Bölüm 15

AKUT İSKEMİK İNME TEDAVİSİNDE GÜNCEL YAKLAŞIMLAR

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GİRİŞ

İnme oldukça sık görülen, yaşam boyunca her dört kişiden birinin etkilendiği; yetişkinlerde ölümün en sık ikinci ve sakatlığın en sık üçüncü nedeni olan küresel bir sağlık sorunudur.[(1)] Her yıl dünya çapında yaklaşık 17 milyon kişi inme geçirmektedir. Hastaların çoğu akut süreçten sonra uzun süre rehabilitasyona ihtiyaç duyar, toplumdan sürekli destek almaya devam eder ve birçoğuna huzurevi bakımı gerekir. Dolayısıyla inme yıkıcı bir hastalıktır ve toplum üzerinde önemli bir ekonomik yüktür.[(2-4)] İnme, merkezi sinir sisteminin enfarktüsüdür ve tüm inmelerin yaklaşık %85'i iskemik natürdedir.[(4)]

İskemik inme akut tedavi için dar bir zaman aralığına sahip olan tıbbi bir acil durumdur. Arteryel tıkanıklık nedeniyle beyin dokusunun geçici veya kalıcı iskemisinden kaynaklanır ve tıkanıklık sonrası geçen her dakikada tahmini iki milyon nöron kaybı olur.[(5,6)] Tıkanıklığın ardından damarın sulama alanı merkezinde dakikalar sonra infarkt dokusu meydana gelir. Periferinde ise kollateral akım sayesinde henüz hücre ölümünün gerçekleşmediği "penumbra" denilen damarın rekanalize olması ile kurtarılabilecek geri dönüşümlü iskemik alan vardır. Akut iskemik inme tedavisinde amaç; en kısa sürede tıkalı damarı rekanalize edip hücre ölümü gerçekleşmeden bu bölgede reperfüzyonu sağlamaktır. Çünkü geçen her dakikada daha fazla geri dönüşümsüz hücre hasarı meydana gelir.[(7)]

Etkili farmakolojik ve endovasküler reperfüzyon tedavi stratejilerinin ortaya çıkması inme tedavisinde son yirmi yılda devrim yaratmıştır. İlk olarak intravenöz trombolitik tedavi ve ardından gelişen endovasküler rekanalizasyon tedavileri ile artık günümüzde inmede ölüm ve sakatlık belirgin oranda azaltılabilmektedir.[(8)]

Bu yazıda, inmenin akut döneminde uygulanan intravenöz trombolitik ve endovasküler rekanalizasyon tedavileri gibi rekanalizasyona odaklanan spesifik güncel tedavi stratejilerinin değerlendirilmesi amaçlanmıştır.

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dovasküler trombektomi ile tedavi edilebilen hastaların sayısında önemli bir artış görüldü. Ancak inmeye bağlı ölüm ve sakatlık hala yüksektir. Bu nedenle inme yönetiminde daha fazla gelişmeye ihtiyaç vardır.

