Northwestern University Feinberg School of Medicine

Burden of Emergency Department Utilization and Abdominal Imaging for Hereditary Angioedema

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Background

- Hereditary Angioedema (HAE) is an inherited C1 inhibitor deficiency that affects 1 in 50,000 individuals in the United States.
- Recent introduction of on-demand HAE therapeutics (e.g. icatibant, ecallantide, lanadelumab) may reduce frequency of HAE attacks requiring emergency department (ED) visits.
- 50% of acute HAE attacks present exclusively with abdominal symptoms.
- Patients with HAE often have unnecessary abdominal imaging.

Research Objectives

1. Estimate national ED utilization among patients with HAE.
2. Evaluate prevalence of radiologic imaging among patients with HAE vs angioedema.
3. Determine patient- and hospital-level associations with inpatient admission among ED patients with HAE.
4. Assess mean cost of ED care per visit among patients with HAE.

Methods

- Analysis of the 2015-2016 Nationwide Emergency Department Sample (NEDS), a representative, cross-sectional sample of ED visits from the Healthcare Cost and Utilization Project by the Agency for Healthcare Research and Quality.
- HAE patients were identified by International Classification of Disease diagnosis codes (ICD-9-CM: 277.6, ICD-10-CM: D84.1).
- Current Procedure Terminology codes used to identify imaging.
- Multivariable logistic regression models invoking stepwise variable selection were constructed to determine the associations of inpatient admission.
- Linear regression models were used to compare log-transformed, inflation-adjusted costs of HAE vs angioedema patients.

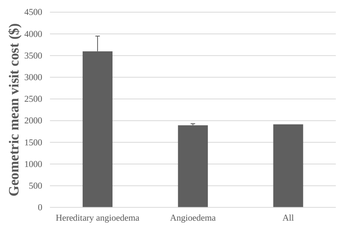
Results

Imaging patterns

Imaging	Diagnosis		
	HAE	Angioedema	Adjusted OR [95% CI]
Abdomen CT	2.7% [1.8-3.6%]	0.3% [0.3-0.4%]	9.32 [6.26-13.86]
Abdomen x-ray	1.7% [0.9-2.4%]	0.1% [0.1-0.2%]	13.26 [7.43-23.67]
Intubation	0.2% [0.0-0.4%]	0.2% [0.1-0.2%]	1.10 [0.31-3.89]
Chest x-ray	5.8% [4.3-7.2%]	6.5% [6.1-6.9%]	1.09 [0.79-1.51]

Models adjusted a priori for age (continuous), sex, and insurance payer.
OR = odds ratio; CI = confidence interval

Cost of ED Care



Error bars denote standard error of the costs for ED visits.
All refers to an ED visit for any reason.

Predictors of Inpatient Admission among HAE patients

Variable	Not admitted	Inpatient admission	
	Prevalence [95% CI]	Prevalence [95% CI]	Adjusted OR [95% CI]
Sex			
Male	93.7 [91.2-96.2]	6.3 [3.8-8.8]	1.00 [ref]
Female	90.9 [87.5-94.3]	9.1 [5.7-12.5]	2.34 [1.17-4.67]
Age			
<18 years	97.8 [96.1-99.5]	2.2 [0.5-3.9]	1.00 [ref]
18-39 years	91.4 [88.5-94.3]	8.6 [5.7-11.5]	3.13 [1.13-8.70]
40-59 years	86.9 [81.1-92.8]	13.1 [7.2-18.9]	7.24 [2.84-18.45]
60+ years	94.7 [89.5-99.9]	5.3 [0.1-10.5]	1.16 [0.22-6.00]
Income			
<50th %'ile	91.0 [88.2-93.9]	9.0 [6.1-11.8]	
≥50th %'ile	93.3 [89.8-96.8]	6.7 [3.2-10.2]	
Insurance status			
Private	93.3 [90.9-95.8]	6.7 [4.2-9.1]	1.00 [ref]
Public	91.9 [88.2-95.6]	8.1 [4.4-11.8]	1.58 [0.92-2.72]
Uninsured	83.5 [76.2-90.8]	16.5 [9.2-23.8]	3.16 [1.45-6.90]
Weekend admission			
No	92.1 [89.6-94.6]	7.9 [5.4-10.4]	
Yes	91.3 [88.0-94.7]	8.7 [5.3-12.0]	

Variable	Not admitted	Inpatient admission	
	Prevalence [95% CI]	Prevalence [95% CI]	Adjusted OR [95% CI]
Metropolitan hospital location			
Yes	91.0 [87.9-94.0]	9.0 [6.0-12.1]	1.00 [ref]
No	96.5 [93.3-99.8]	3.5 [0.2-6.7]	0.35 [0.13-0.95]
Region			
Northeast	90.8 [83.2-98.5]	9.2 [1.5-16.8]	1.00 [ref]
Midwest	92.4 [88.1-96.8]	7.6 [3.2-11.9]	0.58 [0.22-1.49]
South	88.3 [84.1-92.4]	11.7 [7.6-15.9]	0.79 [0.34-1.82]
West	95.9 [92.8-99.0]	4.1 [1.0-7.2]	0.33 [0.12-0.96]
Hospital teaching status			
Non-teaching	93.2 [90.7-95.7]	6.8 [4.3-9.3]	
Teaching	90.8 [86.5-95.1]	9.2 [4.9-13.5]	
Season			
Winter	91.9 [88.4-95.4]	8.1 [4.6-11.6]	
Spring	92.8 [89.8-95.9]	7.2 [4.1-10.2]	
Summer	93.6 [91.0-96.3]	6.4 [3.7-9.0]	
Autumn	91.4 [87.8-95.0]	8.6 [5.0-12.2]	

Final multivariable model was adjusted for sex, age, insurance status, hospital location, and region after stepwise variable selection. Gray cells indicate variable was not included in the final multivariable models.
OR = odds ratio; CI = confidence interval

- Weighted, 8,924 ED visits for patients with HAE were included in this study.
- Annual incidence of ED visits is 69 visits per 100 HAE patients each year.
- Most common reasons for ED visit in HAE patients were HAE (prevalence [95% CI]: 79.3% [74.9-83.7%]) and abdominal pain (7.2% [4.9-9.6%]).
- Patients with HAE vs angioedema had increased odds of abdominal CT and x-ray imaging, despite similar rates of conditions requiring abdominal imaging: pancreatitis, diverticulosis/diverticulitis, intussusception, and nephrolithiasis.
- Inpatient admission was higher in females, adults ages 40-59 years, and individuals without health insurance.
- Annual ED cost of care was $32,939,152 for patients with HAE.
- Patients with HAE vs angioedema had higher mean costs per visit ($3,598 vs $1,893) in bivariable (beta [95% CI]: 4.72 [2.97-7.49]) and multivariable linear regression models adjusted for age, sex, and insurance payer (6.06 [3.79-9.68], P<0.0001).

Limitations

- Data were unavailable to examine HAE severity, phenotypes, imaging findings, follow-up outpatient care, and treatment patterns.
- HAE is a difficult diagnosis, particularly in the ED setting. Our findings may underestimate the prevalence of ED visits among HAE patients.

Conclusions

- HAE is associated with a substantial healthcare and financial burden of ED utilization, with high rates of unnecessary abdominal imaging.
- Collaboration between emergency physicians, allergists, and radiologists may improve management of acute HAE episodes and promote radiology stewardship.

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