International Journal of Epilepsy xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

International Journal of Epilepsy

journal homepage: http://www.journals.elsevier.com/international-journal-of-epilepsy

Research paper

A comparative study of seizures in arterial and venous stroke

R.K. Singh, S.K. Bhoi, Jayantee Kalita, Usha Kant Misra*, D. Gupta

Department of Neurology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Lucknow, India

ARTICLE INFO

Article history:
Received 28 September 2016
Accepted 11 January 2017
Available online xxx

Keywords:
Arterial stroke
CVST
Seizure
Post stroke seizure

ABSTRACT

Objective: This study was undertaken to compare the frequency, spectrum and predictors of seizures in arterial stroke and cerebral venous sinus thrombosis (CVST).
Methods: The patients having seizures following arterial stroke or CVST during 2010–2015 were included. Stroke was confirmed by computerized tomography (CT) scan, magnetic resonance imaging (MRI) and or MR Venography (MRV). The seizures were categorized into early seizures (<14 days) and late seizures (≥14 days) of arterial stroke or CVST. Neurological findings, risk factors for stroke and CVST were noted. The severity of stroke was defined by National Institute of Health Stroke Scale (NIHSS). The outcome on discharge was assessed by modified Rankin Scale (mRS) as good (0–2) or poor (>2).
Results: There were 870 patients with arterial stroke and 128 with CVST. Seizures occurred in 74 (57.8%) of CVST and 119 (13.7%) of arterial stroke. Early seizures were more common in CVST than arterial stroke (98.6% vs. 47.9%, p = 0.001) whereas late seizures were more common after arterial stroke than CVST (52.1% vs. 1.4%, p = 0.001). In the arterial stroke, seizures were predicted by carotid territory ischemic stroke (OR 3.95, 95% CI 1.51–10.32, p = 0.005) and CVST by parenchymal involvement (OR 2.61, 95% CI 1.04–6.55, p = 0.04)
Conclusion: CVST results in more frequent and early seizures whereas in arterial stroke late seizures are common. Post stroke seizures in ischemic stroke were predicted by carotid territory infarction and venous stroke by parenchymal involvement.

1. Introduction

Stroke is the most important cause of mortality and disability after coronary artery disease and cancer. The incidence of stroke is likely to increase with the increasing age of the population. Cerebrovascular disease is the most important cause of epilepsy in elderly population.[1,2] It has been estimated that 6.9–11.5% patients with stroke were at the risk of developing post stroke seizure and the incidence of seizures increased with age.[3–5] Presence of structural brain lesion, EEG abnormalities and partial seizures may have higher recurrence rate.[6] Male gender and cortical location of stroke independently predicted increased risk of seizures. In India, the stroke occurs at younger age because of high incidence of rheumatic heart disease, central nervous system (CNS) infection and high prevalence of cerebral venous sinus thrombosis (CVST). In CVST, seizures are reported in 12–46.7% patients whereas 44.3% of patients may have early seizures.[7–9] The patients with sensory motor deficit, cortical vein thrombosis, and supratentorial lesion on CT or MRI are more likely to have seizures compared to those without these features.[7,9,10] The pathophysiology of seizures in arterial and venous stroke is different. There is no study comparing frequency, spectrum and predictors of seizure in arterial and venous stroke. In the present study, we report the spectrum, predictors and prognosis of patients with seizures in arterial and venous stroke.

2. Subjects and methods

In a hospital based observational study, the patients with stroke and CVST during 2010–2015 were included. The study was approved by the Institute Ethics Committee. (PGI/BE/774)

2.1. Definitions

Stroke was defined as "rapidly developing clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 h

Abbreviations: CVST, cerebral venous sinus thrombosis; CT, computerized tomography; MRI, magnetic resonance imaging; MRV, MR venography; NIHSS, National Institute of Health Stroke Scale; mRS, modified rankin scale; CNS, central nervous system; TOAST, trial of ORG 1072 in acute stroke treatment; ICH, intracerebral hemorrhage; SE, status epilepticus; GCS, Glasgow coma scale; EEG, electroencephalography; ICP, intracranial pressure; MV, mechanical ventilation.

* Corresponding author at: Department of Neurology, Sanjay Gandhi Post Graduate Institute of Medical Sciences, Raebareily Road, Lucknow 226014, India.
E-mail address: drukmisra@rediffmail.com (U.K. Misra).

http://dx.doi.org/10.1016/j.ijep.2017.01.003
2213-6320/

or leading to death, with no apparent cause other than that of vascular origin".[11] The diagnosis of stroke was confirmed on CT/MRI scan. To have a uniform classification, Oxford classification was followed to define the arterial territory of ischemic stroke.[12] The etiological subtypes of ischemic stroke were classified according to the Trial of ORG 1072 in Acute Stroke Treatment (TOAST) criteria. The ischemic stroke was categorized into small vessel stroke, large vessel stroke, cardioembolic, stroke of undetermined source and stroke of other determined source.[13] The hemorrhagic stroke was classified as primary ICH as lobar, ganglionic (caudate, thalamic, putaminal), pontine and cerebellar. The size and intrventricular extension of hematoma were noted.[14] The patients with CVST were defined on the basis of magnetic resonance venography (MRV). The location and extent of thrombosis and number of sinuses involved were noted. Presence of parenchymal lesions and its nature (infarction, hemorrhagic infarction or hemorrhage) were noted.

2.2. Exclusion

The patients with trauma, vascular malformation, coagulopathy, malignancy and tumor bleed were excluded. The patients with past history of seizures, febrile convulsion and associated structural lesion other than arterial stroke or CVST were also excluded.

