International Journal of Neurology Sciences

ISSN Print: 2664-6161
ISSN Online: 2664-617X
IJNS 2024; 6(1): 37-45
www.neurologyjournal.in
Received: 05-03-2024
Accepted: 10-04-2024

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Posterior circulation stroke: Profile and functional outcome in patients attending Tanta stroke unit

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DOI: https://doi.org/10.33545/26646161.2024.v6.i1a.24

Abstract
Background: Posterior circulation stroke (PCS) carries the worst prognosis among other stroke subtypes, with severe disability and death. Posterior circulation ischemic stroke (PCIS) represents 20% of total ischemic strokes and is liable for delayed or misdiagnosis. The objective of this work was to estimate the frequency of posterior circulation ischemic stroke in Tanta University Hospitals. As well as identify functional outcomes and mortality in PCS.
Methods: This study was performed on 119 posterior ischemic patients submitted to CT brain, and MRI brain. Using the following scales: Glasgow Coma Score (GCS) and National Institute of Health Stroke Scale (NIHSS), Adam's scale of posterior circulation ischemic stroke (ASPCS).
Results: PCIS represents19.8% of all ischemic strokes in ER. The mean of NIHSS in PCIS is lower than the mean of NIHSS in ACIS. Fast negative symptoms (vertigo, ataxia, and ocular manifestations are more common in PCIS while motor weakness and language are common in ACIS. Pontine lacunar infarction was the common site in PCIS, cerebellum, midbrain, occipital lobe, and thalamus. DWI-PC-ASPECTS mean was less than the PC-ASPECTS CT brain mean. (13.45%) of our patients received IVT and none received mechanical thrombectomy. PCIS had unfavorable outcomes in 70% of studied patients, the mRS mean was (3) and 18% of them died during follow-up.
Conclusion: Posterior circulation ischemic stroke is a serious neurological emergency that can be life-threatening and has symptoms that are complicated and change over time. In determining the severity of PCIS, the PC-ASPECTS, and notably the DWI-PC-ASPECTS, are more accurate than the NIHSS. Both the prognosis and death rates were greater in PCIS than in ACIS.

Keywords: Posterior circulation ischemic stroke, adam's scale of posterior stroke, posterior circulation—alberta stroke program early CT Score, Tanta University Hospital

Introduction
Acute ischemic stroke is defined as an episode of symptomatic neurological dysfunction caused by focal brain, retinal, or spinal cord ischemia or hemorrhage with evidence of acute infarction on imaging (MR, CT, retinal photomicrographs), regardless of symptomatic duration [1].
Posterior circulation ischemic stroke (PCIS) comprises 20–25% of ischemic strokes produced by occlusion within the vertebrobasilar artery system. Posterior circulation ischemic stroke (PCIS) can exhibit a wide spectrum of clinical manifestations ranging from single cranial nerve palsy to tetraplegia, and coma [2].
The posterior circulation (PC) supplies blood to a wide range of critical tissues, including the cranial nerves, reticular activation system, ascending and descending nerve conduction bundles, and respiratory centers, all of which have complex anatomical structures [3].
Diagnosis of Posterior circulation ischemic stroke (PCIS) and transient ischemic attack (TIA) can be more thought-provoking than Anterior circulation ischemic stroke (ACIS) due to the huge area of brain tissue supplied by the PC, commonly used prehospital stroke scales and triage systems do not adequately represent signs and symptoms of Posterior circulation ischemic stroke (PCIS), atypical presentation as a problem to pre- and early intrahospital, lower knowledge for Posterior circulation ischemic stroke (PCIS) signs and symptoms, deficiencies of pre-and early intrahospital scales and tools, and the risk of false-negative neuroimaging [4].

When measuring the severity of posterior strokes, current clinal measures are less accurate than they are for anterior strokes. (NIHSS) is the stroke severity scale that is most often used. Since it excludes clinical features indicative of the posterior circulation, such as nystagmus or gait abnormalities, ACS is far more accurate than PCS in this regard [5].

Management of the posterior circulation for maximum efficiency when compared to comparable therapies for the anterior circulation, research into the posterior stroke, especially acute reperfusion therapy and neurointervention methods for secondary prevention, has received significantly less attention. The percentage of patients with Posterior circulation ischemic stroke (PCIS) among those who undergo intravenous thrombolysis (IVT) for a stroke range from 5-19%. In addition, the median duration between the start of symptoms and hospital admission is greater in Posterior circulation ischemic stroke (PCIS) patients [6].

Aim of the work: was to estimate clinical, laboratory, and radiological aspects of posterior circulation ischemic stroke and functional outcome in patients who were admitted to the Stroke Unit of the Neuropsychiatry Department, Tanta University Hospitals.

