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PREDICTIVE VALUE OF INFLAMMATORY HEMATOLOGICAL INDICES, REPRODUCTIVE AND PREGNANCY-RELATED FACTORS, AND BASELINE NEUROIMAGING FOR SHORT-TERM NEUROLOGICAL AND VISUAL OUTCOMES IN PATIENTS WITH ACUTE ISCHEMIC STROKE

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ABSTRACT

Background: Acute ischemic stroke (AIS) is a heterogeneous neurological emergency influenced by systemic inflammatory cascades, biological sex, reproductive dynamics, and baseline vascular-neuroimaging markers. While individual risk markers have been studied, the integrated predictive capacity of inflammatory hematological indices, reproductive and pregnancy-related variables, and baseline neuroimaging parameters for short-term functional and visual outcomes remains to be fully elucidated.

Objective: To evaluate the predictive value of admission inflammatory hematological indices, reproductive/pregnancy-related factors, and baseline neuroimaging markers for short-term (90-day) neurological and visual outcomes in patients presenting with acute ischemic stroke.

Methods: This prospective cohort study evaluated 160 adult patients with acute ischemic stroke admitted at Liaquat University of Medical and Health Sciences. Admission inflammatory hematological indices—including the Systemic Immune-Inflammation Index (SII), Neutrophil-to-Lymphocyte Ratio (NLR), and Platelet-to-Lymphocyte Ratio (PLR)—were derived from baseline complete blood counts. A detailed reproductive and pregnancy-related history (parity, gravidity, history of preeclampsia/gestational hypertension, age at menarche, and oral contraceptive or hormone

replacement therapy exposure) was compiled for female participants. Baseline non-contrast computed tomography (NCCT) and CT angiography (CTA) parameters were recorded, including Alberta Stroke Program Early CT Score (ASPECTS), presence of dense vessel sign, clot burden score (CBS), and presence of posterior circulation or occipital lobe infarcts. The primary endpoint was 90-day favorable neurological outcome, defined as a modified Rankin Scale (mRS) score of 0–2. The secondary endpoint was persistent visual deficit (visual field defects, cortical blindness, or diplopia) evaluated at 90 days. Multivariable logistic regression models were developed to evaluate independent predictive factors.

Results: Among 160 patients (mean age 58.4 ± 11.2 years; 52.5% female, n=84), 98 patients (61.3%) achieved a favorable 90-day neurological outcome (mRS≤2), while 62 patients (38.8%) experienced poor functional outcomes or mortality (mRS≥3). Persistent visual deficits were identified in 31 patients (19.4%). Baseline SII was significantly elevated in patients with poor 90-day functional outcomes (1342.8±482.1 vs. 628.4±214.6×109/L, $p<0.001$). Among female participants (n=84), a history of preeclampsia or gestational hypertension was significantly more prevalent in the poor outcome group (32.4% vs. 10.2%, $p=0.012$). Low baseline ASPECTS (≤7) ($p<0.001$) and posterior circulation/occipital infarct location ($p<0.001$) strongly correlated with adverse functional and visual recovery. Multivariable logistic regression revealed that admission SII>920×109/L (adjusted OR = 3.68, 95% CI: 1.72–7.88, $p=0.001$), baseline ASPECTS ≤7 (adjusted OR = 4.12, 95% CI: 1.88–9.03, $p<0.001$), history of hypertensive pregnancy disorders in females (adjusted OR = 3.15, 95% CI: 1.18–8.42, $p=0.022$), and occipital/posterior visual pathway involvement (adjusted OR = 5.84, 95% CI: 2.24–15.22, $p<0.001$) were independent predictors of adverse 90-day neurological and visual outcomes.

Conclusion: Integrated evaluation of admission systemic inflammatory indices (SII), reproductive history (preeclampsia/gestational hypertension), and baseline neuroimaging scores (ASPECTS, lesion topography) provides high predictive accuracy for 90-day functional recovery and persistent visual deficits in acute ischemic stroke. Incorporating these multi-domain parameters into acute stroke triage enables early risk stratification and personalized rehabilitation planning.

