Observational Study

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Prognostic factors for acute posterior circulation cerebral infarction patients after endovascular mechanical thrombectomy

A retrospective study

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Abstract

This article was to analyze the factors influencing the prognosis of posterior circulation cerebral infarction (PCCI) patients, retrospectively.

One hundred forty five patients diagnosed with PCCI in Nanyang Central Hospital between June 25, 2016 and October 14, 2019 were included and underwent cerebral vascular mechanical thrombectomy. The clinical data of those patients were collected. The patients were followed up for 3 months to observe the prognostic efficacy and explore the influencing factors for poor prognosis. The potential prognostic factors for PCCI patients after emergency endovascular mechanical thrombectomy were analyzed by univariate and multivariable logistic regression. The thermodynamic diagram was drawn to explore the associations between the prognostic factors.

The risk of poor prognosis in PCCI patients receiving emergency endovascular mechanical thrombectomy was reduced by 0.552 time with every 1-point increase of the Alberta Stroke Program Early CT in posterior circulation score (odds ratio [OR] = 0.448, 95% confidence interval [CI]: 0.276–0.727). The risk of poor prognosis was increased by 0.827 time for each additional grade in the digital subtraction angiography-American Society of Intervention and Therapeutic Neuroradiology grading (OR = 1.827, 95% CI: 1.221–2.733, $P = .003$) and increased by 0.288 time for every 1-point increase in National Institutes of Health Stroke scale at 24 hours (OR = 1.288, 95% CI: 1.161–1.429). All $P < .05$.

Alberta Stroke Program Early CT in posterior circulation score, digital subtraction angiography-American Society of Intervention and Therapeutic Neuroradiology grading, National Institutes of Health Stroke scale score at 24 hours were factors affecting the prognosis of PCCI patients undergoing emergency endovascular mechanical thrombectomy, which might provide evidence for endovascular treatment of PCCI.

Abbreviations: ASPECT = Alberta Stroke Program Early CT, DSA-ASITN = digital subtraction angiography-American Society of Intervention and Therapeutic Neuroradiology, mRS = modified Rankin scale, NIHSS = National Institutes of Health Stroke scale, OR = odds ratio, PCCI = posterior circulation cerebral infarction.

Keywords: cerebral infarction, endovascular mechanical thrombectomy, posterior circulation, prognostic factors

1. Introduction

Acute cerebral infarction is an acute and severe type of ischemic stroke, which often causes brain dysfunction and seriously threatens humans' life and health.[1] Cerebral infarction can be divided into anterior circulation cerebral infarction and posterior circulation cerebral infarction (PCCI) in clinic. Different from anterior circulation cerebral infarction, PCCI occurs in the blood supply region of the vertebral basilar artery

Editor: Victor C. Kok.

This study was supported by Key project of the Medical science and technology in Henan Province. (No. 202102310079; No. 192102310349).

The authors have no conflicts of interest to disclose.

Supplemental Digital Content is available for this article.

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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How to cite this article: Gao J, Wen C, Sun J, Chen D, Zhang D, Wang N, Liu Y, Wang J, Zhang B. Prognostic factors for acute posterior circulation cerebral infarction patients after endovascular mechanical thrombectomy: a retrospective study. Medicine 2022;101:17(e29167).

Received: 11 October 2021 / Received in final form: 26 January 2022 / Accepted: 6 March 2022

http://dx.doi.org/10.1097/MD.0000000000029167

system, which has more complex anatomical structures and more frequencies in variation of posterior circulation vessels.[2–5] It is very difficult to deal with when cerebral infarction occurs in posterior circulation. PCCI represents a fifth of all acute ischemic stroke cases,[6–8] and the prognosis of it is extremely poor with the mortality of nearly 90%.[9] To improve the prognosis of patients with PCCI was necessary.

Early recanalization of occluded vessels in acute PCCI is crucial for improving the clinical outcomes.[10] Endovascular therapy is characterized by long time window and high rate of recanalization for large vessels, which is identified as an efficiency treatment for patients with acute ischemic stroke.[11,12] Endovascular therapy using mechanical thrombectomy devices is an emerging method for cerebral infarction treatment aiming at retrieving thrombis and restoring blood flow. In recent years, some new devices for mechanical thrombectomy have been developed and used in clinical researches.[13–15] Several studies have indicated that mechanical thrombectomy with stent retrievers can effectively make recanalization of the blood vessels for acute PCCI resulted from basilar artery occlusion.[13,16,17] Despite successful recanalization, PCCI patients receiving mechanical thrombectomy may suffer from the serious complications including symptomatic intracerebral hemorrhage, and the good clinical prognosis at 3 months of patients after mechanical thrombectomy were only about 30%.[18,19] This suggested that there were various factors affecting the clinical prognosis of endovascular mechanical thrombectomy treatment for PCCI patients. To identify those prognostic factors might help the clinicians to provide more timely interventions in patients who at a high risk of poor prognosis and hope to improve the outcomes of these patients.

