学 位 論 文 の 要 旨

氏名　　内村昌裕

学 位 論 文 名　Hemoglobin Decline Within 24 h Post-mechanical Thrombectomy as an Indicator of Poor Clinical Outcomes

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著 者 名　Masahiro Uchimura, Tomohiro Yamasaki, Mizuki Kambara, Tsutomu Yoshikane, Tomomi Kimiwada, Kentaro Hayashi

論 文 内 容 の 要 旨

INTRODUCSTION

Mechanical thrombectomy (MT) has proven to be an effective intervention for patients with acute large vessel occlusion (LVO), significantly improving clinical outcomes by restoring blood flow to ischemic brain regions. Nevertheless, a proportion of patients experience unfavorable outcomes despite successful recanalization. This discrepancy suggests that factors beyond procedural success may influence recovery and represent potential targets for prognostic optimization. One such factor is anemia, which is present in approximately 20% of patients with acute ischemic stroke at admission. Anemia has been identified as a negative prognostic marker in this population; however, its impact on outcomes following MT remains inconclusive due to inconsistent findings across studies. Although post-MT anemia is often managed through various interventions, prevention may represent a more effective strategy. This study aims to investigate the dynamics of hemoglobin (Hb) levels following MT, specifically examining whether the degree of Hb reduction and the lowest recorded Hb levels are associated with patient outcomes. Additionally, the study investigates the factors contributing to Hb decline following MT.

MATERIALS AND METHODS

The study was approved by the Institutional Review Board (IRB) of Shimane University Hospital (approval number: 20230221-3). The collection of data was performed in accordance with the ethical principles outlined in the Declaration of Helsinki, ensuring participant confidentiality and integrity throughout the research process. The Ethics Approval Committee waived the requirement for obtaining informed consent from patients, implementing an opt-out policy. This was a retrospective, single-center cohort study conducted at Shimane University Hospital, enrolling 122 patients who underwent MT between January 2016 and December 2022.

Seven patients with conditions unrelated to the primary focus of the study, such as posterior communicating artery occlusion or the need for retreatment within 24 hours, were excluded from analysis. Additionally, three patients with missing Hb data on admission were excluded, resulting in a final cohort of 102 patients who were included in the study analysis. Hb levels were measured from admission through 10 days post-MT for all patients. In addition to Hb data, demographic and clinical information were collected, including age, sex, weight, and the underlying causes of ischemic stroke (e.g., cardioembolism, intracranial atherosclerosis). Vessel occlusion locations (internal carotid artery, middle cerebral artery, basilar artery, or tandem lesions) were also recorded. Stroke severity at admission was assessed using the National Institutes of Health Stroke Scale (NIHSS), and brain natriuretic peptide (BNP) levels were recorded to identify patients with chronic heart failure (CHF). The study also included data on the use of recombinant tissue plasminogen activator (rt-PA), pre-stroke antithrombotic medication, and comorbid conditions like chronic kidney disease (CKD) and CHF. The method of MT (e.g., stent retriever, contact aspiration, or combined approaches) was documented, along with mTICI scores to assess recanalization outcomes, puncture-to-recanalization (PTR) times, and the total number of device passes. Additionally, complications such as puncture site bleeding and intracranial hemorrhage were recorded. The modified Rankin Scale (mRS) score was assessed both on admission and three months post-MT to evaluate functional outcomes. All MT procedures were performed via femoral artery catheterization, with the selection of MT devices left to the discretion of the operator. Balloon-guiding catheters were used when feasible, and the choice of MT technique (stent retriever, contact aspiration, or combined approaches) was made based on the operator's preference. MT was performed under local anesthesia with supplementary sedation as required. Recanalization outcomes were assessed using the mTICI scale, and rt-PA was administered when clinically indicated. Post-procedural care included hemostasis at the puncture site using either mechanical compression or vascular closure devices, followed by pressure dressing and enforced bed rest. A head CT scan was performed immediately after MT and again the following day to detect any intracranial hemorrhages. Statistical analyses were conducted using JMP® Pro version 17 software. Categorical variables were compared using Fisher's exact test, while continuous variables were analyzed using either the Student's t-test (for normal distributions) or the Mann-Whitney U test (for non-normal distributions). Univariable and multivariable logistic regression analyses were performed to identify factors associated with a 3-month mRS score of 3–6, with significance defined by a p-value of <0.05. The study also explored factors associated with Hb decrease 24 hours post-MT, with a sensitivity analysis conducted to assess multicollinearity using variance inflation factors (VIFs).

RESULTS AND DISCUSSION

A total of 102 patients (57.8% male, median age of 76 years) were included in the final

analysis. The primary cause of ischemic stroke in this cohort was cardioembolism (71.6%), followed by intracranial atherosclerosis (19.6%) and other causes (8.8%). Approximately 30.4% had internal carotid artery occlusions, 54.9% had middle cerebral artery occlusions, and 9.8% had basilar artery occlusions. The median NIHSS score on admission was 17, indicating moderate to severe stroke severity. Hb levels decreased significantly from admission (13.1 g/dL) to 24 hours post-MT (11.4 g/dL) and further dropped on day 4 (10.5 g/dL). The greatest decrease in Hb occurred between admission and 24 hours post-MT, with a median Hb reduction of 1.4 g/dL at 24 hours. Poor prognosis was associated with mRS score on admission (odds ratio [OR], 6.94; 95% confidence interval [CI], 1.28–37.6), NIHSS score (OR, 1.14; 95% CI, 1.04–1.25), modified thrombolysis in cerebral infarction 2c–3 recanalization (OR, 0.16; 95% CI, 0.03–0.73), and Hb decrease 24 hours post-MT (OR, 2.17; 95% CI, 1.07–4.43). Hb decrease 24 hours post-MT was significantly associated with more than two device passes (p-value, 0.037).

This study aimed to identify the most prognostically significant anemia-related parameter in patients with LVO undergoing MT. The most notable Hb reduction occurred within 24 hours post-MT, and this early decrease was significantly associated with poorer clinical outcomes. A greater Hb drop correlated with the need for multiple device passes, suggesting procedural blood loss as a contributing factor. While previous studies have highlighted various anemia indices (e.g., admission Hb, nadir Hb within 5 days), the current findings underscore the prognostic importance of early post-procedural Hb decline. Despite successful reperfusion, impaired cerebral autoregulation in stroke patients may amplify the adverse effects of anemia. Additionally, variability in collateral circulation complicates the direct correlation between absolute Hb values and outcomes. The study found no significant association between perioperative fluid volume or access-site bleeding and Hb reduction, likely due to standardized procedural protocols. The findings suggest that perioperative anemia management should focus on minimizing post-MT Hb decline through procedural strategies—such as optimizing first-pass success using balloon guide catheters and appropriate aspiration catheter selection.

CONCLUSION

This study concluded that a decrease in Hb levels within 24 hours of MT is a significant predictor of poor prognosis in patients with LVO. Specifically, patients who required more than two device passes experienced greater Hb reductions. These findings highlight the importance of optimizing MT procedures to minimize blood loss and reduce the risk of post-MT anemia. Further research is needed to develop strategies for preventing Hb decline and to explore the optimal management of anemia in the perioperative phase of MT for LVO.