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Central Nervous System Vasculitis in Systemic Lupus Erythematosus Patients: Clinical, Laboratory and Magnetic Resonance Imaging Features in A Tertiary Referral Centre

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ABSTRACT

Background: Cerebral vasculitis is an infrequent feature of systemic lupus erythematosus (SLE). Less than 10% of post-mortem investigations show it.

Aim of the work: This study aimed to investigate the clinically manifested central nervous system (CNS) vasculitis, in relation to the clinical, laboratory, neuroimaging characteristics, as well as disease activity in SLE patients.

Patients and methods: The medical records of SLE patients attending to the Rheumatology and Rehabilitation Department; Rheumatology and Clinical Immunology Unit, Faculty of Medicine, Cairo University were reviewed. Systemic Lupus Erythematosus Disease Activity Index (SLEDAI) was measured. Magnetic resonance imaging (MRI) findings for CNS manifesting patients were recorded.

Results: Forty-one SLE patients with CNS manifestations and 47 SLE control without CNS affection, mean age was 29.3 ± 9.3 years, 90.8% were females. Time lapse between disease onset and diagnosis of CNS vasculitis was 5.6 ± 5.2 years. Most common CNS symptoms were convulsions and headache (29.3% each). Stroke and transverse myelitis were reported in 12.2% each. Precipitating factors prior to these manifestations either none were in remission and/or stoppage of treatment. All patients showed vasculitic findings in MRI with various brain destructive lesions; 75% had ischaemic foci (most of them were antiphospholipid negative, 72.4%) and 22% had atrophic changes. There was a statistically significant relation between SLEDAI, Anti-DNA and CNS affections ($p< 0.001$, 0.012).

Conclusion: Cerebral lupus vasculitis manifests diverse clinical CNS affection where convulsion and headache were the most common presentation. SLE patients with CNS manifestations had various changes in MRI brain highly suggestive of vasculitis and were significantly related to disease activity index.

Keywords: CNS vasculitis, SLE, SLEDAI, MRI brain, Convulsion, Headache.

INTRODUCTION

Systemic lupus erythematosus (SLE) is a chronic autoimmune disease of unclear etiology, characterized by involvement of almost every organ and autoantibody production [1].

Vasculitis of cerebral vessels is a rare feature in SLE seen in less than 10% of post-mortem cases [2].

The American College of Rheumatology (ACR) recognizes 19 SLE neuropsychiatric syndromes including seizures, stroke, psychosis and subtle abnormalities of cognitive function [3]. The prevalence of APL and anti-Ro antibodies, systemic disease activity, and Caucasian ethnicity are independent predictors of neuropsychiatric damage [4].

The pathogenic hallmark may include complex interactions among intrathecal immune complexes, vascular endothelium, and other inflammatory mediators. There is variability in the reported clinical CNS symptoms, ranging from headaches to seizure [5]. Neuropsychiatric systemic lupus erythematosus (NPSLE)-related vasculitis and vasculopathy can also affect medium-sized and small vessels and consequently result in chronic microvascular ischemic changes, lacunar infarcts, brain atrophy, large infarcts, intracranial hemorrhage, microhemorrhage, or subarachnoid hemorrhage [7].

A retrospective case analysis on CNS-SLE, performed largely in the southwest of England and South Wales, found that primary neurologic presentation of SLE was not rare [8]. A similar study made a diagnosis of CNS vasculitis in 1% of SLE at Coimbra Hospital and University Center (CHUC), Portugal [9].

Magnetic resonance imaging (MRI) is becoming progressively more important in its management since it assesses the vessel lumen, vessel wall and brain parenchyma [10].

Vasculitis is strongly suggested by the enhancement and thickening of the vascular wall seen on MRI, vascular stenosis, ischemic brain lesions, and intracerebral or subarachnoid haemorrhage are further indirect imaging signs [6]. According to a European study, cerebral angiography is regarded as a diagnostic technique for cerebral vasculitis. If the affected vessels are primarily small vessels, an angiography could be normal [12].

Generally, unless primary cerebral vasculitis is detected, no brain biopsy is required. Nonetheless, a combination of imaging, clinical, and serological data typically has enough diagnostic value to be utilized to establish the diagnosis and start the appropriate immunosuppressive therapy [13].

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The aim of the present work was to investigate the clinically manifested SLE-CNS vasculitis, to record the clinical data, laboratory, brain abnormalities based on MRI findings and to compare the findings (clinically and laboratory) with those in SLE patients without CNS manifestations, as well as to compare the disease activity between both groups.