As far as we know, little evidence exists on exploring the potential factors related to prognosis in PCCI patients receiving mechanical thrombectomy.[20] Raoult et al[21] evaluated the prognostic factors for outcomes after mechanical thrombectomy with solitaire stent in 45 acute ischemic stroke patients from France including 32 anterior circulation occlusions and 13 posterior circulation occlusions. Son et al[22] conducted a study to identify the initial factors affecting the clinical outcome in basilar artery occlusion patients receiving MR-based mechanical thrombectomy in Korea, but they did not analyze the location of the occlusion in the basilar artery. Our study was the first study investigating the prognostic factors for acute PCCI patients after endovascular mechanical thrombectomy in Chinese population. We also included the detailed location of the occlusion in the basilar artery. The findings of the current study might provide a basis for deep understanding factors associated with PCCI patients after endovascular mechanical thrombectomy and might help improve the outcomes of patients receiving endovascular treatment of PCCI in clinic.

2. Methods

2.1. Patients

In this study, the data of 192 patients with PCCI were collected from June 25, 2016 to October 14, 2019 in Nanyang Central Hospital. All patients met the following enrollment criteria: diagnosed with PCCI by computed tomography (CT) or magnetic resonance imaging (MRI) examinations. PCCI is defined as symptomatic ischemia in the vascular territory of the vertebral, basilar, or the posterior cerebral arteries.[23] ≥18 years of age; arrived at the hospital within 24 hours after the occlusion of large vessels in posterior circulation. Patients with the platelet counts $<100 \times 10^9$/L (n=5), blood glucose <2.7 mmol/L (n=7), intracranial tumor according to imaging examination (n=5), intracranial hemorrhage or subarachnoid hemorrhage confirmed by CT or MRI (n=17), gastrointestinal or urinary bleeding within the last 3 weeks (n=4), severe cardiac insufficiency hepatic insufficiency or renal insufficiency (n=5), and those who have undergone surgery within the last 2 weeks (n=4) were excluded. Finally, 145 patients were included and underwent cerebral vascular mechanical thrombotomy. According to modified Rankin scale (mRS) score at 90 days, 0 to 2 indicates good prognosis while 3 to 6 represents poor prognosis.[24] Patients were divided into good prognosis group (n=83) and poor prognosis group (n=62) according to mRS score at 90 days collected from out-patient clinic. All participants volunteered to participate in this study. This study was approved by the Ethics Committee of Nanyang Central Hospital (Approval No. 201812010074).

2.2. Cerebral baseline imaging

Cerebral baseline imaging was applied to determine the acute ischemic PCCI using multi-slice computed tomography (CT) by either non-contrast CT or CT angiogram or magnetic resonance imaging (MRI) via diffusion-weighted imaging (DWI), time-of-flight (TOF), and fluid-attenuated inversion recovery (FLAIR). Patients with PCCI with the onset time <24 hours were subjected to mechanical thrombectomy treatment based on the Guidelines for the early diagnosis and treatment of acute ischemic stroke in China.[25] The recanalization was evaluation based on the modified thrombolysis in cerebral ischemia scales: Level 0 refers to without perfusion; Level 1 indicates only tiny amounts of blood flow through the block section, little or no perfusion; Level 2a means partially perfusion of anterior blood flow, which covers less than half of ischemia area; Level 2b refers to partially perfusion of anterior blood flow, which covers more than half of ischemia area; Level 3 shows completely perfusion of anterior blood flow of downstream ischemia area. Level 2b and Level 3 indicates the criteria of successful endovascular treatment.

2.3. Mechanical thrombectomy treatment

Before mechanical thrombectomy treatment, the acute stroke team would discuss with the neurointerventionalist to determine whether the patient was suitable for the neurointerventional treatment.[26–28] Patients who were eligible for mechanical thrombectomy treatment were subjected to anesthesia. Under local anesthesia, the right femoral artery was punctured with modified Seldinger technique and the arterial sheath was inserted. After the puncture, DSA was immediately performed to preliminarily determine the location of the thrombus and the collateral compensation of the distal end of the occluded vessel. Then the location of the thrombus and the approach of stent thrombectomy were determined. The 6F/8F guiding catheter or long sheath tube was introduced through the femoral artery into the dominant vertebral artery, and selective angiography was performed again to further clarify the thrombosis. The microguide wire and the Rebar microcatheter were used to pass through the vascular occlusion segment, and the microcatheter was pushed by hand for angiography to determine the location of the microcatheter and the length of the thrombus. The Solitaire FR stent was delivered through a microcatheter. The stent was fixed and pushed while the microcatheter was slowly withdrawn to release the stent. The thrombosis was covered by 1/3 of the stent, which was pulled out of the body after being kept for about 5 minutes. Then the stent and microcatheter were gently and slowly withdrawn outward to the guiding catheter, during which negative pressure was used to suction the guiding catheter to minimize the probability of thrombus embolus escape and reduce the rate of re-embolization.[29] Grade 0: no recanalization of occluded vessels; Grade 1: permeable without reperfusion; Grade 2a: partial blood reperfusion, and the reperfusion area <50% under normal condition; Grade 2b: the reperfusion area >50% under normal condition; Grade 3: complete distal vascular filling. Grade 2b-3 are defined as recanalization. Blood pressure should be controlled after operation, and anticoagulant therapy was employed according to the condition.