Subjects and Methods

This work was a prospective cohort longitudinal study conducted on 119 posterior ischemic stroke patients (PCIS). They attended the neurology emergency room (ER) at the Department of Neuropsychiatry and Center of Neurology and Psychiatry, Tanta University Hospital between April 2022 to 1st October 2022. Included patients were followed-up monthly visits for 3 months post-discharge. The study included also 490 patients who came to the ER with acute neurovascular symptoms which were later recognized as ACIS and used for comparison in ER evaluation and early management.

The study included all patients who came to the ER by ischemic stroke whether posterior circulation or anterior circulation during the period of the study after doing the examination, excluding stroke mimics, doing radiological investigations.

Tanta Stroke Chain (TSC) adopts the American Heart Association / American Stroke Association (AHA/ASA), 2018, 2019, and 2021 for acute ischemic stroke management [7-9].

Exclusion criteria comprised Patients with posterior circulation subarachnoid hemorrhage

Included Patients were submitted to Brain Computerized Tomography (CT), CT angiography (cranial and cervical) (CTA), and brain magnetic resonance imaging (MRI). In the patients with renal impairment, we did MRA brain and did not exclude them the patients were admitted using the following scales at admission and follow-up: including Glasgow Coma Score (GCS) National Institute of Health Stroke Scale (NIHSS), Adam's scale of posterior circulation ischemic stroke (ASPCS). DWI posterior circulation Acute Stroke Prognosis Early CT score (pcASPECTS) From 10 points, 1 or 2 points are subtracted for early ischemic changes or hypoattenuation in the left or right thalamus, cerebellum, and each occipital lobe (1 point); any part of midbrain or pons (2 points).

Adam's Scale of Posterior Stroke (ASPCS) is a diagnostic scale that can be used to evaluate posterior circulation strokes [10]. ASPCS consists of seven items, each of the seven elements on the ASPCS ranges in point value from 0 to 2 or 3. There's a maximum score of 19 points. In cases where there was some uncertainty about the intensity of a symptom or when there were many alternatives within a single item, the option with the highest score was highlighted. (Supplementary file1)

Brain MRI was performed using GE Healthcare, Milwaukee, WI, USA. The images were attained by a 1.5–Tesla closed magnet at the radiology department of Tanta University Hospital., (GE Medical Systems, Milwaukee, USA) with quadrature 8 channels head coil.

Through the use of a modified Rankin scale (mRS), the patients were monitored for three months following discharge [11].

SPSS Prism, version 20, 2013, developed by IBM, Illinois, Chicago, USA, was used for the statistical study. The mean, standard deviation, chi-square test, linear correlation coefficient, and student t-test were used to test statistical data. P-values lower than 0.05 were regarded as statistically significant.

Results

The current study included 119 acute PCIS patients which represented 19.8% of total stroke patients referred to the ER, at Tanta University Hospitals during the period of the study (914) patients.

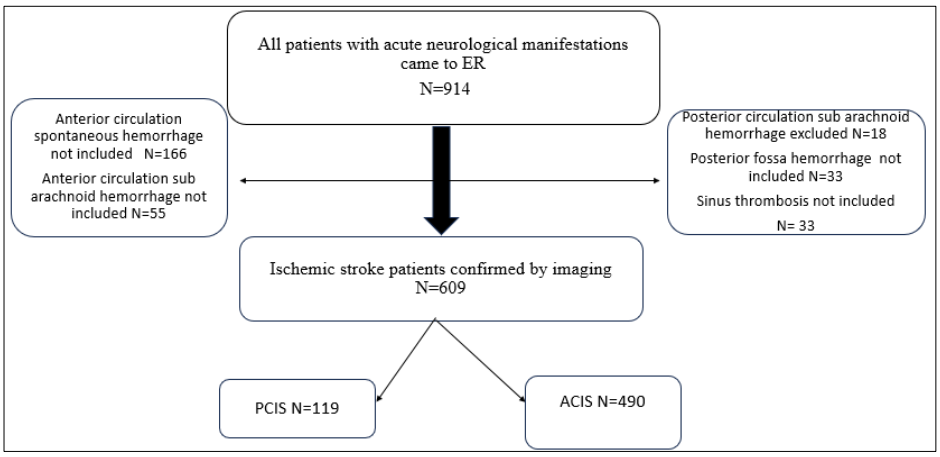


Fig 1: Flow chart showing distribution of patients came to ER with neurological symptoms

The age of the included patient was 35-86 years (63.1±10.8), with 66 (55%) males. 64 (54%) patients had DM, 67 (56%) patients had HTN, 37 (31%) patients had IHD, 22 (18%) patients were AF, 53(45%) patients were smokers, 30(25%) patients had a previous stroke, 22 (18%) patients had a history of hypercholesterolemia, 6 (5%) patients had a history of hepatic problems (5 had a history of HCV treatment and 3 old bilharziasis), 3(2.5%) patients had renal diseases (chronic kidney diseases.1 diabetic nephropathy, 2 hypertensive nephropathy), 20 (17%) patients had a history of severe COVID-19 infection that requires hospitalization or oxygenation at home in the previous year before a stroke.

