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Primary suction thrombectomy for acute ischemic stroke: A meta-analysis of the current literature

Jin Pyeong Jeon[a,b], Sung-Eun Kim[c], Chul Ho Kim[d,*]

[a] Department of Neurosurgery, Hallym University College of Medicine, Chuncheon, Republic of Korea
[b] Department of Neurosurgery, Institute of New Frontier Research, Hallym University College of Medicine, Chuncheon, Republic of Korea
[c] Department of Emergency Medicine, Seoul Emergency Operations Center, Seoul, Republic of Korea
[d] Department of Emergency Medicine and Department of Neurology, Hallym University College of Medicine, Chuncheon, Republic of Korea

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ABSTRACT

Objectives: We conducted a meta-analysis to assess the angiographic and clinical outcomes for ischemic stroke patients treated with primary suction thrombectomy and to compare the procedural outcomes based on the treatment strategies (primary suction vs. stent retriever thrombectomy).

Patients and methods: We conducted a systemic literature review through an online data base from January 2004 through December 2016. The primary outcomes were rate of successful recanalization on final angiogram and good outcome three months after stroke onset. We used a fixed-effect model in cases with heterogeneity < 50%.

Results: Fifteen articles were included. Primary suction thrombectomy achieved a successful recanalization rate of 85.2% (95% confidence interval [CI]: 79.9%–89.3%), a good clinical outcome rate of 52.7% (95% CI: 49.3%–56.2%) after the three-month follow-up, a mortality rate of 13.0% (95% CI: 8.9%–18.5%) and a symptomatic intracranial hemorrhage rate of 6.2% (95% CI: 4.8%–8.0%). The rates of recanalization (odds ratio [OR], 1.064; 95% CI: 0.202–5.608; p = 0.571) and good outcomes (OR, 0.920; 95% CI: 0.570–1.486; p = 0.735) did not differ significantly between primary suction thrombectomy and stent retriever thrombectomy.

Conclusion: Primary suction thrombectomy produced higher recanalization and good clinical outcome rates than did stent retriever thrombectomy. Larger-scale studies are necessary that consider factors such as occlusion site, stroke severity, and concomitant use of endovascular devices.

1. Introduction

Endovascular mechanical thrombectomy has shown beneficial effects for treating acute ischemic stroke compared with medical care with intravenous tissue plasminogen activator (IV tPA) [1]. Mechanical thrombectomy devices can be divided into two groups based on the technique applied for clot removal: non-stent and stent retrievers. Compared with non-stent retrievers (Merci retrieval; Concentric Medical, Mountain View, CA, USA or Penumbra systems; Penumbra, Alameda, CA, USA), stent retrievers (Solitaire; ev3, Irvine, CA, USA or Trevo system; Stryker Neurovascular, Mountain View, CA, USA) mediated the extraction of the thrombus using a radial retrieval force at the center of the thrombus. Stent retriever thrombectomy has shown better angiographic and clinical outcomes than non-stent retrieval thrombectomy in patients with acute anterior circulation stroke [2]. Early recanalization with less ischemia is necessary to obtain good clinical outcome in stroke patients; hence, stent retriever thrombectomy has been widely selected for endovascular intervention.

Recently, the feasibility of primary suction thrombectomy (manual aspiration of the thrombus as first-line therapy) has been increasingly reported in the field of neurointervention. Primary suction thrombectomy has been variously referred to as “A Direct Aspiration, First Pass Technique (ADAPT)” [3], “forced suction arterial thrombectomy (FAST)”, or “primary manual aspiration thrombectomy (MAT)”[4]. ADAPT refers to aspiration alone to remove the thrombus through a high-trackable, large-bore aspiration catheter such as 5 MAX ACE (Penumbra), 5 MAX (penumbra) reperfusion catheter, SOFIA (Microvention Inc, Aliso Vieja, CA, USA) or AXS catalyst distal catheter (Stryker). In FAST, the penumbra reperfusion catheter is used for primary suction, without use of a separator for debulking of the thrombus [5]. In primary MAT, an aspiration catheter for the largest available distal internal diameter is used [4]. Treatment outcomes according to endovascular devices have been well reported in meta-analyses regarding managing acute ischemic stroke. However, systemic literature

* Corresponding author. Address: Gyo-dong, Chuncheon-si, Gangwon-do, 200-704 Republic of Korea.
E-mail address: gumdol52@hallym.or.kr (C.H. Kim).