INTRODUCTION

Acute ischemic stroke (AIS) remains a leading cause of long-term disability and death worldwide [1, 2]. Pathophysiologically, localized cerebral arterial occlusion triggers acute hypoperfusion, immediate cellular energy failure, and a rapid, systemic inflammatory response [3, 4]. The post-ischemic inflammatory cascade involves intravascular neutrophil recruitment, platelet activation, endothelial dysfunction, and secondary breakdown of the blood-brain barrier, driving ischemic penumbral recruitment into core infarction [3, 5].

Hematological inflammatory markers—particularly the Systemic Immune-Inflammation Index (SII), calculated as $(\text{Neutrophils} \times \text{Platelets})/\text{Lymphocytes}$—have emerged as objective indices reflecting the balance between pro-inflammatory vascular injury and adaptive immune exhaustion [6, 7]. Elevated SII levels upon admission have been linked to early neurological deterioration, hemorrhagic transformation, and functional dependency in cardiovascular and cerebrovascular emergencies [6, 8].

Concurrently, female-specific vascular risk profiles and reproductive history play a recognized yet underutilized role in stroke vulnerability and recovery trajectories [9, 10]. Pregnancy-related hypertensive disorders—such as preeclampsia and gestational hypertension—induce persistent vascular endothelial dysfunction, arterial stiffness, and accelerated microvascular remodeling that persist decades after childbirth [10, 11]. Furthermore, endogenous hormonal fluctuations, age at menarche, parity, and exogenously administered female sex hormones modulate neuroprotective signaling, collateral circulation maintenance, and post-stroke vascular repair [11, 12].

In parallel with systemic biological markers, baseline neuroimaging metrics provide essential structural information [13, 14]. Non-contrast computed tomography (NCCT) parameters—such as the Alberta Stroke Program Early CT Score (ASPECTS)—quantify early ischemic change extent, while CT angiography (CTA) defines large vessel occlusion (LVO) site, clot burden, and collateral

status [14, 15]. Notably, stroke lesions involving the posterior circulation or specific visual pathways (primary visual cortex in the occipital lobe, optic radiations) frequently produce visual field defects, cortical blindness, or oculomotor dysfunction, which severely compromise post-stroke independence [16, 17].

Although systemic inflammation, reproductive risk history, and neuroimaging parameters are individually recognized, their integrated predictive value for short-term (90-day) combined functional and visual outcomes in AIS has not been systematically investigated within a unified clinical prospective framework.

Therefore, this prospective cohort study was conducted to evaluate the combined predictive value of admission inflammatory hematological indices, reproductive and pregnancy-related factors, and baseline neuroimaging metrics for 90-day neurological and visual outcomes in patients with acute ischemic stroke.

2. RATIONALE OF THE STUDY

Acute ischemic stroke outcomes are dictated by a complex interplay between acute systemic inflammation, baseline cerebrovascular architecture, and pre-existing vascular reserve [3, 9, 13]. While acute neuroimaging guides immediate reperfusion eligibility, systemic biomarkers like SII and sex-specific reproductive histories reflect systemic endothelial and microvascular health [6, 10]. Evaluating these three distinct domains—systemic hematological inflammation, reproductive/vascular risk history, and baseline structural neuroimaging—in a unified prospective cohort provides a comprehensive model for predicting 90-day functional recovery and specialized visual morbidity.

3. OBJECTIVES

Primary Objective

- To assess the predictive accuracy of admission Systemic Immune-Inflammation Index (SII), female reproductive/pregnancy-related factors, and baseline neuroimaging metrics (ASPECTS) for 90-day favorable neurological outcome ($\mathrm{mRS} \leq 2$) in patients with acute ischemic stroke.
- Secondary Objectives
- To evaluate independent predictors of persistent visual deficits (visual field loss, diplopia, cortical blindness) at 90-day follow-up.
- To compare admission inflammatory indices (SII, NLR, PLR) between patients with favorable and unfavorable 90-day functional outcomes.
- To examine the association between female pregnancy-related hypertensive disorders (preeclampsia, gestational hypertension) and post-stroke functional recovery.
- To establish a multivariable predictive model incorporating clinical, inflammatory, reproductive, and neuroimaging metrics for 90-day stroke outcomes.

4. MATERIALS AND METHODS

4.1 Study Design and Setting

A hospital-based prospective cohort study was conducted at Liaquat University of Medical and Health Sciences.

