THE INFLUENCE OF ANEMIA ON MORTALITY RATES, DURATION OF HOSPITALIZATION, AND RESOURCE UTILIZATION IN PATIENTS ADMITTED WITH A PRIMARY DIAGNOSIS OF VENTRICULAR TACHYCARDIA: A NATIONWIDE ANALYSIS 2016-2020

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Abstract

Background: Ventricular Tachycardia is a life threating arrhythmia with large admission rate. In this analysis, we aim to investigate the impact of anemia in patients admitted due to ventricular tachycardia in terms of mortality, length of stay and total hospital charges. **Methods**: This is an analysis of the National Inpatient Sample Database of the years 2016-2020. Patients admitted with a primary diagnosis of ventricular tachycardia, with or without a secondary diagnosis of anemia were identified using the ICD-CM codes. The primary outcome was mortality. Secondary outcomes were length of stay and resources utilization. Multivariate logistic analysis was performed, and outcomes were adjusted by age, gender, race, Charlson comorbidity index, hospital location, size, region, teaching status and insurance. Data was considered statistically significant with p-value <0.05. **Results**: Among 221720 patients who had a primary diagnosis of ventricular tachycardia, 17.56% had anemia. Adjusted mortality was significantly different in patients with secondary diagnosis of any anemia with odds ratio 1.95, p value < 0.001, 95% Confidence Interval 1.73 – 2.2. In terms of Length of Stay, patients with anemias of any type stayed 3.09 more days in the hospital, p value < 0.001, 95% Confidence Interval 2.78 - 3.41. Patients with anemia also had an increase on their total hospital charges by 61507.92, p value < 0.001, 95% Confidence Interval 53771.36 - 69244.48. **Conclusion:** Patients with anemia had 1.95 higher mortality rate, stayed 3.09 more days in the hospital and had a total hospital cost higher by 61507.92$. Anemia can be a risk marker within patients admitted with ventricular tachycardia, more studies needed to investigate if the treatment of anemia improves the outcome.

INTRODUCTION

Ventricular arrhythmias manifest as a considerable etiological factor contributing to sudden cardiac death, underpinning the necessity to comprehend associated risks[1]. Ventricular tachycardia, delineated by the manifestation of wide complex tachycardia, is characterized by a rate exceeding 100 beats per minute with three or more consecutive beats, thereby substantiating its clinical definition[2]. The manifestation of this condition can either be sustained or non-sustained, with the former denoting durations exceeding 30 seconds[2]

These classifications of arrhythmias are implicated in a substantial proportion of sudden cardiac death incidents in the United States, accounting for the majority[1], [3]. Moreover, they represent 8% of all recorded

instances of wide complex tachycardias4. Structural heart disease is predominantly linked to ventricular tachycardia5, and a significant correlation with coronary artery disease is also evident6. As such, the imperative nature of discerning the risks correlated with this pathological condition is clear. Anemia has been demonstrated to affect outcomes of atrial fibrillation[7,8,9] and studies showed its association with supraventricular tachycardia[10]. Anemia is also known to increase cardiovascular morbidity and mortality[11]. Although There is poor data correlating anemia and ventricular tachycardia.

In this study, the authors aim to study the outcomes in terms of mortality, length of stay and total hospital charges in patients with a primary diagnosis of Ventricular Tachycardia and secondary diagnosis of anemia.

METHODS

This is a retrospective cohort study in which was made using the National Inpatient Sample (NIS) from 2016 to 2020 which is publicly available from Healthcare Cost & Utilization Project. Patients admitted with a primary diagnosis of Ventricular Tachycardia were identified using the International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10CM) codes. Anemias were identified using the ICD-10CM codes and were also subdivided into groups and subgroups (Figure 1).

Inclusion criteria were patients with primary diagnosis of Ventricular tachycardia, older than 18 years and admitted in a non-elective basis. Stata/BE was used to analyze the data.

Study End Point

Inpatient mortality of adult patients admitted in a non-elective basis with primary diagnosis of Ventricular Tachycardia was analyzed in patients with or without anemias as the primary outcome. Length of Stay and Total Hospital charges were also analyzed as secondary outcomes.

Statistical Analysis

Population characteristic analyses were made with percentages for categorical variables and means for continuous variables. Chi-square test or Fisher‘s exact test was used for categorical variables and Mann-Whitney U test for continuous variables. All groups and subgroups of anemia were used as dependent variables. For the descriptive population was used only the Total Anemias group. Statistical significance analysis was considered with p value less than 0.05.