2.4. Data collection

Clinical data were collected from all the subjects including gender, age, body mass index (BMI), fever on admission, preoperative mRS score, Alberta Stroke Program Early CT in posterior circulation (pc-ASPECT) score, digital subtraction angiography-American Society of Intervention and Therapeutic Neuroradiology (DSA-ASITN) grading, history of smoking, drinking, hypertension, diabetes, hyperlipemia, stroke, thrombus length, recombinant tissue-type plasminogen activator application, thrombectomy times, time to revascularization, time to procedure, procedure time, Trial of Org 10,172 in Acute Stroke Treatment (TOAST) classification, occlusion sites, pathogenesis of stroke, recanalization, baseline and postoperative National Institutes of Health Stroke scale (NIHSS) score, pulmonary infection, trachea cannula, circulatory collapse. All the data were harvested by 2 specialists who received professional training in scoring before the study.

2.5. Stroke subtype classification

The subtypes of stroke were classified into 3 groups according to the TOAST classification including large artery atherosclerosis, cardioembolism, and others.[30] Large artery atherosclerosis was defined as patients with 50% or more arterial stenosis in the large ipsilateral arteries with cerebral infarction and without heart disease that could cause embolization. Cardioembolism referred to those had no significant vascular abnormality in the large ipsilateral arteries with cerebral infarction with high or medium-risk cardiogenic diseases that caused emboli. Patients who were undetermined as no specific findings were observed after the usual investigation or if both atherosclerotic and cardiogenic causes were identified were assigned into the others group.

2.6. Power analysis of the sample size

The G^* Power software (Franz, Universitat Kiel, Germany) and the sample size in this study were applied for power analysis to evaluate the efficiency of logistic regression model. The results depicted that among the main variables pc-ASPECT score and NIHSS at 24 hours, the statistical powers were >0.999, indicating that the sample size was able to support the results. α was set at 0.05.

2.7. Statistical analysis

All statistical data were analyzed using SAS 9.4 software (SAS Institute, Cary, NC). The prognosis factors for patients after endovascular mechanical thrombectomy treatment were analyzed by the Shapiro-Wilk normality test. The measurement data of normal distribution were displayed as the mean ± standard deviation ($\bar{x} \pm s$), and comparisons between groups were performed by Student t test. Non-normal distribution data were shown as M (Q1, Q3), and Mann–Whitney U test was applied for comparisons between groups. The enumeration data were expressed as cases and frequency n (%), and comparison between groups was analyzed via chi-squared test or Fisher exact test. Univariate analysis was performed to screen the potential prognostic factors for PCCI patients receiving mechanical thrombectomy. Variables including age, BMI, baseline NIHSS, pc-ASPECT, DSA-ASITN, TOAST classification, and NIHSS at 24 hours were included in multivariate Logistic regression model 1. In addition, age and BMI were adjusted in multivariate Logistic regression model 2 to validate the results in multivariate Logistic regression model 1. The pairwise correlation between the prognostic factors was shown by a thermodynamic diagram. Cluster analysis further analyzed the correlations of the factors with the prognosis of patients. The level of statistical significance was set at $P<.05$.

3. Results

3.1. Basic characteristics of patients

In total, 192 patients diagnosed with PCCI were involved in this study. After excluding patients with the platelet counts $<100 \times 10^9$/L (n=5), blood glucose <2.7 mmol/L (n=7), intracranial tumor according to imaging examination (n=5), intracranial hemorrhage or subarachnoid hemorrhage confirmed by CT or MRI (n=17), gastrointestinal or urinary bleeding within the last 3 weeks (n=4), severe insufficiency of heart, liver, and kidney (n=5) and those who have undergone surgery within the last 2 weeks (n=4), 145 subjects finally participated in our study, including 98 men (67.59%) and 47 women (32.41%). The average age of the patients was 61.97 ± 11.52 years old. After 3 months of follow-up, 83 patients had a good prognosis, accounting for 57.24%, and 62 patients had a poor prognosis, accounting for 42.76%. The screening process was shown in Fig. 1 and the basic characteristics of patients were presented in Table 1.

3.2. Univariate analysis for screening potential factors associated with the prognosis of patients

A univariate analysis was conducted to compare the baseline and treatment characteristics of patients in the good prognosis group with those in the poor prognosis group. As displayed in Table 2 the age of patients with poor prognosis was older than those with good prognosis (64.74 years vs 59.89 years, $t=-2.56$, $P=.012$). The proportion of BMI >23.9 kg/m in the poor prognosis group was higher than that in the good prognosis group ($\chi^2=4.461$, $P=.035$). The baseline NIHSS score (30.82 vs 23.06, $t=-6.412$, $P<.001$) and DSA-ASITN grading ($Z=5.946$, $P<.001$) in the poor prognosis group were higher than that of the good prognosis group. The pc-ASPECT score was lower in the poor prognosis group than that of the good prognosis group (6.23 vs 7.53, $t=6.822$, $P<.001$). The time to revascularization in the poor prognosis group was longer than that in the good prognosis group (1.94 vs 1.65, $t=-2.183$, $P=.031$). The proration of patients in different TOAST classifications was different between the poor prognosis group and the good prognosis group ($P=.001$). The NIHSS score at 24 hours (29.87 vs 15.28, $t=-12.302$, $P<.001$), the pulmonary infection rate ($\chi^2=15.561$, $P<.001$), the trachea cannula rate ($\chi^2=97.094$, $P<.001$), and the circulatory collapse