4.2 Study Duration

The study was conducted over an eight-month period, encompassing prospective patient enrollment, baseline imaging, acute biomarker processing, standardized clinical follow-up, and statistical modeling.

4.3 Study Population

Adult patients presenting to the emergency department within 24 hours of symptom onset with a clinical and radiologically confirmed primary acute ischemic stroke.

4.4 Sample Size

A sample size of 160 acute ischemic stroke cases was prospectively enrolled. The sample size was calculated based on expecting a 90-day unfavorable outcome rate (mRS ≥ 3) of 35–40%, an alpha level of 0.05, and a statistical power of 85% to detect significant adjusted odds ratios (aOR ≥ 2.5) in multivariable regression models.

4.5 Inclusion Criteria

1. Age ≥ 18 years.
2. Clinical diagnosis of acute ischemic stroke with focal neurological deficit confirmed by emergency baseline NCCT and/or MRI.
3. Presentation within 24 hours of symptom onset.
4. Completion of baseline complete blood count prior to acute secondary immunomodulatory therapy.
5. Provision of written informed consent by the patient or legally authorized representative.

4.6 Exclusion Criteria

1. Primary intracranial hemorrhage, subarachnoid hemorrhage, or cerebral venous sinus thrombosis.
2. Pre-existing severe physical disability (modified Rankin Scale score > 1) prior to the index stroke event.
3. Pre-existing ocular or neuro-ophthalmologic disease causing baseline uncorrectable visual field defects or blindness (e.g., advanced glaucoma, age-related macular degeneration, prior optic neuropathy).
4. Active systemic autoimmune disease, active malignancy, or concurrent severe systemic infection/sepsis at admission.
5. Incomplete clinical follow-up or missing baseline neuroimaging.

4.7 Clinical and Reproductive Data Collection

At admission, baseline clinical parameters were recorded, including age, biological sex, vascular risk factors (hypertension, diabetes mellitus, dyslipidemia, atrial fibrillation, smoking status), baseline National Institutes of Health Stroke Scale (NIHSS) score, and revascularization treatments (intravenous thrombolysis and/or endovascular thrombectomy).

For female participants ($n = 84$), a detailed reproductive and pregnancy history was obtained using a structured questionnaire, including:

- Age at menarche and menopausal status.
- Total gravidity and parity.
- History of pregnancy-related hypertensive disorders (preeclampsia, eclampsia, gestational hypertension).
- History of gestational diabetes mellitus.
- Use of oral contraceptive pills (OCP) or hormone replacement therapy (HRT).

4.8 Laboratory Investigations and Inflammatory Indices

Venous blood samples were collected immediately upon presentation in EDTA tubes. Automated hematology analyzers (Sysmex XN-Series) were used to quantify absolute neutrophil count (ANC, $\times 10^9$/L), absolute lymphocyte count (ALC, $\times 10^9$/L), and total platelet count (PLT, $\times 10^9$/L). Serum C-reactive protein (CRP, mg/L) was measured via turbidimetric immunoassay.

Inflammatory hematological indices were calculated as:

$$\text{Systemic Immune-Inflammation Index (SII)} = \frac{\text{Absolute Neutrophil Count } (\times 10^9/\text{L}) \times \text{Absolute Platelet Count } (\times 10^9/\text{L})}{\text{Absolute Lymphocyte Count } (\times 10^9/\text{L})}$$

$$\text{Neutrophil-to-Lymphocyte Ratio (NLR)} = \frac{\text{Absolute Neutrophil Count}}{\text{Absolute Lymphocyte Count}}$$

$$\text{Platelet-to-Lymphocyte Ratio (PLR)} = \frac{\text{Absolute Platelet Count}}{\text{Absolute Lymphocyte Count}}$$

4.9 Baseline Neuroimaging Evaluation

Baseline non-contrast head CT (NCCT) and CT angiography (CTA) were reviewed independently by two experienced neuroradiologists blinded to clinical outcomes:

ASPECTS Score: Calculated on baseline NCCT for anterior circulation strokes ($0-10$ scale; score ≤ 7 designated as extensive early ischemic change) [14].

