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ORIGINAL RESEARCH

Predictive Value of the Neutrophil-to-Lymphocyte Ratio and C-Reactive Protein in Patients with Idiopathic Facial Nerve Palsy

Longdong Xu[1], Tingting Guo[2], Xihua Sheng[2], Huaping Du[2], Ying Tang[2]

[1]Department of Neurology, Changshu NO.5 People's Hospital, Changshu, Jiangsu, 215500, People's Republic of China; [2]Department of Neurology, Suzhou Ninth People's Hospital, Suzhou Ninth Hospital Affiliated to Soochow University, Suzhou, Jiangsu, 215200, People's Republic of China

Correspondence: Ying Tang; Huaping Du, Department of Neurology, Suzhou Ninth People's Hospital, Suzhou Ninth Hospital Affiliated to Soochow University, No. 2666, Ludang Road, Wujiang District, Suzhou, Jiangsu, 215000, People's Republic of China, Tel +86 512-82881179; +86 512-82885052, Email l5850213093@126.com; duhuaping226@126.com

Objective: This study aims to investigate the prognostic value of the neutrophil-to-lymphocyte ratio (NLR) and C-reactive protein (CRP) in patients with idiopathic facial nerve palsy.

Methods: The clinical data of patients with idiopathic facial nerve palsy were retrospectively analyzed. After three months of follow-up, patients were divided into good prognosis and poor prognosis, and the correlation between NLR, CRP and idiopathic facial nerve palsy was analyzed.

Results: Negative correlation of NLR with Portmann score in idiopathic facial nerve palsy (r=−0.788, P<0.05); In contrast to the group with poor prognosis, patients in good prognosis group had low levels of body mass index (BMI), NLR, and C-reactive protein (CRP), and high Portmann score (P<0.05); Multivariate logistic regression analysis showed Portmann score (OR=1.268, 95% CI (1.005–1.616)), NLR (OR=0.262, 95% CI (0.128–0.533)) and CRP levels (OR=0.949, 95% CI (0.895–0.989)) were risk factors of poor prognosis for patients with idiopathic facial nerve palsy. The area under the receiver operator characteristic (ROC) curve of NLR and CRP levels in predicting poor facial nerve function was 0.764 and 0.697, the specificity was 85.5% and 75.0%, and the sensitivity was 74. 0% and 76.0%, respectively. The ROC curve of the combined diagnosis was 0.829, the specificity was 80.7%, and the sensitivity was 82.0%.

Conclusion: Elevated NLR and CRP are associated with a poor prognosis of idiopathic facial nerve palsy and can serve as an indicator for clinical prognosis, and can be widely used in clinical.

Keywords: idiopathic facial nerve palsy, neutrophil-to-lymphocyte ratio, C-reactive protein, predictive value

Introduction

Idiopathic facial nerve palsy, commonly referred to as Bell palsy, represents the prevailing affliction of the seventh cranial nerve. The etiology of idiopathic facial nerve palsy remains incompletely elucidated, with prevailing theories suggesting an association with either an inflammatory response or viral infection.[1,2] Clinical manifestations of idiopathic facial nerve palsy encompass diminished functionality within the facial nerve's innervated region on one side of the face, including reduced forehead wrinkles, incomplete eyelid closure, and asymmetrical mouth corners. With appropriate medical intervention, the majority of patients exhibit a favorable prognosis which has little impact on the patient 's life. But patients, who with poor prognosis or in the early stage of the disease, has a greater impact on communication, oral motor function and psychological difficulties, so it needs to be paid effective attention.[3–5]

The House-Brackmann Facial Nerve Grading System (H-B) is the most commonly used tool for evaluating facial nerve function. Recent study revealed that the H-B grade II–IV of initial facial nerve paralysis was a significant good prognostic factor.[6] The prognostic value of imaging examination for facial palsy is controversial. A study indicated that the lesion side showed significantly higher signal intensities after contrast agent administration. However, there

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was no association between signal intensity measurements and early recovery after 3 months.[7] Electrophysiological testing offers limited support to clinician in predicting disease prognosis, typically requiring evaluation 1–2 weeks after disease onset.[8] However, the prevalence of this approach in clinical practice remains low due to constraints in the availability of primary healthcare facilities and testing personnel, thereby impeding early evaluation.[9] Therefore, it is extremely important to find indicators that can early predict patient prognosis. A recent study revealed that age, hypertension, diabetes, site of injury, blood lipid abnormalities and C-reactive protein were related to the prognosis of idiopathic facial nerve palsy.[10,11]

The neutrophil-to-lymphocyte ratio (NLR) is one of the most commonly used indicators for reflecting inflammation in clinical practice, as well as for evaluating immune diseases and predicting disease prognosis.[12] In central nervous system diseases, an elevated NLR is closely related to poor prognosis and disease recurrence in diseases such as guillain-barre syndrome and cerebral infarction.[13,14] However, the relationship between NLR and idiopathic facial nerve palsy is still controversial.[15] Therefore, this study aims to further investigate the correlation between NLR and the severity and prognosis of idiopathic facial nerve palsy, offering new insights for early prognosis prediction using NLR.

