Incidence and Associated Factors of Missed Diagnosis of Ischemic Posterior Circulation Stroke in the Emergency Department of a Community Hospital in 2018-2019 – A Retrospective Review

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Introduction

Diagnosis of posterior circulation strokes (PCS) are notorious for being misdiagnosed or delayed as compared to anterior circulation strokes (ACS).[1-2]

Previous studies have shown:

- 28 – 59.6% of PCS are initially misdiagnosed in the emergency department (ED),[1-6] and
- 1.7 – 2.3 times more likely than ACS to be missed or delayed.[1-2]

Factors associated with misdiagnosis of PCS include:

- younger age[5, 7]
- absence of neurological deficits or presence of nonspecific symptoms such as dizziness[1-3, 8-10, 29]
- lower National Institutes of Health Stroke Scale (NIHSS) score[11-15]
- low sensitivity of computed tomography (CT) for acute ischemic stroke,[8, 16-19] and
- increased false negatives when magnetic resonance imaging (MRI) was conducted within the first 48 hours of stroke onset.[19-22]

Misdiagnosis may cause significant delays in treatment of PCS which is highly time dependent. Earlier treatment with intravenous alteplase (tPA) for acute ischemic stroke may decrease odds of mortality and disability irrespective of infarct localization if administered within 4.5 hours after stroke.[23-28]

Aims

The aims of the present study were to determine:

(i) the incidence of missed diagnosis of PCS in the ED,

(ii) the clinical factors associated with PCS missed diagnosis in the ED and

(iii) discharge outcomes of missed diagnosis in patients with PCS

Methods

- A retrospective cohort study was performed on all patients with an MRI or CT-verified PCS lesion admitted to a 400-bed community hospital in Michigan, USA, during January 1, 2018 to December 31, 2019.
- All patients from the hospital's stroke registry with ICD-10 billing codes I63.x were included.
- Charts were then reviewed to identify patients with PCS lesion diagnosed on CT or MRI as determined by the neuroradiologist.
- Patients with MRI or CT-verified PCS stroke were divided into two groups:

1. those who were not diagnosed with PCS stroke in the ED were considered "missed", and

2. those correctly diagnosed with PCS stroke prior to leaving the ED were considered "diagnosed".

- Exclusion criteria: Patients who are ≤ 6 years old, diagnosed with transient ischemic attack (TIA), hemorrhagic strokes or ischemic ACS.
- Variables: Demographic data, vascular risk factors, clinical signs and symptoms, ED course including time from symptom onset to arrival in the ED (onset-to-door), time to PCS diagnosis (door-to-diagnosis), time to admission of the patient to the hospital (door-to-disposition), stroke severity upon presentation (as measured by the NIHSS score), severity of disability (modified Rankin score or mRS), length of stay and 30-day in-hospital mortality were compared between groups (Table 1-3).
- The cumulative incidence was calculated using descriptive statistics. Factors associated with missed diagnoses were tested for significance (p <0.05) using Chi square analysis and the Odds Ratio for each factor calculated.

Results

Total N=166
Missed Diagnosis: n = 75
Diagnosed: n = 91

Table 1. Demographic data, vascular risk factors, clinical signs and symptoms

	Missed Diagnosis (n = 91), n (%)	Diagnosed (n = 75), n (%)	p value
Age, mean years ± SD	70.9±14.5	71.7±12.1	0.69
Sex, female	38 (41.8)	42 (56.0)	0.64
Vascular risk factors			
Hypertension	75 (82.4)	63 (84.0)	0.83
Coronary artery disease	24 (26.4)	24 (32.0)	0.49
CHF/cardiomyopathy	11 (12.1)	8 (10.7)	0.81
Diabetes mellitus	41 (45.1)	40 (53.3)	0.35
Hyperlipidemia	40 (43.9)	33 (44.0)	1.00
Tobacco use	16 (17.6)	7 (9.3)	0.18
Alcohol use	7 (7.7)	3 (4.0)	0.51
Previous CVA/TIA	20 (21.9)	23 (30.7)	0.22
Chronic kidney disease	18 (19.8)	17 (22.7)	0.70
Thromboembolism	5 (5.5)	2 (2.7)	0.46
Obesity	27 (29.7)	19 (25.3)	0.60
Obstructive sleep apnea	9 (9.9)	6 (8.0)	0.79
Illicit drug use	1 (1.1)	1 (1.3)	1.00
≤1 vascular risk factor	7 (7.7)	4 (5.3)	1.00
≥2 vascular risk factors	84 (92.3)	71 (94.7)	0.76
Clinical signs and symptoms			
Altered mental status	26 (28.6)	32 (42.7)	0.07
Syncope	9 (9.9)	6 (8.0)	0.79
Dizziness	21 (23.1)	19 (25.3)	0.86
Vertigo	11 (12.1)	8 (10.7)	0.81
Nausea and vomiting	17 (18.7)	13 (17.3)	0.84
Headache	20 (21.9)	21 (28.0)	0.47
Dysphagia	2 (2.9)	3 (4.0)	0.66
Limb ataxia	3 (3.3)	2 (2.7)	1.00
Vision loss	6 (6.6)	11 (14.7)	0.12
≥2 signs and symptoms	83 (91.2)	70 (93.3)	0.77