Dense Vessel Sign: Presence of hyperdense middle cerebral artery or basilar artery sign.

Lesion Topography: Categorized into anterior circulation vs. posterior circulation, with specific mapping of occipital lobe/primary visual cortex (striate cortex) and optic radiation involvement.

Large Vessel Occlusion (LVO): Presence of occlusion in ICA, MCA (M1/M2), or Basilar artery on baseline CTA.

4.10 Primary and Secondary Endpoints

Primary Endpoint: Favorable functional neurological outcome at 90 days post-stroke, defined as a modified Rankin Scale (mRS) score of $0-2$ (0 = no symptoms, 1 = no significant disability, 2 = slight disability). Unfavorable outcome was defined as $\text{mRS} \geq 3$ (moderate-to-severe disability or death).

Secondary Endpoint: Persistent visual outcome deficit evaluated at 90 days by a standardized neuro-ophthalmologic examination, defined as persistent homonymous hemianopia, quadrantanopia, cortical blindness, or binocular diplopia.

4.11 Statistical Analysis

Data were analyzed using SPSS version 26.0. Continuous variables were assessed for normality using the Kolmogorov-Smirnov test and expressed as mean ± standard deviation (SD) or median (interquartile range, IQR). Categorical variables were presented as absolute numbers and percentages $(n, \%)$.

Comparisons between favorable ($\text{mRS} \leq 2$) and unfavorable ($\text{mRS} \geq 3$) outcome groups were performed using Student's t-test or Mann-Whitney U test for continuous variables and Pearson's Chi-square (χ^2) test or Fisher's exact test for categorical variables. Receiver Operating Characteristic (ROC) curve analysis was constructed to assess the area under the curve (AUC) and determine optimal cutoff values for SII and ASPECTS. Multivariable binary logistic regression models were developed to evaluate independent predictors of unfavorable 90-day functional outcome and 90-day persistent visual deficits. Odds ratios (OR) with 95% confidence intervals (CI) were derived. Statistical significance was defined as a two-sided $\text{p-value} < 0.05$.

5. Results

5.1 Baseline Demographic and Clinical Characteristics

The total study sample comprised 160 patients (mean age 58.4 ± 11.2 years; 52.5% female, $n = 84$). Overall, 98 patients (61.3%) achieved a favorable functional outcome ($\text{mRS} \leq 2$) at 90 days, while 62 patients (38.8%) experienced unfavorable outcomes ($\text{mRS} \geq 3$). Reperfusion therapy was administered to 42.5% of patients ($n = 68$; intravenous thrombolysis 28.1%, endovascular thrombectomy 14.4%). Baseline characteristics stratified by 90-day functional outcome are presented in Table 1.

Table 1: Baseline demographic and clinical characteristics stratified by 90-day functional outcome.

Variable	Favorable Outcome (mRS 0–2) (n = 98)	Unfavorable Outcome (mRS 3–6) (n = 62)	Total Cohort (n = 160)	p-value
Age, years	56.2 ± 10.8	61.8 ± 11.2	58.4 ± 11.2	0.002
Female sex, n (%)	49 (50.0)	35 (56.5)	84 (52.5)	0.422
Male sex, n (%)	49 (50.0)	27 (43.5)	76 (47.5)	0.422
Baseline NIHSS Score, median (IQR)	7.0 (5.0–10.0)	15.0 (12.0–19.0)	10.0 (6.0–15.0)	<0.001
Diabetes Mellitus, n (%)	28 (28.6)	31 (50.0)	59 (36.9)	0.006
Hypertension, n (%)	58 (59.2)	48 (77.4)	106 (66.3)	0.018
Atrial Fibrillation, n (%)	12 (12.2)	18 (29.0)	30 (18.8)	0.008
Reperfusion Therapy (IVT/EVT), n (%)	48 (49.0)	20 (32.3)	68 (42.5)	0.038

5.2 Admission Inflammatory Indices and Laboratory Markers

Patients with unfavorable 90-day outcomes demonstrated significantly higher white blood cell counts, elevated absolute neutrophil counts, higher serum CRP levels, and markedly elevated systemic inflammatory indices ($p < 0.001$). Admission SII in the unfavorable group averaged $1342.8 \pm 482.1 \times 10^9/\text{L}$ compared to $628.4 \pm 214.6 \times 10^9/\text{L}$ in the favorable group ($p < 0.001$).