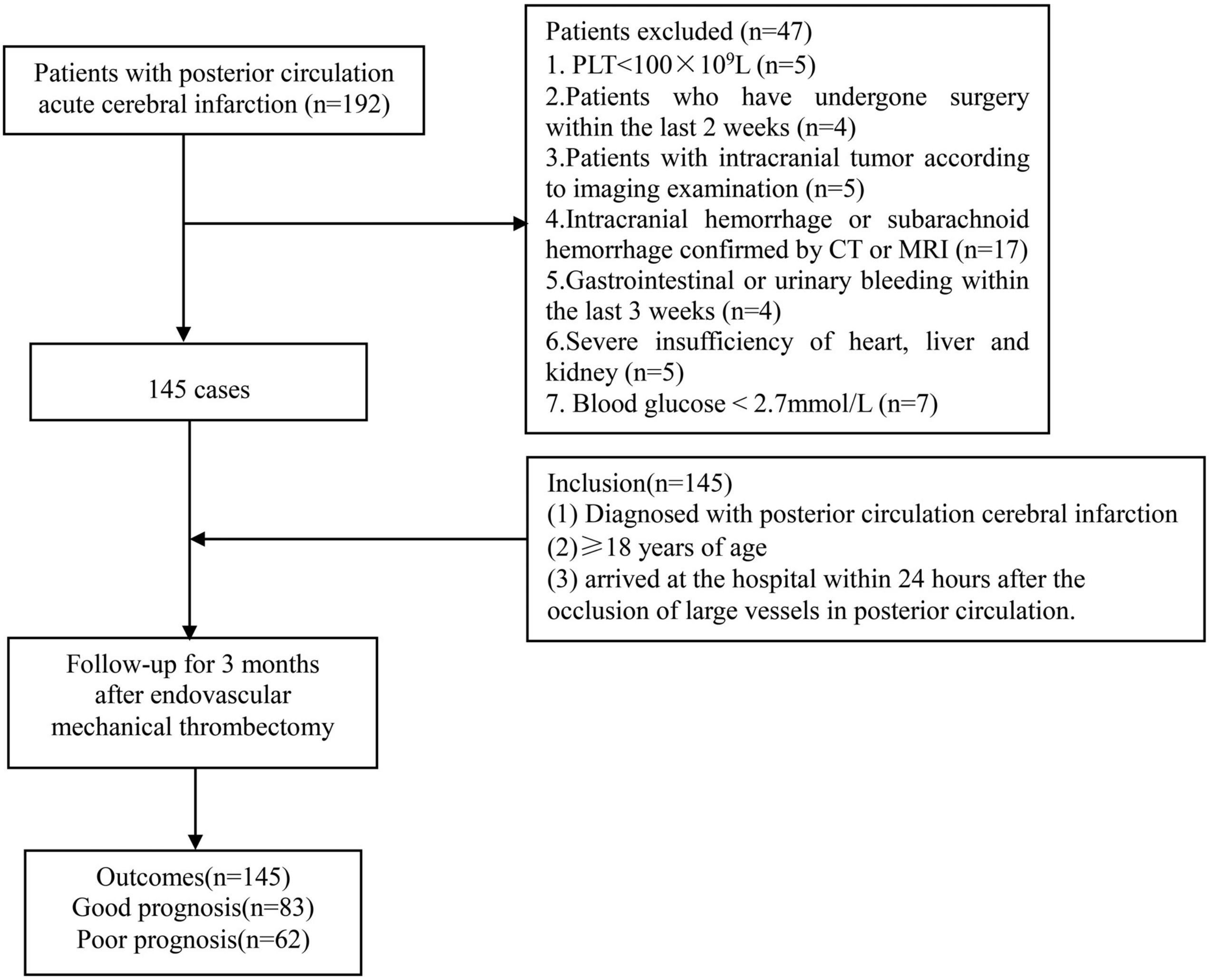

Figure 1. The flow chat of screening process of the participants in this study.

rate ($\chi^2=50.638$, $P<.001$) in the poor prognosis group were higher than those in the good prognosis group.

3.3. Multivariate logistic regression for identifying factors associated with the prognosis of patients

To evaluate the factors associated with the prognosis in PCCI patients after emergency endovascular mechanical thrombectomy, variables including age, BMI, baseline NIHSS, pc-ASPECT, DSA-ASITN, TOAST classification, and NIHSS at 24 hours were included in multivariate logistic regression analysis. As exhibited in Table 3 and Fig. 2, Model 1 was the result of unadjusted multivariate logistic regression. According to data in Model 1, pc-ASPECT score, DSA-ASITN grading, TOAST classification, and NIHSS at 24 hours were factors associated with the poor prognosis in PCCI patients after emergency endovascular mechanical thrombectomy. After adjusting age and BMI, Model 2 showed that the risk of poor prognosis in PCCI patients receiving emergency endovascular mechanical thrombectomy reduced 0.552 times with every 1-point increase of the pc-ASPECT score (odds ratio [OR] = 0.448, 95% confidence interval [CI]: 0.276–0.727, $P=.001$). The risk of poor prognosis was increased by 0.827 time for each additional grade in the DSA-ASITN grading (OR = 1.827, 95% CI: 1.221–2.733, $P=.003$) and increased by 0.288 time for every 1-point increase in NIHSS score at 24 hours (OR = 1.288, 95% CI: 1.161–1.429).