Table 2. ED course and length of stay

	Missed Diagnosis (n = 91), mean ± SD	Diagnosed (n = 75), mean ± SD	p value
Onset-to-door, hrs	0.8 (1.6)	1.1 (1.9)	0.36
Door-to-PCS diagnosis, hrs	48.8 (82.4)	2.8 (4.4)	<0.0001
Door-to-disposition, hrs	5.5 (10.1)	3.4 (2.6)	0.07
Length of stay, days	4.9 (3.3)	4.. (2.9)	0.08

Table 3. NIHSS score, modified Rankin score, onset-to-door time, 30-day in-hospital mortality

	Missed Diagnosis (n = 91), n (%)	Diagnosed (n = 75), n (%)	OR (95% CI)	p value
NIHSS				
Mild (0-4)	68 (74.7)	61 (81.3)		
Moderate to severe (≥5)	23 (25.3)	14 (18.7)	1.5 (0.69 - 3.10)	0.31
Modified Rankin score				
Mild disability (0-2)	35 (38.5)	17 (22.7)		
Moderate to death (3-6)	55 (60.4)	58 (77.3)	0.46 (0.23 – 0.92)	0.03
Onset-to-door				
≤4.5 hours	17 (18.7)	15 (20.0)		
>4.5 hours	74 (81.3)	60 (80.0)	1.01 (0.50 – 2.36)	0.83
30-day in-hospital mortality	4 (4.4)	5 (6.7)	0.64 (0.17 – 2.50)	0.73

Discussion

- Despite being designated as a Stroke Center of Excellence and certified stroke center, almost 55% of acute PCS were missed in our community ED within a 2-year period.
- In this study, patients who present with nonspecific symptoms such as altered mental status, dizziness, nausea and vomiting were 4.6 times more predictive of a missed diagnosis of PCS. The missed diagnosis group also tend to have a low mRS score of 0-2. Vague symptoms may decrease the suspicion for PCS and hamper recognition heuristics of the ED clinician, causing delay in diagnosis.
- Previous studies showed that younger age and lower NIHSS score are also factors associated with misdiagnosis of PCS. These factors were not significant predictors in this study.
- There was significant delay, about 49 hours, before patients who initially have a missed diagnosis of PCS in the ED were eventually diagnosed via a CTA or MRI, as opposed to <3 hours door-to-diagnosis time for the group diagnosed with PCS in the ED. Studies have shown that delay in diagnosis of PCS can cause worsen mortality and functional outcomes; however, there was no significant difference in 30-day in-hospital mortality between the missed and diagnosed groups in this study.
- Four out of 5 patients in both groups arrived outside the ≥4.5 hour AHA/ASA recommended r-tPA intervention window.[30] This could lend to an opportunity to increase community and pre-hospital awareness of PCS signs and symptoms.
- Patients with missed diagnosis of PCS also tend to have longer door-to-ED disposition by about 2 hours and have 0.5 hour longer admissions, although, only approaching significance (p = 0.07 and 0.08, respectively). This could translate to higher cost of care for the patient and the hospital.
- Limitations: This was a retrospective study that relied on medical charts for its data. To the extent that data was incomplete or inaccurate may alter the comparative rates. The study was large enough to observe significant differences in outcomes; however, some subgroup comparisons may have been underpowered for the factor analysis. Larger studies are needed to confirm these findings.

Conclusion

Almost 55% of patients with MRI or CT-verified PCS lesion were missed in our community ED. PCS were 4.6 times more likely to be missed if patients present with nonspecific symptoms. Moreover, diagnosis of PCS via imaging tends to be delayed by an average of 48.8 ± 82.4 hours in patients who present with absent to mild disabling symptoms. Further studies could help identify ways to improve our institution's quality and timely care of patients with PCS in the ED.

References

SCAN FOR REFERENCES