Subjects and Methods

Subjects

Patients with idiopathic facial nerve palsy were recruited from Suzhou Ninth People's Hospital from July 2022 to December 2022. Inclusion criteria were: 1) meeting the diagnostic criteria for idiopathic facial nerve palsy[16] and onset-to-treatment time within 2 days; 2) aged between 18 and 80 years old. Exclusion criteria were as follow: 1) contra-indication to glucocorticoid, such as digestive ulcers, diabetes, or refusal to accept glucocorticoid treatment; 2) history of facial nerve palsy; 3) acute infection that has not yet recovered; 4) blood system diseases, autoimmune diseases, or other diseases that may affect blood routine examination results; 5) pregnant or lactating women; 6) patients who cannot cooperate with the completion of the scale assessment. Patients included in the study completed a 3-month follow-up. All study participants or their legally authorized representatives provided written informed consent. The study involving human participants were reviewed and approved by the Ethics Committee of Suzhou Ninth People's Hospital.

Methods

Clinical Data

Demographic characteristics (age, gender, body mass index (BMI), medical history), laboratory indicators (blood routine, CRP, etc), and facial nerve palsy location were acquired. Laboratory test were completed on the day of the visit, and baseline neutrophil-to-lymphocyte ratio (NLR) was calculated.

Treatment Method

All patients received health education, glucocorticoid treatment, and, if needed, received antiviral medication along with supportive treatments like nutritional support and acupuncture.[17] The specific drug treatment plan was as follows: 1) prednisone, 30mg/qd*5 days, gradually reduced and stopped within 5 days; 2) acyclovir, 0.6g/day, taken in three divided doses, used continuously for 10 days.

Clinical Assessment and Follow-Up

Patients underwent assessments for the severity of facial nerve palsy and facial nerve function both at the initial visit and again three months after beginning the medication. Disease severity was assessed according to the House-Brackmann (H-B) grading standard:[18] Grade I represents normal function, Grade II represents mild abnormality, Grade III represents moderate abnormality, Grade IV represents moderate to severe abnormality, Grade V represents severe abnormality, and Grade VI represents complete abnormality. The Portmann score[18] includes eyebrow wrinkling, eye closure, nasal flaring, whistling, smiling, and cheek puffing, with a maximum score of 3 points for each item and 2 points for static position, for a total of 20 points. The lower the score, the more severe the condition. All patients were divided into a good prognosis group (grades I–II) and a poor prognosis group (grades III–VI) according to the H-B grading.

Statistical Methods

SPSS 22.0 was used for statistical analysis. If the measurement data met the normal distribution, they were expressed as mean ± standard deviation (SD) and compared using *t* test. If the data did not meet the normal distribution, they were expressed as median (P25, P75) and compared using the Mann–Whitney *U*-test. Categorical variables were expressed as numbers (percentages), and chi-square test was used. Spearman correlation analysis was used for bivariate analysis. Binary logistic regression analysis was used to analyze the risk factors for poor prognosis. Receiver operator characteristic (ROC) curve was used to evaluate the predictive value of risk factors, and the area under the ROC curve (AUC), cutoff value, sensitivity, and specificity were calculated. P<0.05 was considered statistically significant.

Results

Overview of Study Population Characteristics

A total of 94 patients were included in the analyses. The mean age of the study participants was (44.2±15.3) years, with 50 (53.2%) males and 15 (16.0%) patients had hypertension. There were 67 patients with left facial nerve palsy, accounting for 71.3%. The number of patients from II to VI of H-B grading were 8, 32, 38, 19, and 7, respectively. The Portmann score ranged from 3 to 13 points, with an average of 8.1±2.4 points. The mean NLR level was 3.56±1.00. Correlation analysis showed that the NLR level was negative correlated with the Portmann score, with a Spearman correlation coefficient of r=−0.788 and P=0.033.