PATIENTS AND METHODS

In this cross-sectional retrospective study, we recruited the medical records of all patients diagnosed with SLE (based on EULAR/ACR Classification Criteria for SLE) [14], and CNS Vasculitis following up at Rheumatology and Rehabilitation Department, Rheumatology and Clinical Immunology Unit, Faculty of Medicine, Cairo University, from 1 January 2020 till 31 December 2023, being a tertiary referral center. They were 41 patients with SLE-CNS. The data of other 47 SLE patients, age- and sex-matched, without neither neurological nor vasculitis manifestations, were recruited as controls.

Cases were identified from three main sources: Neurology, radiology and rheumatology specialist consultants. CNS manifestations were reported from patients' medical records based on ACR Nomenclature for the 19 neuropsychiatric syndromes seen in SLE: Headache, psychosis, seizures, transient ischemic attacks, stroke, transverse myelitis, cognitive dysfunction, chorea, cranial neuropathy and peripheral neuropathy. Such manifestations were reported based on neurological and psychiatric evaluation when required and based on ACR nomenclature to define major NP manifestations [3].

Demographic data, clinical manifestations, routine laboratory investigations, immunological profile, results of brain MRIs were reported. They were used to evaluate SLE patients exhibiting CNS symptoms, the disease duration and the prior therapies (corticosteroids and immunomodulatory medications). Disease activity was reported from medical records at time of CNS manifestations of each patient by using SLE disease activity index (SLEDAI) [15].

Both groups were compared regarding clinical, laboratory, medical treatment, and disease activity.

Ethical consent: The research protocol was approved by The Local Ethics Committee of Cairo University and conforms to the provisions of the Helsinki Declaration from.

Statistical analysis

The collected data were tabulated, coded, and analyzed using STATISTICA SPSS 25 software. Continuous variables were presented as mean values ± standard deviation (SD) and categorical variables were presented as percentages. Differences were considered significant at $p \leq 0.05$.

RESULTS

Forty-one patients with SLE and suggestive of CNS vasculitis were recruited in this study. Other 47 SLE patients, age- and sex-matched, without neither neurological nor vasculitis manifestations, were added as controls. Mean age of all patients was 29.3 ± 9.3 years. The majority of the CNS patients were females: 36 (87.8%) and 5 males (12.2%). Table (1) showed the demographic data features of all patients in both groups were shown in. The time lapse between disease onset and diagnosis of vasculitis was 5.6 ± 5.2 years.

The comparison between the patients with and without CNS vasculitis in the current study regarding multivariate analysis of factors affecting CNS vasculitis, laboratory investigations, immunological profile and medications, showed significant difference regarding disease activity (SLEDAI) ($p <$ **0.001**). SLE without CNS patients, compared to SLE-CNS vasculitis group, showed significant difference regarding Anti-DNA ($p=$ **0.012**).

Other vasculitic lesions were reported in 12 patients (29.26 %), such as cutaneous (purpura, skin vasculitic lesions, gangrene) and retinal vasculitis. Ten of them had antiphospholipid antibodies (APL) negative and only two were APL positive (retinal and mesenteric vasculitis). Consumed C4 showed significant difference in the SLE-without CNS group ($p< 0.001$).

Table (1): Sociodemographic, clinical data and Laboratory findings of the all SLE patients, SLE patients with CNS vasculitis and SLE patients without CNS vasculitis

