МЕХАНИЧЕСКАЯ ТРОМБЭКТОМИЯ ПРИ ОККЛЮЗИИ МЕЛКИХ И СРЕДНИХ СОСУДОВ: ОПЫТ СЭНФОРДА

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MECHANICAL THROMBECTOMY FOR SMALL AND MEDIUM VESSEL OCCLUSION: A SANFORD EXPERIENCE

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РЕЗЮМЕ

АКТУАЛЬНОСТЬ: Клинические исследования последних лет показали, что лечение острого ишемического инсульта, вызванного окклюзией крупных сосудов, с помощью механической тромбэктомии приводит к улучшению реваскуляризации и функциональных исходов. При этом, имеется мало исследований по расширению использования механической тромбэктомии при окклюзиях мелких и средних интракраниальных сосудов, вызвающих ишемический инсульт, в значительном проценте случаев.

ЦЕЛЬ ИССЛЕДОВАНИЯ: Оценить результаты лечения пациентов с острым ишемическим инсультом на фоне окклюзии мелких и средних интракраниальных артерий механической тромбэктомией. Выяснить промежуток времени от начала заболевания до оказания помощи в медицинском центре для жителей отдаленных районов.

МАТЕРИАЛЫ И МЕТОДЫ: Проведен ретроспективный анализ историй болезни 38 пациентов, поступивших в цереброваскулярную службу Сэнфордского госпиталя в Фарго (Северная Дакота), в период с марта 2015 по май 2017 года, которым было проведено эндоваскулярное вмешательство по поводу острого ишемического инсульта, вызванного окклюзией сосудов малого калибра, с использованием устройств, предназначенных для тромбэктомии в мелких артериях.

РЕЗУЛЬТАТЫ: При поступлении у 10 пациентов исходный балл по шкале NIHSS (National Institutes of Health Stroke Scale) был более 10 (26.31%), у 14 пациентов исходный балл по шкале NIHSS составлял более 6 (36.84%), средний балл NIHSS при поступлении составил 14,61. Среднее снижение балла NIHSS составило — 4,94 после вмешательства с использованием механической тромбэктомии. Успешная реканализация была достигнута в 94.74% случаев. В качестве показателей функциональных результатов у 34 пациентов использовались 90-дневные послеоперационные баллы по модифицированной шкале Рэнкина (mRS). Процент пациентов, достигших двух или менее mRS, составил 56%.

Среднее время от начала заболевания до прибытия в приемный покой для жителей отдаленных районов было 200 минут. 91 минуту составило время от прибывания в приемном покое до эндоваскулярного вмешательства.

ВЫВОДЫ: Учитывая высокие показатели реваскуляризации, снижение баллов NIHSS и 90-дневных баллов mRS, механическая тромбэктомия может использоватся для пациентов с окклюзией мелких и средних интракраниальных сосудов.

КЛЮЧЕВЫЕ СЛОВА: Нейрохирургия, Тромбэкстракция, Инсульт, Передняя Мозговая Артерия, Средняя Мозговая Артерия.

ABSTRACT

BACKGROUND: Recent clinical trials have established that treatment of acute ischemic stroke secondary to large vessel occlusion with mechanical thrombectomy leads to improved revascularization and functional outcomes. However, there has been little research into expanding the application of mechanical thrombectomy into stroke secondary to small and medium vessel occlusions, which can still produce significant morbidity.

OBJECTIVE: Is to evaluate the outcomes of patients treated with mechanical thrombectomy for acute ischemic stroke secondary to more distal vessel occlusion and to highlight process times from door to intervention in a center that receives patients from rural and underserved areas.

DESIGN AND METHODS: We retrospectively reviewed the electronic medical record of 38 patients admitted to Sanford Health Cerebrovascular Service in Fargo, ND between March 2015 and May 2017 who underwent endovascular intervention for acute ischemic stroke secondary to a small caliber vessel occlusion using devices designed for thrombectomy in small arteries.

RESULTS: At admission, 10 patients had a baseline NIHSS score of more than 10 (26.31%), 14 patients had a baseline NIHSS score of more than 6 (36.84%), the average NIHSS score at admission was 14.61. The average NIHSS score change was — 4.94 after intervention using mechanical thrombectomy. Successful recanalization was achieved in 94.74% of cases. Ninety-day postoperative Modified Rankin Scale (mRS) scores were used as functional outcome measurements and the data were available for 34 patients. The percent of patients achieving mRS of two or less was 56%.

Large percentage of patients transferred from outside facilities, the median time from last known normal to arrival in the emergency department was prolonged to 200 minutes. The median time between emergency department arrival and recanalization was 91 minutes.

CONCLUSION: Given the high rates of revascularization, reductions in NIHSS scores, and 90-day mRS scores, mechanical thrombectomy may be reasonably extended to patients with occlusion of smaller, more distal vessels.