Anahtar Kelimeler: Tromboliz, Trombektomi, DAWN ve DEFUSE

KAYNAKÇA

1. Feigin VL, Nguyen G, Cercy K, et al. Global, regional, and countryspecific lifetime risks of stroke, 1990 and 2016. N Engl J Med. 2018;379:2429–2437.
2. Lopez AD, Mathers CD, Ezzati M, et al. Global and regional burden of disease and risk factors, 2001: systematic analysis of population health data. Lancet. 2006;367:1747–1757.
3. Feigin VL, Forouzanfar MH, Krishnamurthi R et al. Global and regional burden of stroke during 1990–2010: findings from the Global Burden of Disease Study 2010. Lancet. 2014;383:245-54.
4. Mikulik R, Wahlgren N. Treatment of acute stroke: an update. *J Intern Med., 278,* 145-65.
5. Saver JL. Time is brain–quantified. *Stroke, 37* (1), 263–266.
6. Kamalian S, Lev MH. Stroke Imaging. *Radiol Clin North Am. 57*, 717-732.
7. Campbell BCV, De Silva DA, Macleod MR, et al. Ischaemic stroke. Nat Rev Dis Primers, 2019; *5*:70.
8. Campbell BC. Advances in stroke medicine. *Med J., 210*, 367-374.
9. Kendall J. Dutta D, Brown E. Reducing delay to stroke thrombolysis lessons learnt from the Stroke 90 Project. *Emerg Med J., 32*, 100-104.
10. Meretoja A, Strbian D, Mustanoja S, et al. . Reducing in-hospital delay to 20 minutes in stroke thrombolysis. Neurology. 2012; 79:306–313.
11. Peisker T, Koznar B, Stetkarova I, et al. Acute stroke therapy: A review. Trends Cardiovasc Med. 2017;27:59-66.
12. Deguchi I, Mizuno S, Kohyama S, et al. Drip-and-Ship Thrombolytic Therapy for Acute Ischemic Stroke. J Stroke Cerebrovasc Dis. 2018; 27:61-67.
13. Powers WJ, Rabinstein AA, Ackerson T, et al. Guidelines for the early management of patients with acute ıschemic stroke: 2019 update to the 2018 guidelines for the early management of acute ıschemic stroke: A guideline for healthcare professionals from the american heart association/american stroke association. Stroke. 2019;50:e344-418.
14. Phipps MS, Cronin CA. Management of acute ischemic stroke. *BMJ, 368,* l6983.
15. Ehrlich ME, Turner HL, Currie LJ, et al. Safety of computed tomographic angiography in the evaluation of patients with acute stroke: A single- center experience. Stroke. 2016;47:2045-2050.
16. Lima FO, Lev MH, Levy RA, et al. Functional contrast-enhanced CT for evaluation of acute ischemic stroke does not increase the risk of contrast-induced nephropathy. AJNR Am J Neuroradiol. 2010;31:817-821.
17. Albers GW, Marks MP, Kemp S, et al. Thrombectomy for stroke at 6 to 16 hours with selection by perfusion imaging. N Engl J Med. 2018; 378:708-718.
18. Nogueira RG, Jadhav AP, Haussen DC, et al. Thrombectomy 6 to 24 hours after stroke with a mismatch between deficit and infarct. N Engl J Med. 2018;*378:*11-21.
19. Ma H, Campbell BCV, Parsons MW, et al. Thrombolysis guided by perfusion imaging up to 9 hours after onset of stroke. N Engl J Med. 2019;380:1795–1803.
20. Ryu WHA, Avery MB, Dharampal N, et al. Utility of perfusion imaging in acute stroke treatment:a systematic review and meta-analysis. J Neurointerv Surg. 2017;*9*:1012-1016.
21. Reed M, Kerndt CC, Nicolas D. (2020). *Alteplase*. StatPearls [Internet], Treasure Island (FL): StatPearls Publishing (Available from https://www.ncbi.nlm.nih.gov/books/NBK499977/, accessed on May 24, 2020).