Sociodemographic & clinical data Mean ± SD – n (%)	All patients (n=88)	Cases (n=41)	Controls (n=47)	p-value
Age (Years)	29.3±9.3	27.1±8.5	31.2±9.5	0.047
Sex Female	80 (90.8%)	36 (87.8%)	44 (93.6%)	0.361
Male	8 (9.2%)	5 (12.2%)	3 (6.4%)	
Age at onset (Years)	22.4±9.2	20.3± 8.412	23.9±9.6	0.052
Malar rash	45 (51.1%)	22 (53.7%)	23 (48.9%)	0.721
Photosensitivity	36 (44.4%)	14 (40%)	22 (47.8%)	0.483
Oral ulcer	36 (41.4%)	19 (46.3%)	17 (37%)	0.375
Arthritis	58 (66.7%)	24 (58.55)	34 (73.9%)	0.129
Serositis	36 (41.4%)	13 (31.7)	23 (50)	0.084
Nephritis	55 (63.2%)	25 (61)	30 (65.2%)	0.682
Psychosis	6 (6.8%)	6 (14.6)	0 (0%)	**<0.001**
Convulsions	10 (11.5%)	10 (24.4)	0 (0%)	**<0.001**
SLEDAI	14.8±11.5	22.9±9.6	7.5±6.5	**<0.001****
Anaemia	34 (39.1%)	16 (39)	18 (39.1%)	0.992
leucopenia	32 (36.8%)	15 (36.6)	17 (37.0%)	0.869
Thrombocytopenia	20 (23%)	10 (24.4%)	10 (21.7%)	0.796
Consumed C3	36 (41.4%)	19 (46.3)	17 (37)	0.375
Consumed C4	40 (46%)	10 (24.4)	30 (65.2)	**<.001****
ANA	88 (100)	41 (100)	47 (100)	---
Anti-DNA	56 (64.4)	32 (78)	24 (52.2)	**0.012**
APL (n=80)	24 (30)	12 (31.6)	12 (28.6%)	0.797
Anti-Ro (n=27)	8 (29.6%)	2 (15.4)	6 (42.9)	0.764
Anti-La (n=26)	3 (12%)	1 (7.7)	2 (16.7)	---

* One patient may have more than one symptom-- no value due to a small number, SLEDAI: systemic lupus erythematosus disease activity index, n: number of patients, C: Complement, ANA: antinuclear antibody

Four patients (9.8%) recorded that CNS vasculitis was the presenting symptom of their SLE disease, while 37 patients (90.2%) reported presenting symptoms rather than CNS involvement; arthritis in 23 patients (56.1%), mucocutaneous in 20 patients (48.8%) and fever in 14 patients (34.1%), while only 4 patients (9.8%) presented with nephritis.

Table (2) summarised most common clinical CNS manifestations, precipitating factors, disease activity and received treatment during CNS attacks. (Headache in our patients was not improving with analgesics and other causes of headache were excluded). About 12 patients with suggestive CNS vasculitis received throughout their disease cyclophosphamide. Most of them received it for nephritis. Regarding oral corticosteroids, dosage was variable based on their disease activity, but most of them were on 20 to 30 mg.

Table (2): Various clinical symptoms, precipitating factors and received treatment during the attack in SLE patients with CNS vasculitis

CNS symptoms	Number 41 (%)
Convulsions	12 (29.3%)
Headache	12 (29.3%)
Stroke	5 (12.2%)
Transverse myelitis	5 (12.2%)
Hallucinations	4 (9.8%)
DCL	3 (7.3%)
Cranial nerve	3 (7.3%)
Abnormal behaviour, agitation	3 (7.3%)
Vertigo	2 (4.9%)
Papilledema	2 (4.9%)
Quadriparesis	1 (2.4%)
Dysarthria,	1 (2.4%)
Aphasia	1 (2.4%)
Cognitive	1 (2.4%)
Suicidal attempts	1 (2.4%)
TIAs	1 (2.4%)
Paraplegia	1 (2.4%)
Psychosis	1 (2.4%)
Ataxia	1 (2.4%)
Amnesia	1 (2.4%)
Loss of swallowing	1 (2.4%)
Blurring of vision	1 (2.4%)
Precipitating factors (found in 16)	Total (n=16/41)
Active disease	6 (14.6%)
Stop treatment	6 (14.6%)
Chest infection	1 (2.4%)
Hematemesis	1 (2.4%)
Pregnancy	1 (2.4%)
Pregnancy & stop treatment	1 (2.4%)
Treatment received during the attack	
Steroids	35 (85.4%)
Azathioprine	15 (36.6%)
Cyclophosphamide	13 (31.7%)
Anticoagulant	8 (19.5%)
Anti-epileptic	2 (4.9%)
Plasmapheresis	1 (2.4%)

*One person may have more than one symptom, DCL: disturbed conscious level TIA: transient ischemic attacks, SSS: superior sagittal sinus, TS: transverse sinus.

APL tests were evaluated in all SLE-CNS vasculitis. Positive APL were found in 12 patients. Comparing both groups with and without APL, there were statistically insignificant differences regarding age, sex, different clinical manifestation, laboratory and autoimmune antibodies. Table (3) showed detailed demographic data features of all patients, with CNS vasculitis with negative and positive APL.