The results showed that the clinical picture of PCIS patients referred to the ED as follows; 72 patients (61.02%) had limb weakness (57) patients had hemiplegia, 12 patients were quadriplegic and 3 patients had monoplegia) which represents the most common motor manifestation of PCIS followed by vertigo which was recognized in 46 patients (39%) and then ataxia in 35 patients (29.66%). The next frequent manifestations included DCL (disturbed conscious level) in 27 patients (22.88%), headache in 26 patients (22%), diplopia in 24 patients (20.34%), dysarthria in 20 patients (16.95%), crossed manifestations in 12 patients (10.17%), visual field affection in 12 patients (10.17%), and sensory affection in 12 patients (10.17%). (figure1)

All patients with vertigo had the Head-Impulse Nystagmus Test-of-Skew (HINTS) examination; only two cases of central origin were missed. AICA infarction followed by labyrinthine infarction occurred in both patients.

The findings revealed that PCIS has fast negative symptoms such as vertigo (39%), ataxia (30%), headache (22%), visual field affection (10%), and disturbed conscious level (23%), whereas ACIS has greater limb weakness (88%) and linguistic affection (65%). (Table 1)

Six PCIS patients experienced horizontal gaze palsy, according to the results, which also displayed oculomotor symptoms. Vertical gaze palsy affected three people. Four patients had a smooth pursuit. Saccadic pursuit was present in 3 patients. Three patients had a one and a half. Pretectal syndrome affected one patient, whereas intranuclear ophthalmoplegia affected another. Homonymous hemianopia affected 12 patients. Ptosis affected 4 people. 34 people experienced nystagmus. Six (36%) of the patients had main gaze, four (24%) had upbeat, four (24%) had jerk, four (24%) had abduction, four (24%) had end gaze, four (24%) had rotatory, two (12%) had pendular, and three (18%) had multidirectional nystagmus.

According to the etiology, the results showed that 60 patients (50.42%) had large artery atherosclerosis, 25 patients (21.84%) had cardioembolic disease, 22 patients (18.48%) had small artery disease, 8 patients (6.72%) had undetermined causes, 3 patients (2.52%) had other determined causes, and 3 patients (2.52%) had underdetermined causes (2 patients had arterial dissection, 1 had subclavian steal syndrome).

The results showed a significant difference in the type of ischemic stroke in the studied patients. Large artery and small artery and undetermined were more common in ACIS while cardioembolic were more common in PCIS with p-value <0.001. (Table 2)

The results showed a significant decrease in DWI-PC-ASPECTS compared to PC-ASPECTS in the detection of infarction in the initial ER evaluation with p-value <0.001. (Table 3)

The results showed the distribution of PCIS patients according to the site of the stroke in MRI viewing that the pons is the most affected site for infarction 38 (32%) then 25 (19%) of patients had cerebellum infarction, 21 (18%) had midbrain infarction, 19(16%) had occipital lobe infarction, and 18(15%) had thalamus infarction.

The results showed the distribution of occluded segments of the Vertebro-basilar system among the studied PCIS patients Using DWI. PC-ASPECTS and CTA show that the middle segment is the most occluded in 49 patients (42%) then the distal segment in 39 patients (32%) and the proximal segment in 30 patients (26%).

The results showed a significant decrease in IVT-received patients in 16 (13.45%) PCIS patients compared to 155 (31.63%) ACIS patients with p-value <0.001.

The results showed mRS follow-up during this study of PCIS patients and the number of patients who had unfavorable mRS (3-6) was 83 patients (70%) while favorable mRS represented 36 patients (30%). mRS after 1 month ranging between 1-6 (3±1.9). mRS after 2 months 1-6 (2.3±1.6). mRS after 3 months 1-5 (2.1±1.5). 21 patients died 12 patients were in 1st month (10%) and 9 patients in the second month (8%) after follow-up.

The results showed that significant increase in NIHSS in ACIS compared to PCIS. On the other hand, quantitative assessment of the consciousness level used the GCS was lower in PCIS patients compared to ACIS ones with p-value <0.001. (Table 4)

The results showed a Positive significant correlation between Age, NIHSS, and Aspcs of PCIS patients and the modified Rankin scale. Negative significant correlation between DWI-pc-ASPECTS, and GCS of PCIS patients and modified Rankin scale with p-value <0.001. (Figure 2).

Cases vignette

Case 1

Male patient, 47 years old, hypertensive, heavy smoker. He presented with acute onset of left-side weakness with speech disturbance and difficulty swallowing.