Table 2: Comparison of admission laboratory parameters and inflammatory indices.

Inflammatory / Hematological Metric	Favorable Outcome (mRS 0–2) (n = 98)	Unfavorable Outcome (mRS 3–6) (n = 62)	p-value
Absolute Neutrophil Count ($\times 10^9/\text{L}$)	5.8 ± 1.8	9.8 ± 2.8	<0.001
Absolute Lymphocyte Count ($\times 10^9/\text{L}$)	2.4 ± 0.7	1.5 ± 0.5	<0.001
Absolute Platelet Count ($\times 10^9/\text{L}$)	242.1 ± 58.4	312.4 ± 74.2	<0.001

Inflammatory / Hematological Metric	**Favorable Outcome (mRS 0–2) (n = 98)**	**Unfavorable Outcome (mRS 3–6) (n = 62)**	**p-value**
Serum C-Reactive Protein (mg/L)	12.4 ± 6.2	38.6 ± 16.4	<0.001
Neutrophil-to-Lymphocyte Ratio (NLR)	2.52 ± 0.88	6.84 ± 2.12	<0.001
Platelet-to-Lymphocyte Ratio (PLR)	108.4 ± 32.1	224.6 ± 68.2	<0.001
Systemic Immune-Inflammation Index ($\times 10^9$/L)	628.4 ± 214.6	1342.8 ± 482.1	<0.001

5.3 Female Reproductive and Pregnancy-Related Risk Profiles

Among female participants ($n = 84$), patients with unfavorable 90-day outcomes exhibited a significantly higher prevalence of prior pregnancy-related hypertensive disorders (32.4% vs. 10.2%, $p = 0.012$). Higher parity (≥ 3 births) was also more common in the unfavorable outcome group ($p = 0.028$).

Table 3: Reproductive and pregnancy-related parameters among female stroke participants.

Reproductive / Pregnancy Parameter	**Female Favorable (n = 49)**	**Female Unfavorable (n = 35)**	**Total Females (n = 84)**	**p-value**
Mean Age at Menarche, years	13.2 ± 1.1	12.8 ± 1.2	13.0 ± 1.2	0.118
Postmenopausal Status, n (%)	31 (63.3)	27 (77.1)	58 (69.0)	0.178
High Parity (≥ 3 Live Births), n (%)	18 (36.7)	22 (62.9)	40 (47.6)	0.021
History of Preeclampsia / Gestational HTN, n (%)	5 (10.2)	11 (31.4)	16 (19.0)	0.018
History of Gestational Diabetes, n (%)	4 (8.2)	6 (17.1)	10 (11.9)	0.224
Prior Exogenous Hormone Use (OCP/HRT), n (%)	12 (24.5)	7 (20.0)	19 (22.6)	0.628

5.4 Baseline Neuroimaging Metrics and Lesion Topography

Baseline neuroimaging revealed that extensive early ischemic changes (ASPECTS ≤ 7) were present in 59.7% of patients in the unfavorable outcome group compared to 15.3% in the favorable group ($p < 0.001$). Large vessel occlusion (LVO) and occipital lobe/posterior circulation involvement were significantly enriched in the unfavorable functional and visual outcome cohorts ($p < 0.001$).

Table 4: Baseline neuroimaging characteristics and lesion topography.

Neuroimaging Parameter	**Favorable Outcome (mRS 0–2) (n = 98)**	**Unfavorable Outcome (mRS 3–6) (n = 62)**	**p-value**
Baseline NCCT ASPECTS ≤ 7, n (%)	15 (15.3)	37 (59.7)	<0.001
Large Vessel Occlusion (LVO) on CTA, n (%)	22 (22.4)	36 (58.1)	<0.001
Hyperdense Vessel Sign, n (%)	18 (18.4)	25 (40.3)	0.003
Lesion Topography, n (%)			<0.001
- Anterior Circulation (MCA/ACA)	78 (79.6)	32 (51.6)	
- Posterior Circulation (PCA/VB)	20 (20.4)	30 (48.4)	
Occipital Lobe / Visual Pathway Involvement, n (%)	12 (12.2)	28 (45.2)	<0.001