Table (3): Sociodemographic, clinical data, and laboratory findings of the CNS vasculitic patients with negative and positive APL

Sociodemographic & clinical data	Negative APL (n=29)	Positive APL (n=12)	p-value
Age	26.7±8.3	27.3±9.3	0.830
Sex Female	25 (86.2%)	11 (91.7%)	0.54
Male	4 (13.8%)	1 (8.3%)	
Age at onset	19.7±7.8	21.6±9.7	0.555
Malar rash	13 (44.8%)	9 (75%)	0.078
Photosensitivity	7 (24.1%)	7 (58.3%)	0.036
Oral ulcer	13 (44.8%)	6 (50.0%)	0.763
Arthritis	18 (62.1%)	6 (50.0%)	0.475
Serositis	9 (31.0%)	4 (33.3%)	0.886
Nephritis	17 (58.6%)	8 (66.7%)	0.631
Psychosis	5 (17.2%)	1 (8.3%)	0.463
Convulsions	6 (20.7%)	4 (33.3%)	0.391
SLEDAI	22.1±10.1	24.8±8.7	0.453
Anaemia	11 (37.9%)	5 (41.7%)	0.823
leucopenia	11 (37.9%)	4 (33.3%)	0.781
Thrombocytopenia	8 (27.6%)	2 (16.7%)	0.459
Consumed C3	12 (41.4%)	7 (58.3%)	0.322
Consumed C4	7 (24.1%)	3 (25.0%)	0.953
ANA	29 (100%)	12 (100%)	---
Anti DNA	24 (82.8%)	8 (66.7%)	0.257
Anti-RO (n=28)	2 (18.2%)	0 (0%)	-----
Anti-LA (n=26)	1 (9.1%)	0 (0%)	-----

SLEDAI: systemic lupus erythematosus disease activity index *n:* number of patients *C:* Complement, *ANA*: antinuclear antibody, *Anti ds DNA*: anti double stranded deoxyribonucleic acid, *Apl*: antiphospholipid antibodies. * p<0.05.

Standard brain MRI has been used regularly in our department to evaluate patients with SLE presenting with central nervous system symptoms.

Table (4) summarised MRI findings in all patients with SLE. Being evaluated by both radiological and neurological doctors, all 41 patients were diagnosed to have CNS vasculitis. We found various kinds of destructive brain lesions in this study.

Table (4) showed various MRI brain findings in SLE patients with CNS vasculitis (41 patients). Additionally, we compared brain MI findings in patients with SLE based on their APL status.

Our analysis demonstrated that the incidence of ischaemic foci in different brain sites [**cerebral lesions**: frontal, temporal, and parietal; **cerebellar lesions** in 4 patients; 3 patients had **basal ganglia** affection, 3 patients reported **brain stem** lesions: pontine lesion found in 1 patient and medulla oblongata vasculitic lesion in 2 patients, atrophic changes found in 9 patients (22%), attenuation SSS or TS in 4 patients (9.8%), TS thrombosis in 2 patients (4.9%) and other lesions were found to be higher in patients with SLE with negative APL than in those with positive APL patients].

Attenuation of superior sagittal sinus and transverse sinus (representing venous affection) were found in three patients with negative APL.

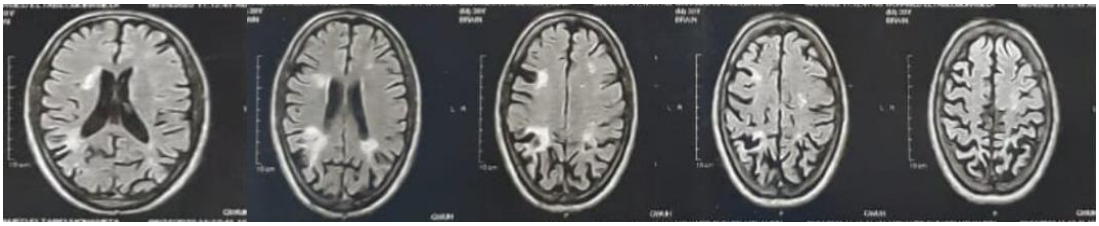
Table (4): MRI brain findings in SLE patients with CNS vasculitis (41 patients) and MRI findings on the basis of their APL status.