3.4. Evaluation of the pairwise correlations among the prognostic factors

The data from the thermodynamic diagram in Fig. 3 revealed the associations between the prognostic factors. As shown in Table 4, the tolerance (TOL) of each variable was <1 and the variance inflation factor (VIF) were all <10, indicating that there was no collinearity between the variables. All the data were clustered into 2 categories via unsupervised learning, which showed that patients in group 2 had a statistical higher proportion of poor prognosis (57.58% vs 10.87%, $\chi^2=27.992$, $P<.001$). Patients in group 2 was associated with a lower ASPECT score (6.67 vs 7.63, $t=4.39$, $P<.001$), higher DSA-ASITN grading ($Z=-5.277$, $P<.001$), and NIHSS score at 24 hours (25.48 vs 12.98, $t=-9.69$, $P<.001$) compared with Group 1 (Table 5). These results

Table 1

Baseline data of subjects.

Variable	Description (n=145)
Gender, n (%)	
Male	98 (67.59)
Female	47 (32.41)
Age, ($\bar{x} \pm s$)	61.97±11.52
BMI, n (%)	
>23.9	96 (66.21)
≤23.9	49 (33.79)
Fever on admission, n (%)	
Yes	10 (6.90)
No	135 (93.10)
Preoperative mRS score, n (%)	
>2	144 (99.31)
≤2	1 (0.69)
Preoperative NIHSS score, n (%)	
Mean±std	26.38±8.15
M (Q_1, Q_3)	27 (20, 34)
Preoperative GCS score, n (%)	
Mean±std	8.52±2.18
M (Q_1, Q_3)	8 (7, 10)
Pc-ASPECT score	
Mean±std	6.97±1.31
M (Q_1, Q_3)	7 (6, 8)
Severity, n (%)	
Mild-to-moderate	32 (22.07)
severe	113 (77.93)
Premonitory symptom, n (%)	
Yes	35 (24.14)
No	110 (75.86)
DSA-ASITN grading, n (%)	
Level 0	47 (32.41)
Level 1	24 (16.55)
Level 2	23 (15.86)
Level 3	16 (11.03)
Level 4	35 (24.14)
History of smoking, n (%)	
Yes	81 (55.86)
History of drinking, n (%)	
Yes	112 (77.24)
History of hypertension, n (%)	
Yes	106 (73.10)
History of hyperlipemia, n (%)	
Yes	15 (10.34)
History of stroke, n (%)	
Yes	16 (11.03)
Follow-up, day	89.72±8.66
Outcomes based on mRs score at 90 days, n (%)	
Good prognosis (0–2)	83 (57.24)
Poor prognosis (3–6)	62 (42.76)

ASPECT=Alberta Stroke Program Early CT; BMI=body mass index; DSA-ASITN=digital subtraction angiography-American Society of Intervention and Therapeutic Neuroradiology; GCS=Glasgow Coma scale; mRs=modified Rankin scale; NIHSS=National Institute of Health stroke scale.

were similar with the findings in the multivariate logistic regression model.

4. Discussion

The clinical data of 145 patients with PCCI who received emergency endovascular mechanical thrombectomy were collected and analyzed. In our study, we found 83 PCCI patients had good prognosis, accounting for 57.24% in all PCCI patients after emergency endovascular mechanical thrombectomy according to mRS score after 3-month follow up. Previously, a study of Dorňák et al[23] revealed that 59% of posterior circulation stroke patients had good clinical outcomes, which was similar with our results. The pc-ASPECT score, DSA-ASITN grading and NIHSS score at 24 hours were prognostic factors for PCCI patients after emergency endovascular mechanical thrombectomy.

Stroke one of the major cause of death and disability all through the world.[31] Compared with the western population, the incidence and mortality of stroke at the age of 45 to 74 are higher in China,[31] while the incidence and mortality of stroke in western countries are generally lower than those in eastern populations.[32] Endovascular treatment is applied in the management of acute ischemic strokes caused by large vessel occlusion via relieving vessel occlusion over the past few years.[33] The morbidity rate of PCCI patients was reported to be about 33.8%, intracerebral hemorrhage is a main complication of PCCI patients receiving endovascular treatment.[34] To avoid symptomatic intracerebral hemorrhage is essential for guiding endovascular treatment to better treat patients and improving the prognosis of patients.