Baseline Characteristics of Patients in Good Prognosis and Poor Prognosis Groups

According to the H-B grading standard at 3 months of follow-up, the patients were divided into good prognosis group (n=69) and poor prognosis group (n=25). Compared with the poor prognosis group, the patients in the good prognosis group had lower BMI index, H-B scores, NLR and CRP levels, and higher Portmann scores (P<0.05), as shown in Table 1.

Logistic Regression Analysis of Predictors Associated with Prognosis of Idiopathic Facial Nerve Palsy

The variables included in the multivariable regression analysis were selected based on an association with P<0.1 in the univariate analysis. Logistic regression analysis showed that Portmann score, NLR, and CRP were predictive factors for the clinical prognosis of patients with idiopathic facial nerve palsy. The higher the Portmann score, the higher the probability of good prognosis, while the higher the NLR and CRP levels, the higher the probability of poor prognosis, as shown in Table 2.

Table 1 Comparing the General Data Between the Two Groups

Characteristics	Good Prognosis Group (*n*=69)	Poor Prognosis Group (*n*=25)	$t/\chi^2/Z$	*P*
Age, y	43[34, 52.5]	40[28, 56.5]	0.617	0.537
Male, n (%)	35(50.7)	15(60.0)	0.634	0.426
Hypertension, n (%)	10(14.5)	5(20.0)	0.415	0.519
BMI (kg/m^2)	21.4±3.8	24.3±5.5	3.402	0.005
Left side, n (%)	49(71.0)	18(72.0)	0.009	0.926
Portmann score	8.4±2.3	7.2±2.4	2.246	0.027
H-B score	3.5[2, 4.5]	4[2, 5]	2.124	0.034
CRP (mg/l)	5[9, 15]	13[7, 19.5]	1.994	0.046
NLR	3.25±0.78	4.41±1.06	5.772	<0.001
Antivirus, n(%)	10 (14.5)	3 (12.0)	0.098	0.754

Notes: *t*, *t* test; χ^2, chi-square test; *Z*, Mann–Whitney *U*-test.
Abbreviations: BMI, body mass index; CRP, C-reactive protein; H-B, House-Brackmann; NLR, neutrophil-to-lymphocyte ratio.

Table 2 Logistic Regression Analysis of the Clinical Outcome of Patients with Idiopathic Facial Palsy

	β	*SE*	Wald	*P*	OR	95% CI
BMI	0.010	0.017	0.379	0.538	1.010	0.978–1.043
Portmann scores	0.228	0.233	3.841	0.045	1.268	1.005–1.616
NLR	−1.340	0.364	13.750	0.000	0.262	0.128–0.533
CRP	−0.042	0.126	2.625	0.049	0.949	0.895–0.989

Abbreviations: BMI, body mass index; NLR, neutrophil-to-lymphocyte; CRP, C-reactive protein. Ratio; SE, standard error; OR, odds ratio; CI, confidence interval.

Relationship Between Different Items of Portmann Score and Functional Prognosis

Comparison of different items in Portmann score, patients who performed well in raising eyebrows and widening nostrils have a better prognosis (P<0.05). However, there was no significant difference in the proportion of patients who performed well in closing eyes, pursing mouth, showing teeth and bulging cheeks between the two groups (P>0.05), as shown in Table 3.

Prognostic Value of NLR or CRP for 3-Month Prognosis of Idiopathic Facial Nerve Palsy

The AUC of NLR alone in predicting poor prognosis of idiopathic facial nerve palsy was 0.764, with a cutoff value of 3.75, sensitivity of 74.0%, and specificity of 85.5%. The AUC of CRP alone in predicting poor prognosis of idiopathic facial nerve palsy was 0.697, with a cutoff value of 12.5mg/l, sensitivity of 76.0%, and specificity of 75.0%. The AUC of NLR combined with CRP in predicting poor prognosis of idiopathic facial nerve palsy was 0.829, with a sensitivity of 82.0% and specificity of 80.7%, as shown in Figure 1 and Table 4.