MRI brain findings	**Number (41)**	**Apl -ve (n=29)**	**Apl +ve (=12)**
Ischemic foci	31(75%)	21(72.4%)	10(83.3%)
Atrophic changes	9(22%)	9 (31%)	0 (0%)
Attenuation SSS or TS	4(9.8%)	3 (10.3%)	1 (8.3%)
TS thrombosis	2(4.9%)	1 (3.4%)	1 (8.3%)
Prominent ventricular system	2(4.9%)	2 (6.9%)	0 (0%)
white matter lesion	2(4.9%)	2 (6.9%)	0 (0%)
Encephalopathy	2(4.9%)	1 (3.4%)	1 (8.3%)

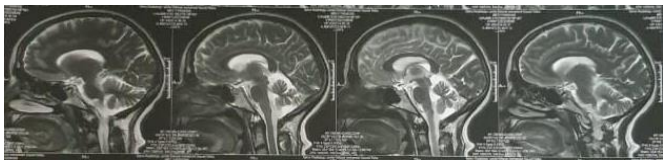
*one person may have more than one symptom,SSS: superior sagittal sinus , TS: transverse sinus; APL: antiphospholipid antibodies.

Most MRI findings in the previously mentioned various clinical manifestations were cerebral ischemic foci followed by cerebellar vasculitic changes and less frequent lesions were found in the brain stem (Figure 1).

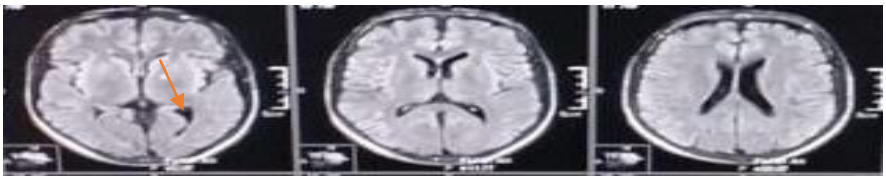
1st patient:



2nd patient:



3rd patient:



4th patient:

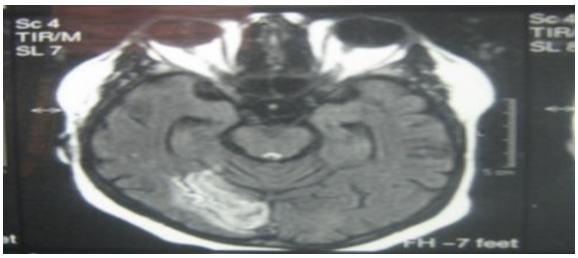


Figure (1): 1st patient: Multiple bilateral cerebral cortical and subcortical, as well as periventricular lesions are seen, showing iso to hypointense signal on T1WIs and hyperintense signal on T2WIs and FLAIR, with consequent mild widening of the related cortical sulci. 2nd patient: Cerebellar atrophy. 3rd patient: left side basal ganglia acute lacunar infarction. 4th patient: Large right occipital subcortical and white matter lesion is seen, showing hyperintense signal on FLAIR.

DISCUSSION

In this retrospective study, CNS vasculitis was reported in 41 SLE patients who were following up at our department and who met the EULAR/ACR SLE Classification criteria [14]. In one study designed on post-mortem histopathology NPSLE patients, 31% of NPSLE patients exhibited cerebral vasculitis, indicating that a significant proportion of cases may still have vasculitis as an underlying cause [16].

In the current study, primary neurologic presentation of SLE was reported in four patients (9.8%), while non-CNS SLE presenting manifestation at the onset of the disease was mostly in the form of arthritis in 56.1% patients, mucocutaneous in 48.8% followed by fever 34.1%. Only 9.8% patients presented with nephritis.

A differently designed study, **Joseph *et al.*** [8] reported that the neurologic presentation of SLE was not rare, CNS was an early manifestation in 27% and in 10% were the first CNS-SLE symptom. Seizures as an early CNS manifestation are also well described by **Toubi and his associates** [17]. In contrast, none of the patients had previously displayed evidence of NPSLE in a study conducted by **Rodrigues and his colleagues** [9] who recorded four cases with CNS vasculitis. Their SLE manifestations were mild mucocutaneous, hematological, and nephritis manifestations.

Moreover, in the current study, we assessed the most common systemic features in the SLE-CNS vasculitis (as major non-CNS features), mucocutaneous manifestations were the most frequently reported system affection followed by nephritis in 61% of the patients. Similarly, another study reported that the most common non-CNS systemic features were skin and mucosal involvement seen in 87% of patients, joint involvement 56%, pulmonary involvement 24%, renal disease 20%, and fever (15%) [8].

