR)	693 {0, 2479}	435 {0, 1668}	$P = 0.36^*$
Length of stay (median, IQR)	7 {4, 11}	3 {1, 7}	1.00 [0.96, 1.04]

*Mann-Whitney Wilcoxon test for continuous variables.
IQR = interquartile range.
OR = odds ratio.

3 | RESULTS

Data were collected for 63 cases and 25 controls (matched for age and injury severity score). The incidence of new-onset atrial fibrillation during the study period was 0.6% (63 cases among 10,494 geriatric trauma patients). The mean age of participants was 82 (interquartile range [IQR] 80–84). Participants were 51% females (N = 26) and 49% males (N = 25). The most common mechanisms of injury included fall (75%; N = 38), and motor vehicle collision (18%; N = 9). The most common pre-existing co-morbidities included hypertension (78%; N = 40), heart disease (53%; N = 27), and diabetes (29%; N = 15).

Patients who developed atrial fibrillation were more likely to be male, compared to controls (49% versus 24%, odds ratio [OR] 3.0 [1.0, 8.9]). Other demographic and clinical factors were not associated with new-onset atrial fibrillation, including mechanism of injury, co-morbid medical conditions, drug or alcohol use, surgical procedures, and intravenous fluid administration (Table 1). The absence of associations with new-onset atrial fibrillation persisted after controlling for sex.

4 | LIMITATIONS

The study is limited by the relatively small sample size from a single institution; these results may not be generalizable to other institutions. We may have identified additional factors associated with new-onset atrial fibrillation with a larger data set. We used data from a trauma registry, which depends upon on the accuracy of medical record documentation. We identified new-onset atrial fibrillation from registry reports, not systematic review of ECGs. We included subjects with a heterogeneous range of injuries; we did not limit the analysis to particular injury patterns or severity. Our analysis did not indicate the consequences or long-term outcomes of new-onset atrial fibrillation.

5 | DISCUSSION

New-onset atrial fibrillation is a potential complication of injury in older adults. In this series, we found that the only factor associated with post-injury new-onset atrial fibrillation was male sex. New-onset atrial fibrillation was not associated with any other demographic, social, or clinical factors.

The exact reasons for the observed sex difference are not clear. Schoenberg et al demonstrated that women tend to die soon after trauma and therefore would not have time to develop complications such as atrial fibrillation.[20] It has also been shown in several studies that women have a more hypercoagulable profile and greater hemodynamic tolerance to shock than men, leading them to need less fluid resuscitation.[21,22] In a 59-year meta-analysis looking specifically at the role of sex in atrial fibrillation, Michelena et al found higher rates of lone atrial fibrillation in male patients. From this, the conclusion was drawn that the atrial fibrillation could possibly be linked to the X-chromosome.[23] However, several other studies have found female sex hormones to be protective against atrial fibrillation as they may reduce the effects of hemorrhagic shock on cardiac and hepatic function.[24] The current evidence is not conclusive as to why females experienced a lower rate of atrial fibrillation following trauma. Further prospective work with characterization of viscoelastic profiles on injured males and females may help to elucidate this phenomenon.

Our study did not indicate that surgery was a predictor for new-onset atrial fibrillation in the geriatric trauma population. This hypothesis proposed pathophysiologic changes such as alterations of electrolytes, atrial stretch from intravenous fluids, and inflammation; factors thought to be associated with both atrial fibrillation and surgical intervention.[25,26] This conclusion should be drawn with caution, however, due to the fact that our study only identified cases with onset during the hospital admission, whereas other literature looked at patients in a 90-day postoperative window with a median detection time of 32 days.[27]

New-onset atrial fibrillation may occur following trauma in geriatric patients. atrial fibrillation in this setting was not associated with traditionally recognized risk factors, such as hypertension, dyslipidemia, diabetes, sleep apnea, and excessive alcohol use. Cardiac monitoring and prompt recognition and treatment are essential to minimize morbidity and mortality resulting from atrial fibrillation.

6 | CONCLUSIONS

Male geriatric patients were at higher risk for developing new-onset atrial fibrillation after injury. Other demographic and clinical factors were not significantly associated with new-onset atrial fibrillation after injury.

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AUTHOR CONTRIBUTIONS

CAM, JL, BN, JM, AS, CH, and MM have made substantial contributions to conception and design, acquisition of data, and analysis and interpretation of data.

CAM, JL, BN, JM, AS, CH, and MM were involved in drafting the manuscript and revising it critically for important intellectual content, and gave final approval of the version to be published.

CONFLICTS OF INTEREST

The authors report no conflicts of interest.

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