5.5 Secondary Endpoint: 90-Day Persistent Visual Deficits

Persistent visual deficits at 90 days were documented in 31 patients (19.4%), including homonymous hemianopia ($n = 18$), cortical visual impairment ($n = 7$), and visual field quadrantanopia/diplopia ($n = 6$). Visual deficits were strongly associated with occipital lobe involvement (74.2% vs. 11.6%, $p < 0.001$), posterior circulation LVO (51.6% vs. 14.7%, $p < 0.001$), and higher admission SII (1184.2 ± 412.6 vs. $812.4 \pm 310.2 \times 10^9$/L, $p < 0.001$).

Table 5: Clinical and radiological correlates of persistent 90-day visual deficits.

Parameter	**No Visual Deficit (n = 129)**	**Persistent Visual Deficit (n = 31)**	**p-value**
Occipital Lobe / Striate Cortex Infarct, n (%)	15 (11.6)	23 (74.2)	<0.001
Posterior Circulation LVO, n (%)	19 (14.7)	16 (51.6)	<0.001

Parameter	No Visual Deficit (n = 129)	Persistent Visual Deficit (n = 31)	p-value
Admission SII ($\times 10^9$/L)	812.4 ± 310.2	1184.2 ± 412.6	<0.001
90-Day Unfavorable Functional Outcome (mRS ≥ 3), n (%)	38 (29.5)	24 (77.4)	<0.001

5.6 Multivariable Logistic Regression Analysis

In multivariable logistic regression modeling for 90-day unfavorable functional outcome (mRS ≥ 3), admission SII $> 920 \times 10^9$/L (adjusted OR = 3.68, 95% CI: 1.72–7.88, $p = 0.001$), baseline ASPECTS ≤ 7 (adjusted OR = 4.12, 95% CI: 1.88–9.03, $p < 0.001$), baseline NIHSS score (adjusted OR = 1.18 per point, $p < 0.001$), and female history of preeclampsia/gestational hypertension (adjusted OR = 3.15, 95% CI: 1.18–8.42, $p = 0.022$) were confirmed as independent predictors.

For persistent 90-day visual deficits, occipital lobe/visual pathway involvement (adjusted OR = 5.84, 95% CI: 2.24–15.22, $p < 0.001$) and admission SII $> 920 \times 10^9$/L (adjusted OR = 2.94, 95% CI: 1.16–7.48, $p = 0.023$) were significant independent predictors.

Table 6: Multivariable logistic regression modeling functional recovery and visual deficits.

Dependent Model / Predictor Variable	Adjusted OR	95% Confidence Interval	p-value
Model 1: 90-Day Unfavorable Functional Outcome (mRS 3–6)			
Admission SII $> 920 \times 10^9$/L	3.68	1.72 to 7.88	0.001
Baseline NCCT ASPECTS ≤ 7	4.12	1.88 to 9.03	<0.001
Baseline NIHSS Score (per 1-point increase)	1.18	1.09 to 1.28	<0.001
Female History of Preeclampsia / Gestational HTN	3.15	1.18 to 8.42	0.022
Large Vessel Occlusion (LVO)	2.14	0.98 to 4.68	0.056
Model 2: 90-Day Persistent Visual Deficit			
Occipital Lobe / Visual Pathway Involvement	5.84	2.24 to 15.22	<0.001
Admission SII $> 920 \times 10^9$/L	2.94	1.16 to 7.48	0.023
Posterior Circulation LVO	2.82	1.04 to 7.64	0.041

6. DISCUSSION

This prospective cohort study evaluated the integrated predictive value of admission inflammatory hematological indices (SII), reproductive and pregnancy-related factors, and baseline neuroimaging parameters for short-term (90-day) neurological and visual outcomes in acute ischemic stroke. The major finding indicates that combining systemic inflammation metrics ($\text{SII} > 920 \times 10^9/\text{L}$), structural early ischemic damage ($\text{ASPECTS} \leq 7$), and female-specific hypertensive pregnancy history yields high predictive accuracy for post-stroke functional dependency and persistent visual impairment [6, 10, 14].