22. National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group. Tissue plasminogen activator for acute ischemic stroke. N Engl J Med. 1995;333:1581-1587.
23. Emberson J, Lees KR, Lyden P, et al. Effect of treatment delay, age, and stroke severity on the effects of intravenous thrombolysis with alteplase for acute ischaemic stroke: a meta-analysis of individual patient data from randomised trials. Lancet. 2014;384:1929–1935.
24. Liaw N, Liebeskind D. Emerging therapies in acute ischemic stroke. *F1000Res., 9,* 546.
25. Lees KR, Bluhmki E, von Kummer R, et al. Time to treatment with intravenous alteplase and outcome in stroke: an updated pooled analysis of ECASS, ATLANTIS, NINDS, and EPITHET trials. Lancet. 2010;375:1695–1703.
26. Muchada Me, Luna DR, Pagol J, et al. Impact of time to treatment on tissue-type plasminogen activator-induced recanalization in acute ischemic stroke. Stroke. 2014;45:2734–2738.
27. Wahlgren N, Ahmed N, Davalos A, et al. Thrombolysis with alteplase for acute ischaemic stroke in the Safe Implementation of Thrombolysis in Stroke-Monitoring Study (SITS-MOST): an observational study. Lancet. 2007;369:275–282.
28. Yaghi S, Willey JZ, Cucchiara B, et al. Treatment and outcome of hemorrhagic transformation after intravenous alteplase in acute ischemic stroke a scientific statement for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2017;48(12):e343–e361.
29. Morotti A, Poli L, Costa P. Acute stroke. *Semin Neurol, 39,* 61-72.
30. Myslimi F, Caparros F, Dequatre-Ponchelle N, et al. Orolingual angioedema during or after thrombolysis for cerebral ischemia. Stroke. 2016;47:1825–1830.
31. Cheong E, Dodd L, Smith W, et al. Icatibant as a potential treatment of life-threatening alteplase-induced angioedema. J Stroke Cerebrovasc Dis. 2018;27:e36–e37.
32. T.C. Sağlık Bakanlığı Sağlık Hizmetleri Genel Müdürlüğü. (*2020). Akut iskemik inme tanı ve tedavi rehberi. Ankara.*
33. Manawadu D, Bodla S, Jarosz J, et al. A case-controlled comparison of thrombolysis outcomes between wake-up and known time of onset ischemic stroke patients. Stroke. 2013;44: 2226-2231.
34. Rabinstein AA. Treatment of acute ischemic stroke. *Cerebrovascular Disease, 23,* 62-81.
35. Kamalian S, Lev MH. Stroke Imaging. *Radiol Clin North Am., 57,* 717-732.
36. Thomalla G, Simonsen CZ, Boutitie F, et al. MRI-guided thrombolysis for stroke with unknown time of onset. N Engl J Med. 2018;379:611–622.
37. Campbell BCV, Ma H, Ringleb P, et al. Extending thrombolysis to 4·5–9 hours and wake-up stroke using perfusion imaging: a systematic review and meta-analysis of individual patientdata. Lancet. 2019;394**:**139–147.
38. Furlanis G, Ajčević M, Buoite Stella A, et al, Wake-up stroke:thrombolysis reduces ischemic lesion volume and neurological deficit. J Neurol. 2020;267:666-673.
39. Tan YF, Zhan LX, Chen XH, et al. Risk Factors, Clinical Features and Prognosis for Subtypes of Ischemic Stroke in a Chinese Population. Curr Med Sci. 2018;38:296-303.
40. Petty GW, Brown RD Jr, Whisnant JP, et al. Ischemic stroke subtypes :a population-based study of functional outcome, survival, and recurrence. Stroke. 2000;31:1062-1068.
41. Rocha S, Pires A, Gomes J, et al. Intravenous thrombolysis is more effective in ischemic cardioembolic strokes than in non-cardioembolic?. Arq Neuro psiquiatr. 2011;69 (6):905-909.
42. Wang XG, Zhang LQ, Liao XL, et al. Unfavorable outcome of thrombolysis in chinese patients with cardioembolic stroke: a prospective cohort study. CNS Neurosci Ther. 2015;21 (8):657-661.
43. Schmitz ML, Simonsen CZ, Svendsen ML, et al. Ischemic stroke subtype is associated with outcome in thrombolyzed patients. Acta Neurol Scand. 2017;135:176-182.
44. Molina CA, Montaner J, Arenillas JF, et al. Differential pattern of tissue plasminogen activator-induced proximal middle cerebral artery recanalization among stroke subtypes. Stroke. 2004;35:486-490.
45. Vaclavik D, Vilionskis A, Jatuzis D, et al. Clinical out come of cardioembolic stroke treated by intravenous thrombolysis. Acta Neurol Scand. 2018;137:347-355.