For the primary outcome and secondary outcomes, firstly the variables that significantly impacted the result were defined as those with a p-value less than 0.2 on the unadjusted odds ratio (OR) using Cochran-Mantel-Haenszel test. This selection of significant variables for the adjustment on primary and secondary outcomes tests were made to avoid overfitting. Age, median income per patient zip code, Charlson comorbidity index, and insurance coverage type had p-value less than 0.2 and were considered significant for the adjustment of the OR and coefficient in the primary and secondary outcomes.

Primary outcome was obtained with OR using Cochran-Mantel-Haenszel test adjusted for the significant variables within all anemia groups. Secondary outcomes were obtained using adjusted linear regression for the significant variables within all anemia groups.

RESULTS

Between 2016 and 2020 there were 221720 patients admitted with a primary diagnosis of Ventricular Tachycardia. The characteristics of the population are demonstrated on Table 1.

Population Characteristics

Because we had 0 patients with secondary diagnosis of Acquired Red Cell Aplasia, Sideroblastic Anemia and Congenital Anemia, these subgroups were removed from the analysis.

Primary Outcome

For the primary outcome of inpatient mortality, the Odds Ratio was adjusted for the significant variables of age, median income per patient zip code, Charlson comorbidity index, and insurance coverage type. Crude outcomes can be observed on Table 2. We could observe that patients with any type of anemia had 1.95 more chance of dying from Ventricular Tachycardia than the general population. Some anemia subgroups also had statistically significant Odds Ratio for mortality as shown in Table 3. Patients with Enzyme Deficiency anemia and Thalassemia did not have any deaths on their subgroup.

Secondary Outcomes

Regarding the duration of inpatient hospitalization, it was observed that patients diagnosed with any variant of anemia exhibited a mean prolonged stay of 3.09 days relative to the general patient population. A tabulated presentation of the findings related to the respective subgroups of anemias is delineated in Table 4.

We could also observe that anemia also impacts the Total Hospital Charges (Table 5). Patients with anemia have a mean increase of 61507.92 dollars of their hospital resources utilization during admission.

DISCUSSION

In this retrospective cohort, we aimed to verify the existence of a correlation between anemia and ventricular tachycardia outcomes in the inpatient population. Anemia has a high prevalence in the US[12] and it is associated with poor outcomes in heart diseases due to its hyperdynamic state[13-16]. Although there are data on the relation between anemia and heart failure and atrial fibrillation[7-9], its relation to ventricular tachycardia lack evidence. In this study, authors used the national inpatient sample from 2016 to 2020 to analyze the difference in outcomes in patients with a primary diagnosis of ventricular tachycardia and anemia compared with the general population.

Weidner K et al found in their study comparing the relation between anemia and ventricular tachyarrhythmias an increase in the mortality rate in patients with anemia[17]. It was a study with 2184 patients, retrospective, registry-based in patients who developed ventricular tachyarrhythmia. In their study, length of stay, and total hospital charges were not analyzed and neither anemias were classified on subtypes. In our study the primary outcome of death had statistical odds ratio of 1.95 with $p < 0.001$ for patients with any type of anemia, they also stayed an average of 3.09 more days and had a cost of an average of 61507.92 more dollars. Our mortality outcome is similar to the one Weidner K et al had on their study. There is strong data suggesting anemia is related to worse outcomes in patients with ventricular tachycardia.

Although we aimed to analyze all types of anemia in this study, our population was composed mostly of iron deficiency anemia, chronic diseases anemia and other unspecified anemias. The results from other subtypes might have been impacted by sample size.

This study has some limitations, firstly, the secondary diagnosis ICD 10 code can be misclassified at the time of putting it on the hospital system. Secondary diagnosis also can be part of medical history instead of an active problem, although anemia usually is a chronic condition, some patients with resolved anemia could have it on the list as past medical history. Several conditions can have anemia as consequence and not all of them are considered when calculating the Charlson Comorbidity Index to adjust the results making it a possible confounder. It is important to do a prospective study in this subject for better evaluation and also to see if treatment of anemia improves outcomes on these patients.

CONCLUSION

Patients presenting with anemia have been observed to experience adverse outcomes when admitted to the hospital with a primary diagnosis of ventricular tachycardia. It can be postulated that anemia may serve as a risk indicator for the prognosis associated with ventricular tachycardia. However, this study refrains from examining whether the amelioration of underlying anemia impacts mortality rates or contributes to a reduction in the duration of hospital stay. Further research investigations are imperative to shed light on the possibility of anemia rectification exerting an impact on the clinical prognosis of ventricular tachycardia patients.