The pc-ASPECT score is a semi-quantitative scoring system to assess early ischemic lesions in the middle cerebral artery in patients with acute ischemic stroke. According to pc-ASPECT score, the lesion size can be obtained accurately in a short time.[35] The lower pc-ASPECT score indicates larger infarction area. In some randomized controlled trials, pc-ASPECT score was applied to screen whether patients with acute ischemic stroke were suitable for endovascular thrombotomy.[36–38] A lower pc-ASPECT score indicated a more severe status of acute ischemic stroke. In our study, pc-ASPECT score was a factor influencing the prognosis for PCCI patients undergoing emergency endovascular mechanical thrombectomy and the risk of poor prognosis reduced 0.552 times for every 1-point increase in pc-ASPECT score. This conclusion was supported by multiple evidences. Kawiorski et al[39] demonstrated that ASPECT score is a sensitive tool for acute stroke and serve as a marker to determine whether recanalization therapy is necessary. The infarcts area and the number of pons and midbrain involved in pc-ASPECT score were reported to be crucially related to functional outcomes in PCCI according to studies from Wong et al.[40] Another 15-year retrospective study of PCCI patients receiving endovascular recanalization demonstrated that functional outcome before recanalization can be effectively predicted in line with pc-ASPECT score.[41] The pc-ASPECT score are mainly used for thrombolysis in patients, which has a higher accuracy of judging prognosis.[42] One of the limitations of the scoring system is that the scoring failed to include all middle cerebral artery blood supply area.[43] The area supplying blood from the anterior cerebral artery is not included, which is difficult to evaluate the prognosis in internal carotid artery occlusion.

In the present study, DSA-ASITN grading was also a prognosis factor for PCCI patients undergoing emergency endovascular mechanical thrombectomy. DSA-ASITN grading was effectively used in determination of acute ischemic stroke.[44,45] DSA is also reported to be a diagnostic method for measuring the degree of stenosis, although it is unable to quantitatively evaluate the hemodynamic status of different types of compensatory types.[46,47] The risk of poor prognosis in PCCI patient undergoing emergency endovascular mechanical thrombectomy was increased by 0.827 times for each additional grade increase

Table 2

Univariate analysis of factors for risk of poor prognosis.

Variables	Good prognosis (n = 83)	Poor prognosis (n = 62)	Statistical magnitude	*P*
Gender, n (%)			$\chi^2=0.001$	.972
Male	56 (67.47)	42 (67.74)		
Female	27 (32.53)	20 (32.26)		
Age, Mean ± SD	59.89 ± 11.38	64.74 ± 11.20	$t=-2.56$	.012
BMI, n (%)			$\chi^2=4.461$	.035
>23.9	49 (59.04)	47 (75.81)		
≤23.9	34 (40.96)	15 (24.19)		
Fever on admission, n (%)			–	1.000
Yes	6 (7.23)	4 (6.45)		
No	77 (92.77)	58 (93.55)		
Baseline mRs score, n (%)			–	1.000
>2	82 (98.80)	62 (100.00)		
≤2	1 (1.20)	0		
Baseline NIHSS score, Mean ± SD	23.06 ± 7.44	30.82 ± 6.89	$t=-6.412$	<.001
Pc-ASPECT score, Mean ± SD	7.53 ± 1.11	6.23 ± 1.18	$t=6.822$	<.001
DSA-ASITN grading, n (%)			$Z=5.946$	<.001
Level 0	40 (48.19)	7 (11.29)		
Level 1	18 (21.69)	6 (9.68)		
Level 2	12 (14.46)	11 (17.74)		
Level 3	3 (3.61)	13 (20.97)		
Level 4	10 (12.05)	25 (40.32)		
History of smoking, n (%)			$\chi^2=0.046$	.830
No	36 (43.37)	28 (45.16)		
Yes	47 (56.63)	34 (54.84)		
History of drinking, n (%)			$\chi^2=0.198$	.657
No	63 (75.90)	49 (79.03)		
Yes	20 (24.10)	13 (20.97)		
History of hypertension, n (%)			$\chi^2=2.680$	.102
No	18 (21.69)	21 (33.87)		
Yes	65 (78.31)	41 (66.13)		
History of diabetes, n (%)			$\chi^2=0.507$	.476
No	62 (74.70)	43 (69.35)		
Yes	21 (25.30)	19 (30.65)		
History of hyperlipemia, n (%)			$\chi^2=0.764$	.382
No	76 (91.57)	54 (87.10)		
Yes	7 (8.43)	8 (12.90)		
History of stroke, n (%)			$\chi^2=0.973$	.324
No	72 (86.75)	57 (91.94)		
Yes	11 (13.25)	5 (8.06)		
Length of thrombus, Mean ± SD	13.94 ± 9.16	14.48 ± 9.08	$t=-0.355$	.723
rt-PA, n (%)	11 (13.25)	13 (20.97)	$\chi^2=1.529$	.216
Number of thrombectomy, n(%)			-	.428
Yes	0 (0.00)	1 (1.61)		
No	83 (100.00)	61 (98.39)		
Time to revascularization, h, Mean ± SD	1.65 ± 0.71	1.94 ± 0.85	$t=-2.183$	.031
Time to procedure, h, Mean ± SD	9.58 ± 5.16	8.19 ± 3.67	$t=1.889$	.061
Procedure time, h, Mean ± SD	10.01 ± 5.17	8.61 ± 3.63	$t=1.924$	.056
TOAST classification, n(%)			-	.001
Large artery atherosclerosis	71 (85.54)	43 (69.35)		
Cardioembolism	5 (6.02)	17 (27.42)		
Others	7 (8.43)	2 (3.23)		
Occlusion sites, n (%)			$\chi^2=1.949$	.583
Proximal basilar artery 1	16 (19.28)	14 (22.58)		
Middle Basilar 2	18 (21.69)	18 (29.03)		
Distal basilar artery 3	35 (42.17)	23 (37.10)		
Vertebral artery V4	14 (16.87)	7 (11.29)		
Pathogenesis of stroke, n (%)			-	.082
Simple embolic occlusion of basilar artery	13 (15.66)	18 (29.03)		
Acute occlusion based on basilar artery stenosis	44 (53.01)	33 (53.23)		
Tandem Lesions	25 (30.12)	10 (16.13)		
Others	1 (1.20)	1 (1.61)		
Recanalization, n (%)	83 (100.0)	61 (98.39)	–	.428
NIHSS score at 24 h, Mean ± SD	15.28 ± 6.33	29.87 ± 7.95	$t=-12.302$	<.001
Pulmonary infection, n (%)	57 (68.67)	59 (95.16)	$\chi^2=15.561$	<.001
Trachea cannula, n (%)	3 (3.61)	52 (83.87)	$\chi^2=97.094$	<.001
Circulatory collapse, n (%)	0 (0.00)	30 (48.39)	$\chi^2=50.638$	<.001