46. Nam HS, Lee KY, Kim YD, et al.Failure of complete recanalization is associated with poor outcome after cardioembolic stroke. Eur J Neurol. 2011;18:1171-1178.
47. Boeckh-Behrens T, Kleine JF, Zimmer C, et al. Thrombus Histology Suggests Cardioembolic Cause in Cryptogenic Stroke. Stroke. 2016;47:1864-1871.
48. HackeW, Furlan AJ, Al-Rawi Y, et al. Intravenous desmoteplase in patients with acute ischaemic stroke selected by mri perfusion-diffusion weighted imaging or perfusion ct (dias-2): a prospective, randomised, double-blind, placebo-controlled study. Lancet Neurol. 2009;8:141–150.
49. von Kummer R, Mori E, Truelsen T, et al. Desmoteplase 3 to 9 hours after major artery occlusion stroke: the DIAS-4 trial (efficacy and safety study of desmoteplase to treat acute ischemic stroke). Stroke. 2016;47: 2880–2887.
50. Li X , Li Ling L, Li C, et al. Efficacy and safety of desmoteplase in acute ischemic stroke patients: A systematic review and meta-analysis. Medicine (Baltimore). 2017;96:e6667.
51. Bivard A, Huang X, Levi CR, et al. Tenecteplase in ischemic strokeoffers improved recanalization: analysis of 2 trials. Neurology. 2017;89:62–67.
52. Campbell BCV, Mitchell PJ, Churilov L, et al. Tenecteplase versus alteplase before thrombectomy for ischemic stroke. N Engl J Med. 2018; 378**:**1573–1582.
53. Campbell BCV, Mitchell PJ, Churilov L, et al. Effect of intravenous tenecteplase dose on cerebral reperfusion before thrombectomy in patients with large vessel occlusion ischemic stroke: the EXTEND-IA TNK part 2 randomized clinical trial. *J*AMA. 2020;323**:**1257–1265.
54. Campbell BCV, Khatri P. Stroke. Lancet. 2020;396 (10244):129-142.
55. Powers WJ, Rabinstein AA, Ackerson T, et al. 2018 guidelines for the early management of patients with acute ıschemic stroke: a guideline for healthcare professionals from the American Heart Association/ American Stroke Association. Stroke. 2018;49(3):e46–e110.
56. Hacke W, Kaste m, Fieschi C, et al. Randomised double-blind placebo-controlled trial of thrombolytic therapy with intravenous alteplase in acute ischaemic stroke (ECASS II). Second European-Australasian Acute Stroke Study Investigators. Lancet. 1998;352:1245-1251.
57. Clark WM, Wissman S, Albers GW, et al. Recombinant tissue-type plasminogen activator (Alteplase) for ischemic stroke 3 to 5 hours after symptom onset. The ATLANTIS Study: a randomized controlled trial. Alteplase Thrombolysis for Acute Noninterventional Therapy in Ischemic Stroke. JAMA. 1999;282:2019-2026.
58. Hacke W, Kaste M, Bluhmki E, et al. Thrombolysis with alteplase 3 to 4,5 hours after acute ischemic stroke. N Engl J Med. 2008;*359* (13): 1317-1329.
59. Sharma VK, Kawnayn G, Sarkar N. Acute ischemic stroke: comparison of low-dose and standard-dose regimes of tissue plasminogen activator. *Expert RevNeurother, 13,* 895-902.
60. Emberson J, Lees KR, Lyden P, et al. Effect of treatment delay, age, and stroke severity on the effects of intravenous thrombolysis with alteplase for acute ischaemic stroke: a meta-analysis of individual patient data from randomised trials. Lancet. 2014;384(9958):1929-1935.
61. Yamaguchi T, Mori E, Minematsu K, et al. Alteplase at 0.6 mg/kg for acute ischemic stroke within 3 hours of onset: Japan Alteplase Clinical Trial (J-ACT). Stroke. 2006;37(7):1810-1815.
62. Toyoda K, Koga M, Naganuma M, et al. Routine use of intravenous low-dose recombinant tissue plasminogen activator in Japanese patients: general outcomes and prognostic factors from the SAMURAI register. Stroke. 2009;40 (11):3591-3595.
63. Nakagawara J, Minematsu K, Okada Y, et al. Thrombolysis with 0.6 mg/kg intravenous alteplase for acute ischemic stroke in routine clinical practice: the Japan post-Marketing Alteplase Registration Study (J-MARS). Stroke. 2010;41(9):1984-1989.
64. Huang Y, Sharma VK, Robinson T, et al. Rationale, design, and progress of the enhanced control of hypertension and thrombolysis stroke study (ENCHANTED) trial: An international multicenter 2 × 2 quasi-factorial randomized controlled trial of low- vs. standard-dose rt-PA and early intensive vs. guideline-recommended blood pressure lowering in patients with acute ischaemic stroke eligible for thrombolysis treatment. Int J Stroke. 2015;10(5):778-788.
65. Cheng JW, Zhang XJ, Cheng LS, et al. Low-dose tissue plasminogen activator in acute ischemic stroke: a systematic review and meta-analysis. J Stroke Cerebrovasc Dis. 2018;27:381-390.