- GCS: 15. NIHSS:4. ASPCS:5
- Onset to door: 2 days after stroke
- By examination, he was conscious and dysarthric with left-side weakness grade 4 mild and rt facial palsy.
- Pc-ASPECTS:10, DWI Pc-ASPECTS:8
- CTA: vertebrobasilar dolichoectasia.
- mRS:1 after 3 months. (figure 3).

Case 2

- Female patient, 65 years old, hypertensive, diabetic. She presented with acute onset of DCL.
- GCS:9. NIHSS:11. ASPCS:8
- Onset to door: 5 hours after waking up.
- By examination, her GCS was E2 M5 V2 with NO side weakness, pupil round regular reactive, and planter unelicited bilateral.
- After 3 days of admission, the patient became conscious and oriented.
- CTA: showed bilateral thalamic infarction suspicious for the artery of Percheron infarction"
- mRS:1 after 3 months. (figure 4)

Case 3

Male patient, 57 years old, hypertensive, heavy smoker. He presented with an acute onset of unsteadiness and left-side weakness.

- GCS:15. NIHSS:3. ASPCS:2
- Onset to door: 1 day after stroke
- By examination, he was conscious and had left-side weakness grade 4.
- DWI Pc-ASPECTS:8
- CTA: stenosis in V4 segment. (figure 5)

Discussion

This study showed that PCS is prevalent in geriatrics, with no significant gender predominance **.**These results go with Kim and colleagues 2016 [12] with age being a significant risk factor because increased blood flow causes arterial wall stress, which results in intimal thickening. Over time, these compensatory reactions could deteriorate**.**

The study found that PCIS represents nearly a fifth of ischemic strokes in ER. These results were in agreement with Zurcher and colleagues 2019 [13] as a result of the fact that around 20% of the brain's blood supply passes via the PC.

The study showed that NIHSS was more in ACIS patients than PCIS patients however GCS in PCIS is more than in ACIS. The severity of PC strokes, measured by NIHSS, was less severe on admission. These results were in harmony with the work of Zurcher and colleagues in 2019 [13]**.** These discrepancies have clear underlying causes. NIHSS has an 11-point scale. Language, face, motor weakness, and neglect were solely anterior circulation functions. When it comes to posterior circulation stroke, however, the only true symptoms are visual field malfunction and limb ataxia, with some patients also experiencing face involvement and motor paralysis. Due to the motor weakness of the limb, ataxia is often left out of the test. Nystagmus, dysphagia, anisocoria, and gait are only a few of the significant aspects of posterior circulation that are not taken into account at all in this scale. This might be used to create a new scale with varying weights for NIHSS items (e.g., 4 points for tetra ataxia) and other items like oculomotor brainstem abnormalities like nystagmus. This limitation of the measurement instrument is not unique to the NIHSS; it also applies to the modified Rankin scale, which places greater emphasis on evaluating motor functions.

The study showed that Adam's scale of posterior circulation ischemic stroke (ASPCS) had great sensitivity and specificity regarding the prognosis and measuring the severity of PCIS in ER. These results follow the study of Wiśniewski and colleagues 2021 [10]. The ASPCS satisfied the requirements for daily use in stroke units, including adequate psychometric characteristics, excellent repeatability, and simple performance. Due to its predictive qualities, it may also be used to more precisely choose candidates for certain treatments. It can help with a more thorough assessment of posterior stroke.

The results were in correlation with Akhtar and colleagues 2009 [14]. Akhtar's results showed the shared symptoms and signs of PCIS were unilateral limb weakness (49.1%), dizziness (46.7%), unilateral numbness (24.8%), dysarthria (24.8%), and dysphagia (10.3%).

On the contrary, Dizziness was the most common symptom in NEMC-PCR studies accounting for 47% of Searls and colleagues 2012 [15].

PCI often causes dizziness because the vestibular nucleus is superficial in the brainstem, has a lengthy conduction channel, and is vulnerable to ischemia. PCIS dizziness is usually accompanied by cerebellar or brainstem dysfunction, however aged individuals with solitary dizziness and risk factors for cerebrovascular illnesses should be examined for posterior circulation ischemia. The brainstem reticular upward activation system maintains consciousness. If the injury affects this structure, awareness may be affected. Thus, awareness disturbance is a typical PCIS symptom.

These results were supported by the work of Zurcher and colleagues 2019 [13] who reported that Less paresis, sensory impairments, aphasia, and neglect were seen in PC patients, however, greater visual field abnormalities, cerebellar or (central) vestibular symptoms, and a lower state of awareness were present. The oculomotor brainstem symptoms were the only pathognomonic symptom for PC stroke.