KEYWORDS: Neurosurgical Procedures, Thrombectomy, Stroke, Anterior Cerebral Artery, Middle Cerebral Artery

INTRODUCTION

Recent clinical trials have established that treatment of acute ischemic stroke secondary to large vessel occlusion with mechanical thrombectomy using a stent retriever leads to improved revascularization and functional outcomes. Yet minimal research has been conducted into expanding the application of mechanical thrombectomy to stroke secondary to small and medium vessel occlusions in part due to limitation in catheter size. New devices have been designed for the purpose of performing thrombectomy in cases of small vessel occlusion. However, to date, there is little available published evidence regarding their safety and efficacy. A study using the pRE LITE showed that thrombectomy of small vessels using this device resulted in good revascularization with reasonable safety [1]. Another study evaluated the use of the Mindframe device, one of the devices used at Sanford Health, for emergent mechanical thrombectomy in cases of acute stroke with occlusion in smaller caliber vessels. Results showed the device was effective and safe for use in treatment of small vessel occlusion, but as the study included only nine patients, further investigation was recommended [2]. In the Russian literature there are not enough studies devoted to the problem of surgical treatment of stroke in the acute period. The question of the timing of specific types of operations for patients with stroke of medium-caliber arteries remains relevant [3]. The successful line of randomized controlled trials devoted to endovascular interventions in acute stroke is a great achievement in stroke treatment. Inclusion of endovascular thrombectomy will possibly change the established clinical practice and improve outcomes in some patients with stroke. There is also no consensus on the timing of thrombectomy [4]. Russian clinical guidelines cover the main issues of treatment ischemic stroke in the acute period with the use of intravascular x-ray surgical interventions to restore patency intra-and extracranial arteries [5]. The first aim of the present study is to evaluate the outcomes of patients treated with mechanical thrombectomy at Sanford Health Fargo for acute ischemic stroke secondary to small caliber vessel occlusion of the M2 and M3 segments of the Middle Cerebral Artery (MCA) and the A2 and A3 segments of the Anterior Cerebral Artery (ACA). Treatment of small caliber vessels using mechanical thrombectomy is predicted to have a high rate of successful revascularization with an acceptably low risk of mortality. The secondary aim of this study is to provide process time intervals for a center that receives patients with smaller vessel occlusions from rural and underserved areas, which may serve as a baseline for future comparable studies involving this specific patient population.

METHODS

Based on the Sanford Health Fargo Stroke Task Force database, we analyzed data of all patients 18 years of age and older treated for acute ischemic stroke involving small caliber vessel occlusion using mechanical thrombectomy. Location of small vessel occlusions included the M2 and M3 segments of the MCA, as well as the A2 and A3 segments of the ACA. Retrospective review was subsequently conducted of the electronic medical record of 38 patients, admitted between March 2015 and May 2017, who fit these criteria.

Data obtained included demographic information, procedural data, and clinical outcomes. Demographic information included stroke risk factors such as history of diabetes, hypertension, hyperlipidemia, atrial fibrillation, tobacco use, alcohol consumption, associated cardiovascular and cerebrovascular events (transient ischemic attack, myocardial infarction, pulmonary embolism, deep vein thrombosis,

hypercoagulable state, congestive heart failure), body mass index (BMI), and medications on admission. Procedural data included last known normal (LKN) time, ED arrival time, time of CT/MRI imaging, time of groin puncture and recanalization, whether the patient received tPA, and a final pass TICI score. Process time intervals were calculated between different procedural data variables and are listed in Table 1. Clinical outcome measures collected included NIHSS (National Institutes of Health Stroke Scale) score at admission and within 48 hours postoperatively, rate of symptomatic hemorrhagic transformation, 90-day mRS, and 30-day mortality. mRS scores were obtained through blinded patient telephone encounters with a neurology clinic RN, using an established questionnaire, as well as through direct patient follow-up visits in the Stroke Clinic and/or chart review by a Vascular Neurologist.

Statistical analysis included calculations of the median for each procedural data interval, as well as averages for demographic information, such as age and BMI, and functional outcomes, such as admission NIHSS and 48-hour postoperative NIHSS. Further analysis of functional outcome data included calculating the percentage of patients with changes in NIHSS scores of 6 or greater, as well as 10 or greater, the average change in NIHSS from admission to 48 hours post-thrombectomy and percentage of patients achieving a mRS score of two or less.