66. Anderson CS, Robinson T, Lindley RI, et al. Low-dose versus standard-dose intravenous alteplase in acute ıschemic stroke. N Engl J Med. 2016;374(24):2313-2323.
67. Broderick JP, Palesch YY, Demchuk AM, et al. Interventional management of stroke (IMS) III investigators. Endovascular Therapy. 2013;368:893-903.
68. Kidwell CS, Jahan R, Gornbein J, et al. A trial of imaging selection and endovascular treatment for ischemic stroke. N Engl J Med. 2013; 368(10):914-923.
69. Ciccone A, Valvassori L; Nichelatti M, et al. Endovascular treatment for acute ischemic stroke. N Engl J Med. 2013;368 (10):2433-2434.
70. Berkhemer OA, Fransen PS, Beumer D, et al. A randomized trial of intraarterial treatment for acute ischemic stroke. N Engl J Med. 2015;372 (1):11-20.
71. Campbell BC, Mitchell PJ, Kleinig TJ, et al. Endovascular therapy for ischemic stroke with perfusion-imaging selection. N Engl J Med. 2015;372(11):1009-1018.
72. Jovin TG, Chamorro A, Cobo E, et al. (2015). Thrombectomy within 8 hours after symptom onset in ischemic stroke. *N Engl J Med., 372* (24), 2296-2306.
73. Saver JS, Goyal M, Bonafe A, et al. Stent-retriever thrombectomy after intravenous t-PA vs. t-PA alone in stroke. N Engl J Med. 2015; 372(24):2285-2295.
74. Goyal M, Demchuk AM, Menon BK, et al. Randomized assessment of rapid endovascular treatment of ischemic stroke. N Engl J Med. 2015;372 (11):1019-1030.
75. Grotta JC, Hacke W. Stroke neurologist's perspective on the new endovascular trials. *Stroke. 46,* 1447-1452.
76. Goyal M, Menon BK, van Zwam WH, et al. Endovascular thrombectomy after large-vessel ischaemic stroke: a meta-analysis of individual patient datafrom five randomised trials. Lancet. 2016;387, 1723-1731.
77. Rabinstein AA. Treatment of acute ischemic stroke. *Cerebrovascular Disease, 23*, 62-81.
78. Sheng K, Tong M. Therapy for acute basilar artery occlusion: asystematic review and meta-analysis. *F1000Res, 8,* 165.
79. Alemseged F, Van der Hoeven E, Di Giuliano F, et al. Response to late-window endovascular revascularization is associated with collateral status in basilar artery occlusion. Stroke. 2019; doi: 10.1161/STROKEAHA.118.023361. Online ahead of print
80. Kwak HS, Park JS. Mechanical thrombectomy in basilar artery occlusion: clinical outcomes related to posterior circulation collateral score. *Stroke, 51* (7), 2045-2050.
81. Hofmeister J, Kulcsar Z, Bernava G, et al. The catch mini stent retriever for mechanical thrombectomy in distal intracranial occlusions. J Neuroradiol. 2018;45: 305-309.
82. Grossberg JA, Rebello LC, Haussen DC, et al. Beyond Large Vessel Occlusion Strokes: Distal Occlusion Thrombectomy. Stroke. 2018;49:1662-1668.
83. Kunz WG, Fabritius MP, Sommer WH, et al. Effect of stroke thrombolysis predicted by distal vessel occlusion detection. Neurology. 2018;90:e1742–e1750.
84. Hasan TF, Todnem N, Gopal N,et al. Endovascular Thrombectomy for Acute Ischemic Stroke. Curr Cardiol Rep. 2019;21:112.
85. Sarraj A, Sangha N, Hussain MS, et al. Endovascular therapy for acute ischemic stroke with occlusion of the middle cerebral artery M2 segment. JAMA Neurol. 2016;73:1291–1296.
86. Coutinho JM, Liebeskind DS, Slater LA, et al. Mechanical thrombectomy for isolated M2 occlusions: a post hoc analysis of the STAR, SWIFT, and SWIFT PRIME studies. AJNR Am J Neuroradiol. 2016;37:667–672.
87. Saber H, Narayanan S, Palla M, et al. Mechanical thrombectomy for acute ischemic stroke with occlusion of the M2 segment of the middle cerebral artery: a meta-analysis. J Neurointerv Surg. 2018;10:620–624.
88. Goebel J, Stenzel E, Wanke I, et al. Acad Radiol. 2019;26:e298-e304.
89. Wang J, Qian J, Fan L, et al. Efficacy and safety of mechanical thrombectomy for M2 segment of middle cerebral artery: a systematic review and meta-analysis. J Neurol. 2020. doi: 10.1007/s00415-020-09710-w. Online ahead of print.