ASPECT = Alberta Stroke Program Early CT, BMI = body mass index, DSA-ASITN = digital subtraction angiography-American Society of Intervention and Therapeutic Neuroradiology, mRs = modified Rankin scale, NIHSS = National Institute of Health stroke scale; rt-PA = recombinant tissue plasminogen activator; SD = standard deviation; TOAST = Trial of Org 10,172 in Acute Stroke Treatment.

of DSN-ASITN grading. This may be because collateral circulation is associated with cerebral tissue reperfusion rate and vascular recanalization rate. Good collateral circulation can protect ischemic penumbra and reduce infarct volume and the risk of postoperative bleeding transformation, which might affect the clinical outcome of patients after vascular recanalization.[48] Another prognosis indicator for PCCI patients undergoing emergency endovascular mechanical thrombectomy in our study was NIHSS score at 24 hours. NIHSS score is commonly applied in stroke trials to measure the prognosis. It is often detected 24 hours after the treatment by evaluating several clinical indicators, which is a marker reflecting brain dysfunction.[49] It is performed reliably by various clinicians before and after treatment to evaluate the severity of stroke in a relatively

Variables	Model1 OR (95%CI)	P	Model2 OR (95%CI)	P
Age			0.994 (0.949–1.042)	0.806
BMI			1.076 (0.903–1.282)	0.413
Preoperative NIHSS score			0.891 (0.797–0.997)	0.043
ASPECT score	0.448 (0.340–0.591)	<0.001	0.448 (0.276–0.727)	0.001
DSA–ASITN grading	1.714 (1.719–2.492)	0.005	1.827 (1.221–2.733)	0.003
TOAST classification				
Large artery atherosclerosis	Ref			
Cardiac embolism	4.805 (1.121–20.605)	0.009	5.219 (0.969–28.121)	0.054
Others	0.224 (0.026–0.947)	0.044	0.209 (0.020–2.211)	0.193
NIHSS score at 24 h	1.201 (1.123–1.285)	<0.001	1.288 (1.161–1.429)	<0.001

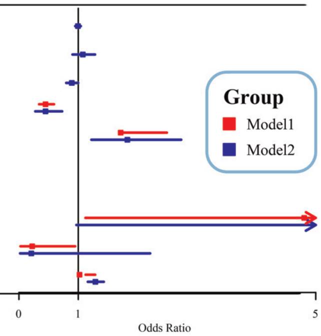

Figure 2. Forest plot to show the result of multivariate logistic regression.