The study showed that the HINTS examination when done on all patients with vertigo at the ER only misses 2 cases from the total number of central causes of vertigo. The results were supported by the work of Kattah and colleagues 2018 (16)**,** A 3-step ocular motor evaluation called HINTS may distinguish central from peripheral etiologies of acute vertigo with greater sensitivity and specificity than DW-MRI within 72 hours.

In PCIS, the results showed that the most common cause was large artery atherosclerosis represented about half of our patients followed by cardioembolic which represented 21%, and then small artery disease (18%).

The results showed significant variances in the etiology of both PCIS and ACIS. Atherosclerosis was the most common in ACIS, and PCIS, followed by cardioembolic. Surprisingly cardioembolic percentages were high in PCIS

Regarding these stroke mechanisms, these results do not follow the work of Libman and colleagues 2001 (17**)** who suggested no differences in etiology between AC and PC strokes. On the contrary, Zurcher and colleagues 2019 [13]. Observed atherosclerosis and cardioembolic strokes in the PC to occur with comparable frequency as documented in the New England Medical Center Posterior Circulation Stroke Registry, and found PC stroke to be less cardioembolic and more frequently caused by lacunas. In particular, when the first workup does not reveal a clear etiology, this may have consequences for the workup and subsequent preventative strategies. Subramanian and colleagues 2009 [18] also discovered that multivariate analysis revealed atrial fibrillation to be less common in PC strokes, whereas Hafeez and colleagues 1998 [19] observed a higher frequency of cardioembolic stroke mechanism in PC strokes in a small group of 69 patients in univariate analysis.

Anatomical variations between the posterior and anterior circulations may have affected stroke pathology and prognosis. This may be explained by the difference between anterior and posterior circulation in terms of the design and distribution of strategic perforators, which are more susceptible to ischemia processes and time delay because they lack collateral circulation. Kumar and colleagues 2015 [20].

This study showed higher sensitivity and specificity while using DWI-PC-ASPECTS in comparison to PC-ASPECTS CT brain in the initial ER in the detection of PCIS. The results were in harmony with the work of Salerno and

colleagues 2022 [21]. Who found that Non-contrast CT NCCT reliably excludes hemorrhagic stroke. Due to minor lesions and skull base-related beam hardening, it has poor PCS diagnosis sensitivity. The PC has less brain tissue, which may explain why posterior fossa lesions are less visible on CT and infarcts are less severe. Artifacts make early lesions harder to spot on PC. If stroke must be established early, MRI may be superior.

According to the current study, the pons had the highest infarction in PCIS and the middle segment of the basilar artery had the highest obstructed rate.

These findings matched those of Kim and colleagues (2016), who discovered that people with atherosclerotic lesions had a higher prevalence of mid-BA segment blockage. (38.5%) as opposed to places that are distal (15.4%) and proximal (30.8%).

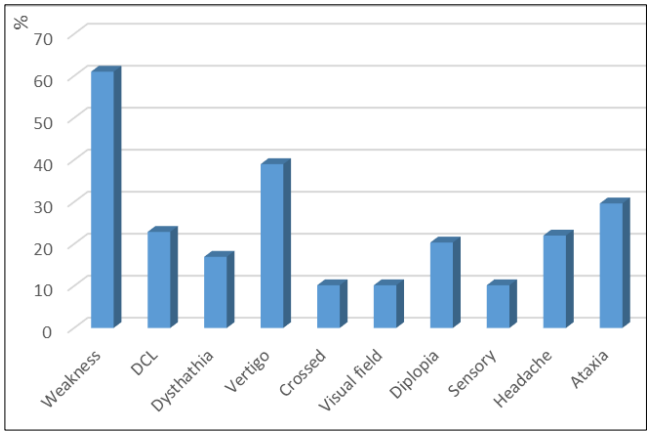
The mid-basilar segment stenosis was the most often found area linked to higher infarction rates. The increase of perforators from the mid-basilar area may be related to this. Samaniego *et al*. 2019 [22].

Furthermore, further analysis of DWI-pc-ASPECTS revealed a strong association between midbrain infarction and poor outcomes. This supported the findings of Kaneko and colleagues in 2021 [23]. This could be because the midbrain relays signals from the brainstem's reticular formation to the ascending reticular activating system, which regulates the flow of consciousness.

El Horany and colleagues 2022 [24] observed high variability in outcomes and differences between studies in pc-ASPECTS. This could be explained by the differences in how these studies analysed the pc-ASPECT either a brain CT or MRI basis. We hypothesized that correlations would be more relevant if pc-ASPECTS was evaluated using MRI, as prior work has shown that MRI is more sensitive than CT in the evaluation of posterior circulation ischemic stroke infarctions, particularly in the brainstem, and that diffusion-weighted imaging (DWI) sequences may identify early warning signs of infarction. Kaneko and colleagues, 2021 [23].