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TABLES AND FIGURES

Iron Anemia	Total Nutritional Anemias	Total Anemias
B12 Deficiency		
Folate Deficiency		
Other Nutritional Deficiency		
Enzyme Deficiency	Total Hemolytic Anemias	
Thalassemia		
Sickle Cell		
Hereditary Hemolytic		
Acquired Hemolytic		
Acquired Red Cell Aplasia	Total Aplastic Anemias	
Other Aplastic Anemias		
Post Hemorrhagic Anemias		
Chronic Disease Anemia		
Sideroblastic Anemia		
Congenital Anemia		
Chemotherapy Anemia		
Other Specified Anemia	Total Other Anemias	
Other Anemias		

Figure 1 – Division of Anemia groups and subgroups

Patient Characteristics		Without Anemia	With Anemia	Total	p value
Sex	Male	75.4%	70.62%	74.56%	
	Female	24.6%	29.38%	25.44%	<0.01
AGE (mean)		66.09	68.63		
RACE	White	77.17%	68.76%	75.69%	
	Black	12.58%	19.88%	13.87%	
	Hispanic	5.7%	6.3%	5.81%	
	Asian	1.89%	2.02%	1.92%	
	Native American	0.45%	0.51%	0.46%	
	Other	0.22%	2.53%	2.26%	<0.01
Charlson Index	0	10.28%	3.55%	9.1%	
	1	15.51%	7.68%	14.13%	
	2	20.31%	12.94%	19.02%	
	> 3	53.9%	75.84%	57.75%	<0.01
Median income	<49999	26.66%	29.76%	27.2%	
	50000-64999	26.74%	24.95%	26.42%	
	65000-85.999	24.96%	24.43%	24.86%	
	>86000	21.65%	20.85%	21.51%	<0.01
Type Insurance	Medicare	63.71%	73.83%	65.49%	
	Medicaid	8.7%	8.3%	8.63%	
	Private insurance	25.27%	16.15%	23.67%	
	Self-Pay	2.32%	1.72%	2.21%	<0.01
Region Hospital	Northeast	21.33%	19.29%	20.97%	

Patient Characteristics		Without Anemia	With Anemia	Total	p value
	Midwest	23.05%	25.11%	23.41%	
	South	38.23%	39.08%	38.38%	
	West	17.39%	16.52%	17.24%	<0.01
Bed Size	Small	14.84%	14.13%	14.72%	
	Medium	27.31%	25.75%	27.03%	
	Large	57.85%	60.12%	58.25%	<0.01
Location	Rural	5.32%	4.3%	5.14%	
	Urban	94.68%	95.7%	94.86%	<0.01
Teaching Hosp	No	23.97%	21.25%	23.5%	
	Yes	76.03%	78.75%	76.5%	<0.01

Table 1 – Population Characteristics

Totals	Number of Patients	Proportion (%)
Ventricular tachycardia	221720	100
Iron Anemia	6550	2.95
B12 Deficiency	225	0.1
Folate Deficiency	30	0.01
Other Nutritional Deficiency	1635	0.74
Total Nutritional Anemias	8300	3.74
Enzyme Deficiency	5	0
Thalassemia	180	0.08
Sickle Cell	195	0.09
Hereditary Hemolytic	55	0.02
Acquired Hemolytic	165	0.07
Total Hemolytic Anemias	595	0.27
Acquired Red Cell Aplasia	0	0
Other Aplastic Anemias	1515	0.68
Post Hemorrhagic Anemias	4220	1.9
Chronic Disease Anemia	11515	5.19
Sideroblastic Anemia	0	0
Congenital Anemia	0	0
Chemotherapy Anemia	110	0.05
Total Aplastic Anemia	16620	7.5
Other Specified Anemia	150	0.07
Other Anemias	15475	6.98
Total Other Anemias	15620	7.04
Total Anemias	38925	17.56

Table 2 – Number of patients for each anemia group

Primary outcome adjusted with variables with p<0.2

Types Anemia	Odds Ratio	Std Error	t	p value	95 Interval	95 Interval
Iron Deficiency	0.88	0.14	-0.78	0.437	0.64	1.21
B12 Deficiency	0.56	0.56	-0.58	0.563	0.08	3.99
Folate Deficiency	13.56	15.97	2.21	0.027	1.35	136.41
Other Nutritional	1.51	0.4	1.56	0.119	0.9	2.55