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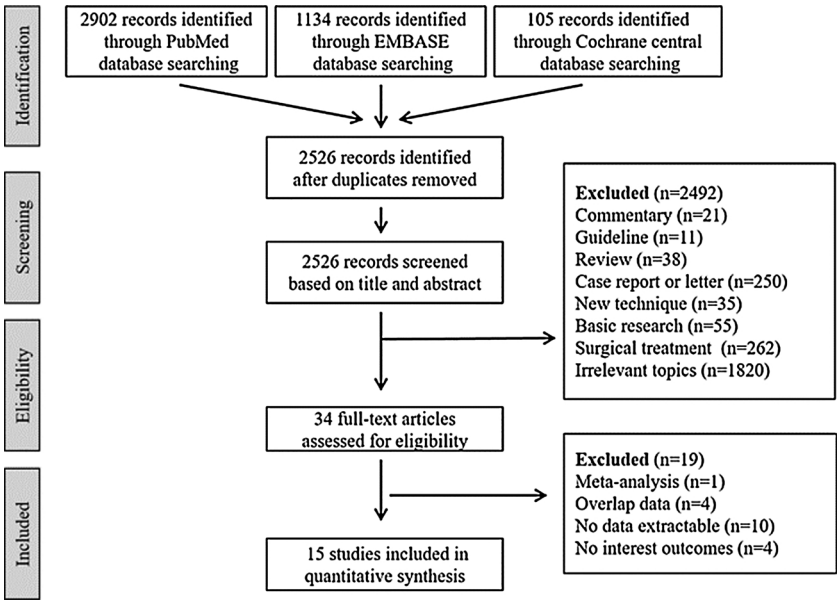

Fig. 1. Flow diagram for identification of relevant studies.

reviews have not well described primary suction thrombectomy, even though a number of studies have been published since 2014. Herein, we conducted a meta-analysis to evaluate the treatment outcomes after primary suction thrombectomy, providing information on successful recanalization, clinical outcome and complications. In addition, we compared the procedural outcomes between primary suction and stent retriever thrombectomy.

2. Material and methods

2.1. Literature search and study selection

We conducted the electronic search through PubMed, Embase, and the Cochrane Central Register of Controlled trials in the Cochrane Library databases for articles published between January 2004 and December 2016. Our search consisted of the following combination of key words or MeSH terms: “direct aspiration,” “ADAPT,” “manual aspiration,” “first-pass,” “ischemic stroke,” “endovascular therapy,” “cerebral infarct,” “intra-venous,” “intra-arterial,” “fibrinolysis,” “thrombolysis,” “thrombectomy,” “aspiration,” “hemorrhage,” “embolus,” “death,” “peri-operative complications,” and “mortality.”

Our criteria for inclusion in this meta-analysis were as follows: (1) studies that included the patients who presented with acute ischemic stroke; (2) participants over 18 years of age; (3) endovascular treatment using primary suction thrombectomy without prior mechanical thrombectomy with stent retriever or debulking of the thrombus; (4) a minimum of 10 endovascular procedures through the common femoral artery; (5) extracting the number of events such as recanalization, clinical outcome, and complications was possible; and (6) randomized controlled studies, prospective or retrospective case-controlled studies that had a quality score of > 5 on the Newcastle-Ottawa scale. The exclusion criteria were as follows: (1) patients who did not present with acute ischemic stroke; (2) incomplete data or unclear distinction between primary suction thrombectomy and other mechanical thrombectomy; (3) unavailability of data on baseline characteristics including age and NIHSS (National Institute of Health Stroke Scale) score in patients who underwent primary suction thrombectomy; and (4) review articles or case reports.

The primary outcomes were rates of successful recanalization on final angiogram and good clinical outcome on three-month follow-up, but we also investigated the rates of mortality and symptomatic intracranial hemorrhage (S-ICH) after the procedure. Comparative outcome studies were based on the treatment methods including primary suction vs. stent retriever. We defined successful recanalization as thrombolysis in cerebral ischemia $\geq$2b or thrombolysis in myocardial infarction grades 2 or 3 [6] and defined good clinical outcome as a three-month modified Rankin scale score of $\leq$2. We defined S-ICH as any intracerebral hemorrhage concomitant with an increase of at least 4 points on the NIHSS score within 24 h or resulting in death [7]. We added information on the complications after receiving email from the correspondent, if needed. Two authors (JPJ and CK) independently evaluated the eligibility of the studies and extracted the data using a uniform standardized form. We resolved disagreements by discussion and consultation with a third author. This study was approved by the institutional review boards, and we performed this meta-analysis based on the PRISMA guidelines.

2.2. Statistical analysis

We estimated the cumulative incidence (event rate) and 95% confidence intervals (CIs) from each study and present dichotomous variables as odds ratio (OR) with a 95% CI. We evaluated heterogeneity using the I^2 test; if $I^2 < 50\%$, we used a fixed-effect model was used. We used Comprehensive Meta-Analysis software v2.2.064 (Biostat, Englewood, NJ, USA) and R software, V3.1.0 for all the above, with statistical significance considered $p < 0.05$.

3. Results

3.1. Identifying relevant studies

Fig. 1 displays a flow diagram of the detailed search process. After we screened records for eligibility, we included 34 articles. Among them, we excluded 19 articles from the final analysis due to overlapping data (n = 4), lack of extractable data (n = 10), absence of interest outcomes (n = 4), and previous meta-analysis (n = 1; Supplemental Figure). Two studies [7,8] compared the angiographic and clinical outcomes between primary suction and stent retriever thrombectomy. The mean age in each study ranged from 59 to 70.1 years, and the median puncture-to-recanalization time ranged from 26 to 85 min. Detailed baseline characteristics of the enrolled studies are described in Table 1.