In order to study particularly the articular disease as a CNS vasculitis association, it was reported in 58.5% of patients (SLE-CNS vasculitis), while 73.9% in SLE control patients without CNS had joint manifestation with p=0.129. In agreement with another differently designed study which involved CNS in SLE, suggested that

articular disease may be "protective" and associated with a reduced chance of CNS involvement [18]. **Karassa *et al.*** [18] reported that compared to those without CNS involvement, patients with NP symptoms experienced far less arthralgia or acute symmetric arthritis. However, in a different study, the opposite was demonstrated: 37% of individuals with CNS lupus had prior joint involvement as have others [19]. NPSLE was significantly correlated with the existence of cutaneous vasculitic lesions, thrombocytopenia was a substantial risk factor for this involvement [19]**.** Other vasculitic lesions reported in the current work (29.26 %) were mainly cutaneous lesions and were found in 21.9 % of our participants. One of the most prevalent extracerebral symptoms of SLE patients is skin vasculitis, with neuropsychiatric lesions being an indicator of overall vascular pathology disease activity [20]**.** In the current study, SLEDAI was significantly higher in SLE-CNS vasculitic patients (22.9±9.6) with p<0.001, similar to **Kakati *et al.*** [21] who reported a significant difference between patients with NPSLE and those without NPSLE regarding SLEDAI score**.** In comparison with patients without NPSLE, those with cognitive impairment (33.6 ± 9.1) and headache (24.2 ± 5.6) had significantly higher SLEDAI scores (p = 0.001) as stated by **Zaky and coworkers** [22].

The evaluation of APL tests in our participants revealed: 31.6% and 28.6% positive tests in both CNS-SLE vasculitis compared to SLE patients without CNS respectively. Cerebral vasculitis can manifest both inflammatory and thrombotic features with complex and heterogenous findings [23]. Numerous pathogenic pathways may be involved, including thromboembolic processes, accelerated atherosclerosis, small vessel vasculopathy, white matter abnormalities caused by APLs, and ischemic and hemorrhagic events. Although it hasn't been shown, it is possible to claim that APLs contributed to the patient's endothelitis aetiology and direct neuronal injury based on earlier research [24]**.**

There were conflicting reports, **Govini and colleagues** [25] concluded that NPSLE involvement in SLE patient was strongly associated with APL. In research done by **Tantawy *et al.*** [26] APL positivity was higher in NPSLE group; however, the difference is not statistically significant. On the other hand, **Hawro *et al.*** [27] found that patients with NPSLE and those without it had similar APL characteristics**.**

Regarding blood testing and auto-immune profile, anaemia, leucopenia, and thrombocytopenia were reported in 39%, 36.6%, 24.4% respectively. **Karassa and his colleagues** [18] confirmed an early finding that revealed a significant and notably correlation between NP involvement in SLE patients and vasculitis and thrombocytopenia**.** Another study reported one patient was pancytopenic, four thrombocytopenic, 3 neutropenic, and 5 were lymphopenic [8]**.**

Complement consumption (C3 and C4) were found 46.3% and 24.4% in the current study. Consumed C4 showed significant difference in the SLE-without CNS group (p< 0.001). In contrast, **Joseph and his colleagues** [8] reported abnormally low C3 and/or C4 levels in 42% patients, but 66% of complement levels were normal during a typical neurologic disease flare-up**.** There appeared to be a considerable correlation between low blood levels of C3, and NPSLE patients. This association likely suggests a same pathogenic mechanism, such as immune complexes being locally deposited in blood vessel walls with complement activation that leads to vasculitis. Between 7 to 15% of NPSLE, postmortem patients have been found to have brain artery vascular disease [28]**.**

In the current research, all patients had positive ANA tests, while 78% patients had positive anti-DNA with no association between the blood tests and the clinical outcome. Similarly, ANA level results were available in 82.9 % of patients in another study including NPSLE [8]. Anti- DNA antibody results were positive in 72% of patients, which is characteristic of SLE as mentioned by **Hahn** [29]**. Joseph and his colleagues** [8] reported that although ANA and anti-DNA results did not appear to have any bearing on disease outcome or CNS relapse rate, an abnormal CSF was associated with a poor prognosis. In one study by **Winn *et al.*** increased dsDNA antibody titres have been suggested as useful in detecting NPSLE patients [30]**.**

The current study observed various CNS vasculitis manifestations in patients with lupus. The most commonly reported symptom was convulsion in 29.3% patients. Seizures are already known to occur in 14 to 25% of lupus patients compared to 0.5 to 1% in the general population. Similar results were reported in other studies [8].