2.3. Seizure

The seizures were defined as early seizure if occurred within 14 days of stroke onset, and late seizure if occurred after 14 day. The seizures occurring before the diagnosis of stroke were defined as presenting seizure. The presenting seizure was included in early seizure for comparison between early seizure and late seizures. Early seizure witnessed by doctor or paramedical staff was documented and EEG was done. Late seizure was documented in subsequent follow up of patients. Status epilepticus (SE) was categorized into convulsive and nonconvulsive. Convulsive SE was defined as 5 min or more of continuous clinical and/or electrographic seizure or recurrent seizure without recovery of consciousness to baseline between the seizures. Nonconvulsive SE was defined as alteration of consciousness lasting for 30 min or more with epileptiform discharges in EEG with or without suppression of EEG activity by IV benzodiazepine.

2.4. Evaluation

Stroke risk factors such as diabetes, hypertension, hyperlipidemia, heart disease, obesity and hyperhomocysteinemia were noted. The patient was considered hypertensive if there was documented history of hypertension, received antihypertensive treatment or blood pressure was above 140/90 mm of Hg after 2 weeks of stroke or on follow up.[15] The patients were considered diabetic if they were on antidiabetic treatment or fasting blood sugar was $\geq$126 mg/dl or 2 h post prandial blood sugar $\geq$200 mg/dl. The underlying etiology of CVST such as pregnancy, oral contraceptive pills, factor V Leiden mutation, prothombin gene mutation, hyperhomocysteinemia, antinuclear antibody, antiphospholipid antibody and hematological causes (anemia, paroxysmal nocturnal hematuria, polycythemia, and thrombocytopenia) were noted.

Consciousness was assessed by Glasgow Coma Scale (GCS). Presence of cranial nerve palsy and fundus abnormalities was noted. Focal weakness was categorized as hemiplegia, monoplegia or quadriplegia (as partial or complete weakness). Muscle tone and tendon reflex were graded as increased, normal or decreased. Coordination and sensations were also tested in the patients who could co-operate. Severity of stroke was graded using NIHSS score. Outcome on discharge was defined by modified Rankin Scale (mRS) as good ($\leq$2) or poor (>2).

2.5. Treatment

The patients were given symptomatic and supportive treatment including management of underlying cause. Seizures were treated with antiepileptic drugs and SE by 0.1 mg/kg lorazepam IV followed by sodium valproate 20 mg/kg, levetiracetam 30 mg/kg or phenytoin 10 mg/kg IV. Raised intracranial pressure (ICP) was treated by mannitol, respiratory failure by mechanical ventilation, fever by cold sponging and paracetamol. Fluid, electrolyte and calories were administered by nasogastric and/or intravenous route. The patients with arterial stroke received management of the risk factors. The patients with CVST were treated with low molecular weight heparin (LMWH) or unfractionated heparin (UFH) for 14 days followed by oral anticoagulant to maintain INR of 2–2.5.

3. Results

Our results are based on 128 patients with CVST and 870 patients with arterial stroke which were admitted during 2010–2015. Seizures were present in 74 (57.8%) patients with CVST and 119 (13.7%) with arterial stroke. In the patients with arterial stroke, 29 patients had ICH; 18 (62.1%) of them had early and 11(37.9%) had late seizures. The hematomas were lobar in 18 and ganglionic/thalamic in 19 patients. In ischemic arterial stroke, 51 (56.7%) patients had late seizure and 39 (43.3%) had early seizure, and status epilepticus was present in 24 (26.7%). Status epilepticus was present in both CVST (24.3%) and arterial (25.2%) stroke. Secondary generalized seizures were more common in arterial stroke (90.8%) than CVST (81.1%) ($p = 0.05$). Early seizures were also more common in CVST (98.6%) compared to arterial (47.9% $p = 0.001$), whereas late seizures were more common in arterial (52.1%) compared to CVST (1.4%; $p = 0.001$). Presenting seizures resulted in SE more commonly in arterial (19.3%) than CVST (16.2%).

Table 1
Comparison of demographic and clinical parameters in arterial stroke and cerebral venous sinus thrombosis (CVST) with seizure.

Parameters	CVST, n = 74 (%)	Arterial, n = 119 (%)	P value
Age (in years)	31.9 ± 12.5	54.6 ± 16.3	<0.001
Female	34 (45.9)	39 (32.8)	0.07
Seizures-			
Early	73 (98.6)	57 (47.9)	0.001
Late	1 (1.4)	62 (52.1)	
Status epilepticus	18(24.3)	30 (25.2)	1.00
Focal deficit	48 (64.9)	106 (89.1)	0.001
Admission GCS (mean ± SD)	12.11 ± 3.50	12.28 ± 3.044	0.72
Mechanical ventilation	9 (12.2)	6 (5)	0.09
Types of lesion			
Ischemic	13 (17.6)	90 (75.6)	0.001
Hemorrhage	49 (66.2)	29 (24.4)	
3 month mRS			
Good ($\leq$2)	58 (78.4)	53 (44.5)	0.001
Poor (>2)	16 (21.6)	66 (55.5)	
Death	10 (13.5)	3 (2.5)	0.006

GCS = Glasgow Coma Scale, mRS = Modified Rankin Scale.

Please cite this article in press as: R.K. Singh, et al., A comparative study of seizures in arterial and venous stroke, Int J Epilepsy. (2017), http://dx.doi.org/10.1016/j.ijep.2017.01.003