The study showed that only 13% of our patients received r-tPA while in ACIS about 31% received r-tPA. This result was in the same line as the work of Keselman and colleagues 2020 [25] found in their study that patients with PCS account for 5–19% of all stroke patients receiving IVT. Machner and colleagues 2021 [26] Described why the lower rate of getting IVT in PCIS was due to PC stroke patients taking longer to get to the hospital, even though their NIHSS was lower. However, when compared to other factors, these variations were negligible. Since NIHSS was already taken into account in the multivariate analysis, the lower IV thrombolysis rate in PC stroke patients cannot be explained by lower NIHSS or delays. Some PC strokes may have gone undiagnosed because they mask their symptoms as those of other ailments, making it more difficult to determine whether they need immediate medical attention.

Unfavorable MRS represents about 70% of our PCIS patients. The results were not in harmony with the NEMC-PCR Center study that showed 78.7% of patients with PCCI had a good prognosis. Kim 2020 [27] explained higher mortality and worse MRS in PCIS. Possible explanations for why PCIS increases disability risk relative to ACIS. ACIS patients were more likely to be older, have a higher NIHSS score at presentation, have a history of TIA, and have a history of peripheral artery disease, all of which are independently related to worse functional outcomes. Our research found no evidence that ACI patients were more likely than PCI patients to have early progression or recurrence during hospitalization, as measured by NIHSS changes between discharge and admission. Nasra and colleagues 2019 [28] explained this worrying variation may be attributable to low treatment adherence and the high cost of rehabilitation services in Egypt.



DCL: disturbed conscious level

Fig 1: Clinical picture of PCIS patients referred to the ED

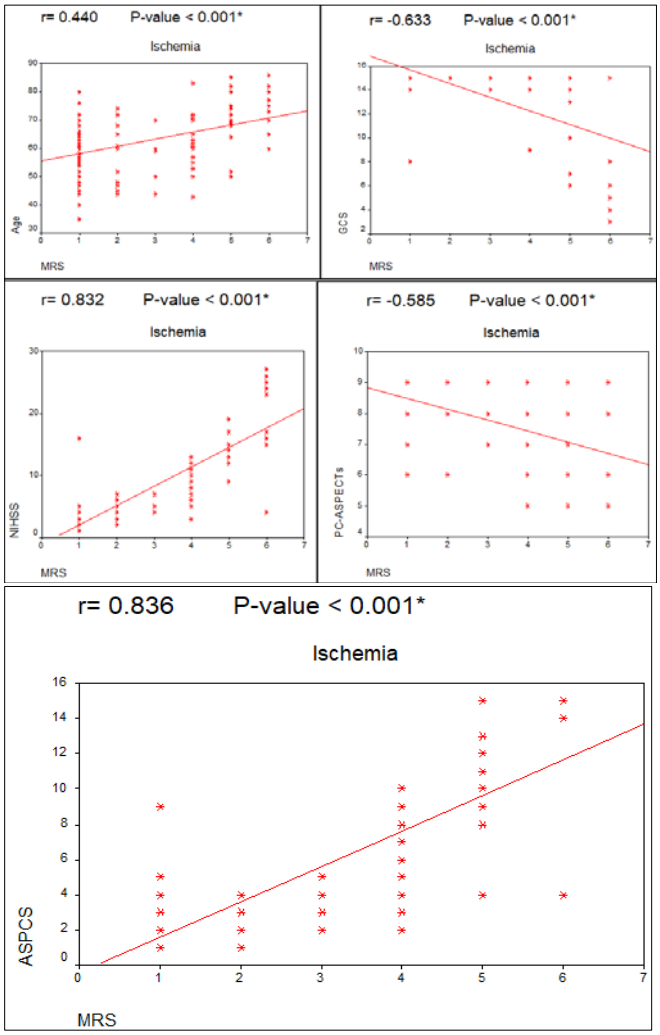


Fig 2: Positive significant correlation between the age, NIHSS, and ASPCS of PCIS patients and the modified Rankin scale. Negative significant correlation between DWI-pc-ASPECTS, and GCS of PCIS patients and modified Rankin scale.