RESULTS

Thirty-eight patients were included in this analysis, 24 women and 14 men, with the majority of the study group identifying as Caucasian (n=35). The mean age was 73 years, with a range 25 to 100 years of age. Thirty-six of these patients had one or more stroke risk factors with the most prevalent being hypertension (n=34), followed by hyperlipidemia (n=30), atrial fibrillation (n=16) and a history of diabetes mellitus (n =12). Thirteen patients had previously experienced a vascular event such as a transient ischemic attack, myocardial infarction, pulmonary embolism, deep vein thrombosis or had hypercoagulable state or congestive heart failure. Of the study group, 23 received tPA prior to mechanical thrombectomy and 30 were transferred into our facility. Due to the large percentage of patients transferred from outside facilities, the median time from last known normal to arrival in the emergency department (ED) was prolonged, at 200 minutes, as seen in Table 1. There was a wide range of time periods from last known normal to arrival in the ED (from 0 minutes, indicating symptom onset in the ED, to 1261 minutes), which can be attributed not only to the variability in time since symptom onset, but also to the fact that the majority of the patients transferred came from distant, rural, and underserved areas. However, after initial assessment in the ED, the median time between ED arrival and recanalization was 91 minutes. Other time interval data is shown in Table 1.

The percentage of procedures achieving individual TICI (thrombolysis in cerebral infarction) scores on the final pass of (1, 2a, 2b, 3) is seen in Table 2. Successful recanalization, as determined by a final TICI score of 2b or greater, was achieved in 94.74% of cases.

Table 1.

Median workflow times in minutes for each data point, as calculated, representing the 38 patients who underwent mechanical thrombectomy at Sanford Health in Fargo, ND.

Workflow Times	Median (minutes)
Last Known Normal to ED Arrival	200
ED to CT/CTA	17
ED to MRI/MRA	31
ED to Groin Puncture	47
ED to Recanalization	91
Groin Puncture to Recanalization	28

Table 2.

Percentage of patients in which TICI scores of 3, 2b, 2a, and 1 were achieved.

	Percentage (number of patients)
TICI 3	60.53% (n=23)
TICI 2b	34.21% (n=13)
TICI 2a	5.26% (n=2)
TICI 1	0% (n=0)

We have measured outcomes via two metrics, total change in the NIHSS score preoperatively to 24–48 hours postoperatively and 90-day mRS scores. The percentage of patients with a 10+ drop in NIHSS score was 26.31% (n=10) and the percentage of patients with a 6+ reduction was 36.84% (n=14). Additionally, accounting for variability in NIHSS scoring, there were two additional patients with a decrease in NIHSS score of 5, equating to 16 patients and a percentage of patients with a drop of 5+ of 42.10%. The average NIHSS score at admission was 14.61 and the average change in the NIHSS score was –4.94. However, we were unable to assess five patients postoperatively to collect NIHSS scores, two patients due to incapacitation and three patients due to death within 48 hours. mRS data were collected to measure functional outcomes 90-days postoperatively via blinded patient telephone encounters, with a neurology clinic RN using an established questionnaire as well as retrospective chart review conducted by a vascular neurologist. Data was available for 34 patients, and the percentage of patients with a favorable score of two or less was 56%.

The most common complication seen postoperatively was hemorrhagic transformation of infarct seen in 36.84% of the patients (n=14), with only a small percentage being symptomatic (5.26%, n=2), as defined by a 48-hour postoperative NIHSS increase of 4 or greater with radiographic evidence of ICH. The 30-day mortality rate was 23.68% (n=9).

DISCUSSION

Mechanical thrombectomy has been shown to improve outcomes in acute stroke patients with proximal large vessel occlusions, but this intervention has not been widely pursued, much less studied, in cases of distal/small vessel occlusions. Occlusions of the M2 segment, for example, would be excluded based on ASA/AHA guidelines, but strokes in this territory can certainly still result in significant morbidity if left without acute treatment. This study provides real-world data on the efficacy and safety of mechanical thrombectomy in the treatment of acute ischemic stroke caused by small caliber vessel occlusion. It further highlights the need for successfully implemented protocols for acute stroke care which facilitate prompt clinical decision-making and decrease time to intervention at centers capable of performing mechanical thrombectomy.

The process times from door to revascularization rival or eclipse those reported in previously published trials on mechanical thrombectomy. This is of paramount importance when acute stroke care is being provided to a geographically disparate patient base who may be arriving to the emergency department several hours from symptom onset or last known normal.

In our experience thrombectomy performed on small caliber vessels leads to high rates of successful revascularization with reasonably good early and later neurologic outcomes. Therefore, it seems reasonable to suggest that mechanical thrombectomy could be extended to patients beyond the current guidelines. By extending the application of mechanical thrombectomy to patients with smaller vessel occlusions, the morbidity and mortality for an expanded ischemic stroke population could be reduced.

CONCLUSION

Given the high rates of revascularization, reductions in NIHSS scores, and 90-day mRS scores, mechanical thrombectomy may be reasonably extended to patients with occlusion of smaller, more distal vessels.

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