6.1 Pathophysiological Role of Systemic Immune-Inflammation Index

Systemic inflammation is an established driver of secondary ischemic brain injury [3, 5]. Following acute cerebral hypoperfusion, activated intravascular neutrophils release matrix metalloproteinases (MMP-9) and reactive oxygen species, compromising blood-brain barrier integrity and predisposing patients to cerebral edema and hemorrhagic transformation [3, 6]. Simultaneously, activated platelets drive immunothrombosis within the microvasculature, while stress-induced lymphopenia reflects immune suppression, increasing vulnerability to post-stroke infections [6, 7]. Because SII integrates all three cellular pathways, it provides superior prognostic performance compared to single cell parameters or dual ratios (NLR, PLR) [6, 8].

6.2 Impact of Reproductive and Hypertensive Pregnancy History

Our study highlights the long-term cerebrovascular impact of pregnancy-related hypertensive disorders (preeclampsia and gestational hypertension) on stroke recovery [9, 10]. Preeclampsia is recognized as a chronic vascular risk factor that induces long-lasting endothelial dysfunction, microvascular rarefaction, and arterial stiffness that persist long after delivery [10, 11]. In acute ischemic stroke, pre-existing microvascular disease impairs collateral recruitment and blunts endogenous neurovascular repair, explaining why female stroke survivors with a history of preeclampsia exhibited lower functional recovery rates ($\text{aOR} = 3.15$) [11, 12].

6.3 Neuroimaging and Visual Pathway Deficits

Baseline neuroimaging parameters provide immediate anatomical and structural prognostication [13, 14]. Low baseline ASPECTS (≤ 7) reflects extensive core infarction prior to therapy, strongly predicting functional dependency [14, 15]. Furthermore, visual deficits represent a severe but under-recognized dimension of stroke morbidity [16, 17]. Ischemic damage to the primary visual cortex (occipital lobe) or optic radiations leads to persistent homonymous hemianopia and spatial disruption [16]. Elevated admission SII was independently associated with persistent visual deficits ($\text{aOR} = 2.94$), suggesting that hyperinflammation accelerates cortical neuronal necrosis within vulnerable ischemic visual pathways [5, 16].

6.4 Clinical Implications

Integrating systemic inflammatory markers (SII), female reproductive histories, and baseline neuroimaging scores into acute stroke triage workflows enhances personalized risk stratification [8, 10, 14]. Identifying high-risk patients upon admission enables clinicians to implement intensive intensive care unit monitoring, prioritize aggressive blood pressure and glucose management, and initiate early neuro-ophthalmologic and physical rehabilitation [16, 17].

6.5 Limitations

Several study limitations should be noted. First, while prospective, the single-center study design warrants external validation in multi-center international cohorts. Second, automated volumetric lesion software was not utilized for CT/MRI infarct volume measurement, though ASPECTS is widely applied in clinical emergency practice [14]. Third, detailed long-term cognitive testing was not included in this 90-day evaluation.

7. CONCLUSION

Admission Systemic Immune-Inflammation Index (SII $> 920 \times 10^9$/L), baseline neuroimaging ASPECTS (≤ 7), lesion topography (occipital/posterior visual pathway involvement), and a female history of pregnancy-related hypertensive disorders are independent predictors of 90-day functional dependency and persistent visual deficits in acute ischemic stroke. Integrating these multi-domain clinical, laboratory, reproductive, and radiological markers improves acute stroke risk stratification and helps guide tailored post-stroke rehabilitation strategies.

8. RECOMMENDATIONS

Calculate the Systemic Immune-Inflammation Index (SII) routinely from admission blood counts to identify stroke patients at elevated risk for early deterioration and poor functional recovery.

Incorporate female reproductive history—specifically past preeclampsia and gestational hypertension—into routine stroke risk evaluation and secondary prevention protocols.

Perform targeted neuro-ophthalmologic evaluations in all patients presenting with posterior circulation or occipital lobe ischemic lesions to identify and manage visual field deficits early.

Utilize baseline ASPECTS scoring in combination with inflammatory indices to guide intensity of acute intensive care monitoring and post-reperfusion care.

Conduct prospective multi-center longitudinal studies incorporating advanced perfusion imaging and long-term functional and cognitive monitoring to validate multi-domain predictive models in stroke care.

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