Fig 3: Case 1

Fig 4: Case 2

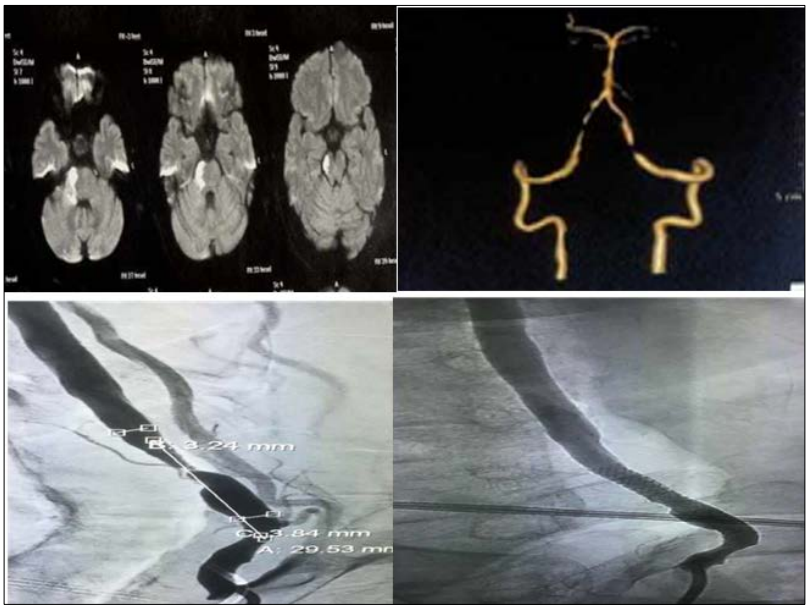


Fig 5: Case 3
Upper row left image: MRI brain DWI film shows pontine and midbrain infarction
Right image: CTA showed stenosis in v4.
Lower row Left image: vertebral artery pre stent. Right image: vertebral artery post stenting

Supplementary file 1

Adam's scale of posterior circulation ischemic stroke (ASPCS)

Item	Score
Reactivity	0. Conscious 1. Somnolence, confusion 2. stupor 3. coma
Eyes	0. normal eye movement and visual fields 1. nystagmus, double vision, hemianopia 2. eye movement disturbances 3. ophthalmoplegia, cortical blindness
Pharynx	0. normal swallowing, no dysarthria 1. mild dysarthria 2. moderate dysarthria, choking on liquids 3. anarthria, choking on solid foods, nasogastric tube
Strength	0. without motor deficit of limbs or face 1. mild motor deficit of limbs or face 2. moderate/severe motor deficit of limbs or face 3. limb paralysis
Balance	0. Romberg's attempt negative, normal gait 1. guided walk, Romberg's attempt unstable 2. walking with aids or the help of another person 3. bedridden
Ataxia	0. without ataxia 1. ataxia present in one limb 2. ataxia present in two limbs
Sensory	0. without reactive and defective sensory deficit 1. paraesthesia, facial or single limb hypoesthesia 2. hemianesthesia

Table 1: Comparison between PCIS patients and ACIS patients in initial clinical presentation

		Group				Chi-Square	
		PCIS		ACIS			
		N	%	N	%	X^2	P-value
Symptom	Weakness	72	61.02	431	87.96	48.316	<0.001*
	DCL	27	22.88	49	10.00	14.427	<0.001*
	Dysthathia	20	16.95	91	18.57	0.168	0.682
	Vertigo	46	38.98	25	5.10	105.843	<0.001*
	Crossed	12	10.17	0	0.00	50.834	<0.001*
	Visual field	12	10.17	0	0.00	50.834	<0.001*
	Diplopia	24	20.34	33	6.73	88.966	<0.001*
	Sensory	12	10.17	71	14.49	1.506	0.220
	Headache	26	22.03	28	5.71	31.297	<0.001*
	Ataxia	35	29.66	0	0.00	154.217	<0.001*
	Language	0	0.00	319	65.10	161.615	<0.001*

*: Significant. DCL: disturbed conscious level

Table 2: Comparison between PCIS patients and ACIS patients in etiology according to TOAST classification

		Group				Chi-Square	
		PCI		ACI			
		N	%	N	%	X^2	P-value
TOAST	LargeAartery	60	50.85	264	53.88	128.444	<0.001*
	Cardioembolic	25	21.19	84	17.14	31.936	<0.001*
	Small artery	22	18.64	105	21.43	54.244	<0.001*
	Un determined	8	6.78	30	6.12	12.737	<0.001*
	Under determined	3	2.54	7	1.43	1.600	0.206

*: Significant. TOAST: Trial of Org 10172 in Acute Stroke Treatment.

Table 3: Comparison of initial positive findings in PC-ASPECTS and DWI-PC-ASPECTS of studied PCIS patients

	T-Test							
	DWI PC-ASPECTs			PC ASPECTs CT			T	P-value
Range	5	-	9	7	-	10	-16.446	<0.001*
Mean ±SD	7.805	±	1.149	9.771	±	0.605		

*: Significant, The posterior circulation—Alberta Stroke Program Early CT Score (pc-ASPECT)

Table 4: Comparison between PCIS patients and ACIS patients in GCS, NIHSS.

		PCI			ACI			P-value
GCS	Range	3	-	15	3	-	15	<0.001*
	Mean ±SD	13.415	±	3.390	13.898	±	1.680	
NIHSS	Range	1	-	27	2	-	42	<0.001*
	Mean ±SD	8.110	±	7.061	12.876	±	8.413	

*: Significant. GCS: Glasgow coma scale. NIHSS: National Institute of Health Stroke Scale.