Discussion

Idiopathic facial nerve palsy is the most common cause of peripheral facial nerve palsy in clinical practice, yet its pathogenesis remains unclear. Viral infections are still considered one of the potential mechanisms.[2,19] Studies have found that idiopathic facial nerve palsy and Guillain-Barré syndrome share common immune pathways, indicating that it is a cell-mediated autoimmune inflammatory disease.[20] Inflammatory responses caused by herpes viruses, EB viruses, or induced autoimmune reactions lead to secondary edema of the facial nerve. This swelling within the facial nerve canal can cause facial nerve palsy due to direct compression or ischemia resulting from the compression.[21] Antiviral and steroid therapy have been effective in providing evidence for the above mechanism, but antiviral therapy alone is not recommended.[17,22] In this study, all patients received glucocorticoid therapy and those with severe symptoms also received antiviral treatment. Nonetheless, the prognosis was not significantly linked to antiviral therapy. Other studies have suggested that microcirculatory disorders caused by atherosclerosis or vasculitis could also lead to idiopathic facial nerve palsy.[23]

Table 3 Relationship Between Different Item Scores and Functional Prognosis in the Portmann Scores

score>1 n (%)	Raising Eyebrows	Closing Eyes	Widening Nostrils	Pursing Mouth	Showing Teeth	Bulging Cheeks
Good prognosis (n=69)	38(56.7)	18(26.1)	41(59.4)	24(34.8)	19(27.5)	16(23.2)
Poor prognosis (n=25)	8(32.0)	8(32.0)	8(32.0)	4(16.0)	5(20.0)	2(8.0)
χ^2	4.449	0.321	5.793	3.095	0.548	2.734
P	0.035	0.571	0.016	0.079	0.459	0.140

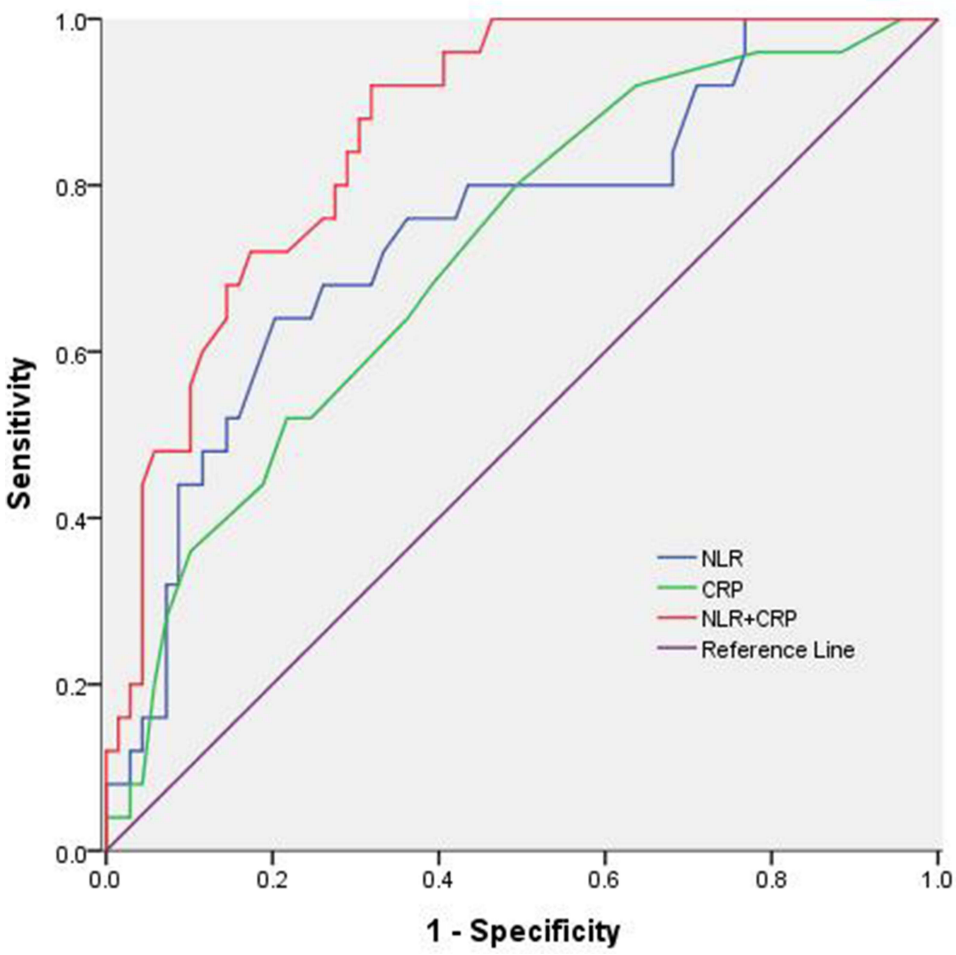

Figure 1 ROC of NLR and CRP levels on poor neurologic prognosis in patient with idiopathic facial nerve palsy.
Abbreviations: NLR, neutrophil-to-lymphocyte ratio; CRP, C-reactive protein.