Total Nutritional	1.02	0.14	0.17	0.862	0.78	1.34
Enzyme Deficiency	1					
Thalassemia	1					
Sickle Cell	0.85	0.87	-0.15	0.877	0.12	6.32
Hereditary Hemolytic	32.92	25.63	4.49	<0.001	7.15	151.45
Acquired Hemolytic	3.9	2.2	2.41	0.016	1.29	11.79
Hemolytic Anemias	2.61	0.95	2.65	0.008	1.28	5.32
Other Aplastic	1.3	0.36	0.94	0.345	0.76	2.23
Post Hemorrhagic	4.19	0.48	12.44	<0.001	3.35	5.26
Chronic Disease	1.44	0.14	3.67	<0.001	1.18	1.75
Chemotherapy	2.08	1.64	0.93	0.354	0.44	9.8
Total Aplastic	2.09	0.17	9.14	<0.001	1.78	2.45
Other Specified	2.25	1.59	1.14	0.252	0.56	9
Other	1.69	0.14	6.31	<0.001	1.43	1.98
Total Other	1.69	0.14	6.39	<0.001	1.44	1.99
Total Anemias	1.95	0.12	10.78	<0.001	1.73	2.2

Table 3 – Adjusted Odds Ratio for mortality for each anemia group.

LOS outcome adjusted with variables with p<0.2

Types Anemia	Coefficient	Std Error	t	p value	95 Interval	95 Interval
Iron Deficiency	2.21	0.36	6.07	<0.001	1.49	2.92
B12 Deficiency	1.04	0.72	1.43	0.153	-0.38	2.46
Folate Deficiency	2.53	1.84	1.37	0.17	-1.08	6.14
Other Nutritional	1.64	0.48	3.42	0.001	0.7	2.58
Total Nutritional	2.01	0.3	6.75	<0.001	1.42	2.59
Enzyme Deficiency	-					
Thalassemia	-1.71	0.41	-4.13	<0.001	-2.52	-0.9
Sickle Cell	-2.23	0.48	-4.64	<0.001	-3.17	-1.29
Hereditary Hemolytic	1.77	1.08	1.64	0.102	-0.35	3.89
Acquired Hemolytic	5.91	3.71	1.59	0.111	-1.37	13.18
Hemolytic Anemias	0.67	1.18	0.56	0.72	-1.65	2.98
Other Aplastic	2.89	1.14	2.53	0.011	0.65	5.12
Post Hemorrhagic	13.34	0.89	14.97	<0.001	11.59	15.09
Chronic Disease	1.79	0.27	6.62	<0.001	1.26	2.32
Chemotherapy	0.29	1.34	0.21	0.831	-2.34	2.91
Total Aplastic	4.51	0.3	14.84	<0.001	3.92	5.11
Other Specified	1.33	0.92	1.45	0.148	-0.47	3.12
Other	1.46	0.17	8.75	<0.001	1.14	1.79
Total Other	1.46	0.17	8.8	<0.001	1.14	1.79
Total Anemias	3.09	0.16	19.08	<0.001	2.78	3.41

Table 4 – Results in terms of Length of Stay for each anemia subgroup.

TOTCHG outcome adjusted with variables with p<0.2

Types Anemia	Coefficient	Std Error	t	p -value	95 %Interval	95 %Interval
Iron Deficiency	30924.8	5240.32	5.9	<0.001	20653.3	41196.3
B12 Deficiency	-9250.92	14960.75	-0.62	0.536	-38575.35	20073.51
Folate Deficiency	11688.2	40182.19	0.29	0.771	-67072.54	90448.94

Other Nutritional	14372.68	8377.33	1.72	0.086	-2047.65	30793.01
Total Nutritional	27198.45	4513.96	6.03	<0.001	18350.67	36046.22
Enzyme Deficiency	1					
Thalassemia	-23836.3	11736.13	-2.03	0.042	-46840.19	-832.43
Sickle Cell	-24873.1	14602.33	-1.7	0.089	-53495.03	3748.75
Hereditary Hemolytic	72837.17	36885.01	1.97	0.048	539.2	145135.1
Acquired Hemolytic	162320.3	80914.66	2.01	0.045	3720.25	320920.4
Hemolytic Anemias	37118.2	26123.28	1.42	0.155	-14085.79	88322.19
Other Aplastic	42449.89	27059.34	1.57	0.117	-10588.86	95488.64
Post Hemorrhagic	324171.5	24617.66	13.17	<0.001	275918.7	372424.4
Chronic Disease	30007.2	5953.45	5.04	<0.001	18337.89	41676.51
Chemotherapy	-49683	9090.21	-5.47	<0.001	-67500.65	-31865.39
Total Aplastic	99666.91	7718.92	12.91	<0.001	84537.12	114796.7
Other Specified	3532.51	14359.26	0.25	0.806	-24612.93	31677.96
Other	24778.2	3812.03	6.5	<0.001	17306.27	32250.13
Total Other	24607.27	3779.81	6.51	<0.001	17198.5	32016.05
Total Anemias	61507.92	3947.04	15.58	<0.001	53771.36	69244.48

Table 5 – Total hospital charges regression by anemia subgroups