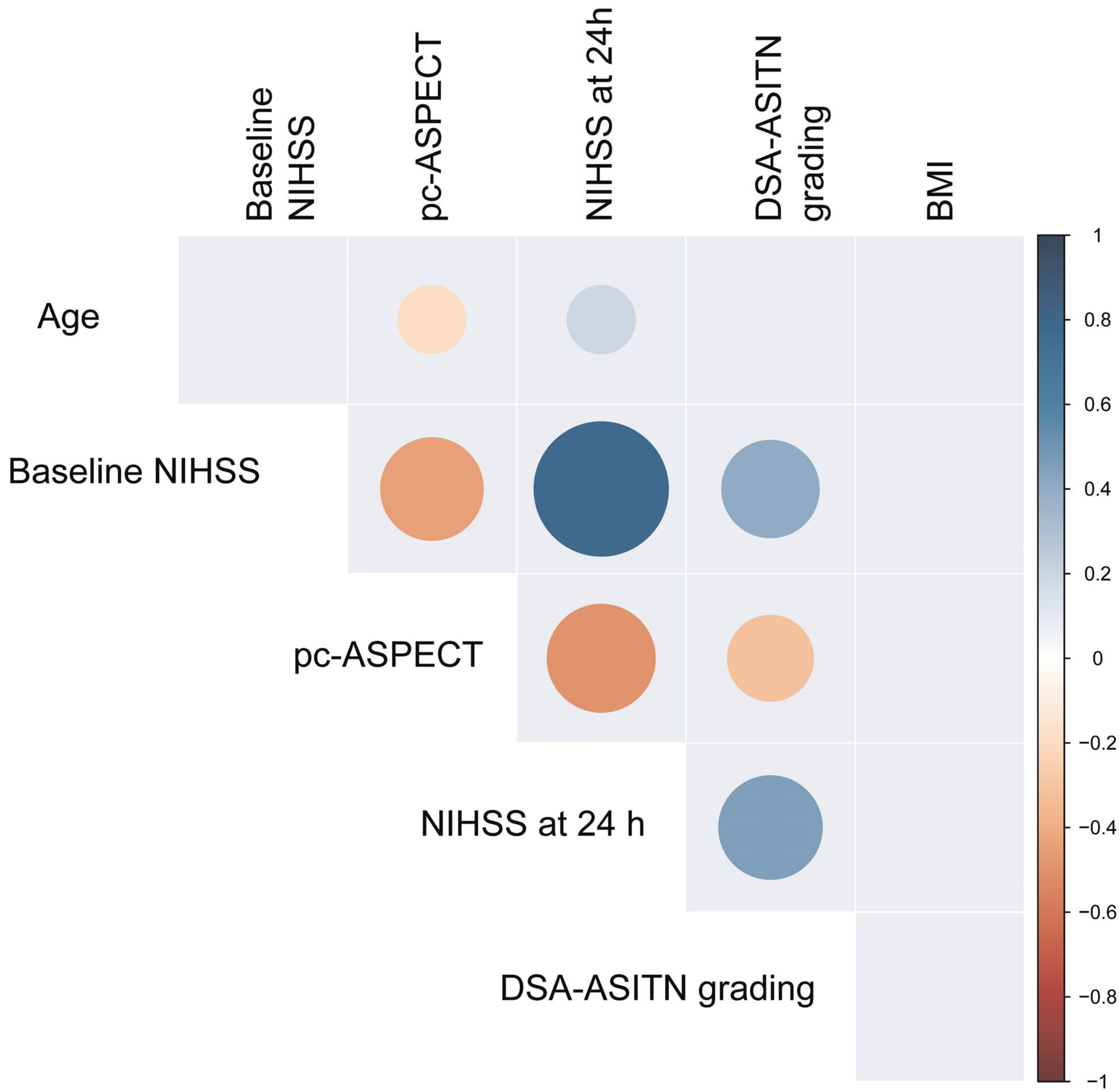

Figure 3. The thermodynamic diagram evaluating the associations between the prognostic factors.

short period of time, which was widely applied in clinic.[50] The maximum score of NIHSS is 42 and higher score means more severe neurological deficits.[49] In this study, each additional point of NIHSS score at 24 hours increased the risk of poor prognosis by 0.288 times, which indicated that NIHSS score at 24 hours was an independent prognosis indicator for PCCI patients undergoing emergency endovascular mechanical thrombectomy. Previous studies revealed that early NIHSS score appears to have close association with long-term functional prognosis after stroke,[51,52] which supported our conclusion. However, the direct determinants of the prognosis of cerebral infarction are the degree of neurological deficit at the onset and the characteristics of early disease changes under the action of multiple factors, and NIHSS score has shortcomings in evaluating the stability of arterial plaques in ischemic penumbra,[53] NIHSS scores lack the reliability in assessing overall outcomes. In addition, the predictive power of NIHSS score for neurological prognosis is time-dependent, and its predictive power decreases with time increases.[54] Thus, the dynamic combination of spatial change and temporal change of NIHSS score may be a new perspective and attempt to evaluate the long-term prognosis of cerebral infarction with NIHSS score.

PCCI accounts for nearly 20% of all ischemic strokes.[55] In clinic, when cerebral infarction occurs in posterior circulation, it is still very difficult to deal with. Neurological deficits caused by PCCI was described as catastrophic with severe disability and death.[56] Due to the rarity of PCCI cases, it is challenge for obtaining a large sample size to study the prognosis of those patients. It is essential to deep understanding more detailed prognostic factors of this disease. This study analyzed the factors associated with the prognosis of PCCI patients after emergency endovascular mechanical thrombectomy. For patients who have risk factors of poor prognosis, clinicians should pay special attentions on them, and various indicators of those patients should be frequently detected. In addition, effective care and treatments should be applied to improve the management and prognosis of patients with PCCI.

This study had some limitations. First, due to the rarity of the diseases, the sample size was small. Secondly, several vital variables may affect the prognosis of patients were not included in our study, for example, pre-mormid mRS scores. Large scale sample size study with more comprehensive variables was required to further analyze the factors influencing the prognosis of PCCI patients receiving emergency endovascular mechanical thrombectomy (Supplementary Table 1, http://links.lww.com/MD/G677).

5. Conclusion

As far as we know, a variety of factors influence the clinical prognosis of endovascular mechanical thrombectomy treatment for PCCI. In this study, we found ASPECT score, DSA-ASITN grading, NIHSS score at 24 hours were independent factors affecting the prognosis of PCCI patients undergoing emergency endovascular mechanical thrombectomy, which might offer reliable markers for improving the prognosis for PCCI patients.

Author contributions

Jun Gao and Baochao Zhang designed the study, Jun Gao wrote the manuscript, Jun Gao, Changming Wen, Jun Sun, Di Chen, Donghuan Zhang, Ning Wang, Yifeng Liu, and Jie Wang collected, analyzed, and interpreted the data. Baochao Zhang critically reviewed, edited, and approved the manuscript. All authors read and approved the final manuscript.

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