Most patients gradually recover within 2–4 weeks from the onset and fully recover by approximately three months. Recovery can still occur up to one year after onset. Despite treatment, there are still some patients with sequelae like hemifacial spasm, impaired communication and dysgeusia.[24,25] Therefore, it is crucial to identify patients with poor prognosis early in the clinical diagnosis and treatment process. Studies have shown that the abnormal rate of blink reflex in patients with facial nerve palsy can reach 100%, and it can appear in the early stage of the disease, which is helpful for early prognosis of the disease. However, facial nerve compound muscle action potential (CMAP) abnormalities, such as prolonged latency and decreased wave amplitude, often exist in patients with idiopathic facial nerve palsy, but early examinations typically show no significant abnormalities. It generally appear around 2 weeks after onset, and a decrease

Table 4 Predictive Efficacy of NLR and CRP Levels on the Outcome of Idiopathic Facial Nerve Palsy

	AUC	*P*	95% *CI*
NLR	0.764	<0.001	0.643–0.884
CRP	0.697	0.004	0.590–0.850
NLR+CRP	0.829	<0.001	0.733–0.924

Abbreviations: NLR, neutrophil-to-lymphocyte ratio; CRP, C-reactive protein; AUC, area under curve; CI, confidence interval.

in CMAP wave amplitude of more than 90% can be a significant indicator of poor prognosis.[26–28] Consequently, neurophysiological examinations are commonly used to evaluate patient prognosis. However, such examinations are costly, require significant expertise, and are most effective around two weeks after onset. Therefore, their application in clinical practice, especially in primary hospitals, is limited.

CRP is an accessible clinical marker commonly used to indicate inflammation levels. It is especially suitable for use in primary hospitals. Multiple studies have shown that CRP is closely related to the prognosis of idiopathic facial nerve palsy, as well as red blood cell distribution width.[15,29] In our study, we observed higher CRP levels in patients with a poor prognosis compared to those with a good prognosis, aligning with prior research.

NLR is another marker reflecting systemic inflammation, associated with various neurological diseases. In acute inflammatory demyelinating polyneuropathy, some studies have shown that NLR is closely related to the severity of the disease and can be used as one of the early prognostic evaluation indicators.[13] Studies have shown that in patients with idiopathic facial nerve palsy, higher levels of NLR are associated with more severe facial nerve palsy symptoms and longer recovery time.[30] However, although other research shows no significant difference in NLR levels between patients with differing prognoses.[31] Therefore, the relationship between NLR and idiopathic facial nerve palsy remains controversial. This study found that NLR levels were negative correlated with Portmann scores, indicating a positive correlation between NLR and disease severity. Univariate analysis showed that patients with a good prognosis had lower NLR levels than those with a poor prognosis, while multivariate regression analysis showed that increased NLR was associated with a higher risk of poor prognosis, suggesting that NLR could be a useful clinical prognostic indicator.

Based on the patient's NLR and CRP levels, clinicians can devise individualized treatment plans. For example, patients with elevated NLR and CRP may require more aggressive treatment or more frequent follow-ups. During the course of treatment, monitoring the patient's NLR and CRP levels can help clinicians evaluate the effectiveness of treatment.

In addition, our result indicated that the higher the Portmann score in the early stages of the disease, the higher the incidence of good prognosis, which was consistent with those of previous study.[32] Further analysis showed that patients with the same Portmann score, the better the completion of the three functions of raising eyebrows and widening nostrils, the higher the incidence of good prognosis at three months. The diagnostic criteria for poor prognosis differ in different studies and the Results may be different.[33] Poor prognosis was defined as H-B >2 in our study. Patients were treated within 2 days of disease onset and the results indicated that patients in the good prognosis group had a low H-B score in initial visit. However, some patients' symptoms have gradually worsened during the first week. Therefore, the initial neurological assessment cannot fully reflect the severity of the patient's condition.

This study is a single-center study with a relatively small sample size. Patients with comorbidities such as diabetes were not included in this study, which may lead to bias in the research results. In addition, dynamic monitoring of NLR was not performed, which needs to be improved in future studies.

Conclusion

Taken together, the increasing in NLR and CRP levels was related to poor 3-month prognosis of facial nerve function and had a certain predictive value. The combination of the two had a higher predictive value.

Ethical Approval

The study was approved by the Ethical Committee of Suzhou Ninth People's Hospital (No. KY2022-001-01) and conducted in accordance with the Declaration of Helsinki.

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Disclosure

The authors declare no potential conflicts of interest in this work.

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