Similar to our results which reported headache in 29.3%, previous reports have identified headache as one of NPSLE most common symptoms [25] and presenting a major clinical neurological feature (54%) in another study [8]. NPSLE patients' headache scores were significantly higher (p = 0.001) by **Zaky *et al.*** [22]**.**

According to previous research, CNS vasculitis was diagnosed by combining clinical, serological, and MRI data as done in the current study [33]. MRI is thought to be the most sensitive non-invasive imaging method modality for diagnosis of cerebral vasculitis [34]. Therefore, **Hongil *et al.*** [28] states that compared to earlier reports, the frequency of cerebral vasculitis in SLE patients may really be much greater.

The current study evaluated MRI findings as it was the only available imaging performed for our 41 participants, so the cases were expected to be small vessels vasculitis. Multiple lesions affecting different vascular systems, the most commonly reported finding

was ischaemic foci (75%) followed by atrophic changes in 22%, attenuation of SSS or TS in 9.8% patients, while TS thrombosis was reported in 4.9%. In CNS-SLE, MRI characteristics are often non-specific and change depending on the clinical pattern of CNS involvement [8]. However, **Hanly *et al.*** [35] noted that the most prevalent neuropathological finding in SLE is primary inflammatory small vessel disease with consecutive microinfarcts and microhemorrhages. MRI showed numerous lacunar infarctions with temporal localization and parenchymatous cerebral atrophy are typical CNS abnormalities with NPSLE [20].

Zaky *et al.* [22] added that 38.2% of SLE participants had brain abnormalities; 16 had NPSLE and 5 no-NPSLE. Among the anomalies in the brain, there was a noticeably greater incidence of white matter alterations in NPSLE (46% patients) ($p = 0.038$). In NPSLE patients, 16.7% of patients had ischemia, 10% had encephalopathy, and 10% suffered from hemorrhage [22]. Eighty percent of SLE patients with a long history showed abnormal brain MRIs, according to another study [36].

The most common results for small vessel disease were found previously in 2015, white matter hyperintensity in 53.7% of patients, atrophy in 18.5%, micro bleeds in 13.7% and lacunes in 11.1% [37]. According to different research, 57.1% had white matter hyperintensities, which were associated with grey matter hyperintensities in 30.8%, 23.3% had parenchymal abnormalities and atrophy as the most prevalent MRI brain abnormality in NPSLE patients (15%) [38]. **Joseph *et al.*** [8] performed MRI brain scans on 31 patients, 10 patients showed nonspecific white matter lesions, 3 patients had periventricular white matter changes, 2 patients showed subcortical lesions, 2 patients had evidence of intracranial hemorrhage, while only 1 patient had infarcts in the basal ganglia and parietal cortex. Contrarily, in other studies, individuals with NPSLE had 11%–16% lacunar infarcts [34-38].

LIMITATION

There are certain limitations in our retrospective investigation. Initially, we assessed individuals at various stages of the illness as a unified group. Second, there is no available MRI brain for the SLE control group, as it was not routinely performed as part of the clinical workup for the patients without CNS manifestations, although we did not evaluate the variation in patients' incidence of subclinical brain lesions. Lastly, in this study, cerebral angiography was not available in most of the studied CNS vasculitic cases. The brain biopsy is not done to any of our SLE-CNS patients due to its association with high risks and limitations.

Recommendations: Further larger scale studies are recommended, prospective evaluation with cerebral angiography involving SLE-CNS vasculitis with medium sized vessels, as a routine for NPSLE manifesting patient, especially for those who have a history of different system vasculitis lesions and in patients with non-classic laboratory findings of SLE (patients with absent DNA, leucocytosis and normal complement) and in patient without CNS for early detection of subclinical lesions.

CONCLUSION

The diagnosis of CNS vasculitis is uncommon and difficult. This study included a large number of SLE associated CNS vasculitis with a combination of results, such as imaging, serology, and clinical testing, which could be sufficient for diagnostic value. MRI, which has the diagnostic utility to prevent invasive procedures and treatment delays, appears to be sensitive enough to identify brain lesions associated with clinical complaints. However, we recommend not only to do MRI brain, but also to do MRA and MRV in suspicious CNS vasculitis.

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