Conclusion

Posterior circulation stroke is potentially fatal with complicated and variable symptoms. Due to its numerous anatomical forms and non-focal symptoms, Posterior circulation stroke diagnosis is difficult. Quantitative methods, such as the NIHSS, may not be enough on their own. NIHSS underestimates posterior circulation stroke severity, hence dizziness, vertigo, and ataxia should be carefully considered. When comparing the PC-ASPECTS to the NIHSS, the former is preferable, particularly for detecting mild strokes. While MRI is the gold standard for imaging an acute PC infarct, it may sometimes miss a minor infarct in its early stages. In summary posterior circulation ischemic stroke is missed and underdiagnosed or delayed diagnosis due to less awareness and attention to its unusual presentation and high probability of false neuroimaging. also, even if diagnosed, stroke scales are underestimating posterior circulation stroke leads to high morbidity and mortality.

Recommendations: Enhanced ability to identify symptoms before hospital admission and during triage. Educating and raising awareness among EMS personnel about atypical stroke symptoms. All patients reporting vertigo symptoms should be required to undergo the HINTS (head impulse test, nystagmus, test of skew) diagnostic triad. to prevent underestimating PCS, employ severity measures like the ASPCS and the extended NIHSS (eNIHSS). DWI-PC-ASPECTS is an alternative to PC-ASPECTS CT for guiding the proper diagnosis and treatment of patients with PCS; however, we lacked information about the efficacy of this approach.

Limitations

This single-center research cannot account for referral pattern variations in other stroke centers in the nation. Low patient numbers may not reflect other acute stroke treatment settings. However, it indicates the necessity to add factors to the stroke scale or use a new scale for posterior circulation stroke. We only monitored patients for 3 months, therefore longer-term follow-ups are needed to further understand PCS. No patients in our study had mechanical thrombectomy.

List of Abbreviations

ACIS: Anterior circulation ischemic stroke. ASPCS: Adam's scale of posterior circulation ischemic stroke. AHA/ASA: American Heart Association / American Stroke Association. BA: Basilar artery. (CT): Computerized Tomography. COVID-19: Coronavirus disease of 2019. CTA: Computerized Tomography angiography. DM: diabetes mellitius. DCL: disturbed conscious level. DWI-PC-ASPECTS: diffusion weighted imaging posterior circulation—Alberta Stroke Program Early CT Score. EMS: Emergency Medical Services. GCS: Glasgow Coma Score. HINTS (Head-Impulse Nystagmus Test-of-Skew). HIT: Head impulse test. HTN: hypertension. IHD: ischemic heart diseases. IVT: intra venous thrombolysis. MRI: magnetic resonance imaging. mRS: modified Rankin scale. NIHSS: National Institute of Health Stroke Scale. PCIS: Posterior circulation ischemic stroke. PCS: Posterior circulation stroke. TSC: Tanta Stroke Chain. TIA: transient ischemic attack.

Cover letter

- The manuscript is an original article meeting the aim and scope of the journal.
- Absence of duplicate submission: All authors and the corresponding one reveal that the content of the manuscript has not been published or submitted for publication elsewhere.
- All authors have read and approved the manuscript.

Declarations

(a) Ethics approval and consent to participate section

- The manuscript was approved from The Research Ethics Committee and Quality Assurance Unit, Faculty of Medicine, Tanta University.
- The URL: http://tqac.tanta.edu.eg/new-tqac/
- QualityAssuranceUnit@hotmail.com
- Approval Code: 35348/3/22
- Name of the PI: Ahmed Safwat Abd El Mohsen El said
- Name of the department: Neuropsychiatry.
- Type of the research: Promotion research.
- Date of approval: March 2022.
- The study's protocol had approved by The Research Ethics Committee and Quality Assurance Unit, Faculty of Medicine, Tanta University. Participation was voluntary, informed consents were approved by all participants and any possible risks were clarified.

a. **Consent of publication:** Not applicable.
b. **Competing interests:** All authors disclose that they have no competing interests related to the study.
c. Availability of data and materials: The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.
d. **Funding:** No funding had been received.

e. Authors Contributions

ASE: participated in the study's design, patients' selection, statistical analysis, data analysis, references collection, manuscript writing, AAB: participated in the study's idea , design, patients' selection, neurological examination, statistical analysis, data analysis ,references collection, manuscript writing, revision, and final approval, WSB: participated in study's design, patients' assessment, manuscript revision, and final approval, EAE .participated in study's idea and design, patients' assessment and inclusion, data analysis ,statistical analysis, manuscript writing, revision and final approval.

All authors state that they have read and approved the manuscript.

Acknowledgement: We would like to thank the neurology medical and para-medical staff, Tanta University Hospitals for their great help in patients' selection and evaluation.

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