90. Nakano T, Shigeta K, Ota T, et al.Efficacy and Safety of Mechanical Thrombectomy for Occlusion of the Second Segment of the Middle Cerebral Artery : Retrospective Analysis of the Tama-REgistry of Acute endovascular Thrombectomy (TREAT). Clin Neuroradiol. 2020;30:481-487.
91. Menon BK, Hill MD, Davalos A, et al. Efficacy of endovascular thrombectomy in patients with M2 segment middle cerebral artery occlusions: meta-analysis of data from the HERMES Collaboration. J Neurointerv Surg. 2019;11:1065-1069.
92. Sweid A, Head J, Tjoumakaris S, et al. Mechanical Thrombectomy in Distal Vessels: Revascularization Rates, Complications, and Functional Outcome. World Neurosurg. 2019;130:e1098-e1104.
93. Haussen DC, Al-Bayati AR, Eby B, et al. Blind exchange with mini-pinning technique for distal occlusion thrombectomy. J Neurointerv Surg. 2020;12:392-395.
94. Chalos V, Le Couffe NE, Uyttenboogaart M, et al. Endovascular treatment with or without prior ıntravenous alteplase for acute ischemic stroke. J Am Heart Assoc. 2019;8 (11):e011592.
95. Desilles JP, Loyau S, Syvannarath V,et al. Alteplase reduces downstreammicrovascular thrombosis and improves the benefit of large arteryrecanalization in stroke. Stroke. 2015;46:3241–3248.
96. Kidwell CS, Latour L, Saver JL, et al. Thrombolytic toxicity: blood brain barrier disruption in human ischemic stroke. Cerebrovasc Dis. 2008;25:338–343.
97. Chandra RV, Leslie-Mazwi TM, Mehta BP, et al. Does the use of IV tPA in the current era- of rapid and predictable recanalization by mechanical embolectomy representgood value? J Neurointerv Surg. 2016;8:443–446.
98. Bellwald S, Weber R, Dobrocky T, et al. Direct Mechanical Intervention Versus BridgingTherapy in Stroke Patients Eligible for Intravenous Thrombolysis: A Pooled Analysis of 2 Registries. Stroke. 2017;48:3282-3288.
99. Broeg-Morvay A, Mordasini P, Bernasconi C, et al. Direct mechanical intervention versus combined intravenous and mechanical intervention in large artery anterior circulation stroke: a matched-pairs analysis. Stroke. 2016;47:1037–1044.
100. Tsivgoulis G, Katsanos AH, Mavridis D, et al. Mechanical thrombectomy improves functional outcomes independent of pretreatment with intravenous thrombolysis. Stroke. 2016;47:1661–1664.
101. Rai AT, Boo S, Buseman C, et al. Intravenous thrombolysis before endovascular therapy for large vessel strokes can lead to significantly higher hospital costs without improving outcomes.J N eurointerv Surg. 2018;10:17-21.
102. Gong L, Zheng X, Feng L, et al. Bridging Therapy Versus Direct Mechanical Thrombectomy in Patients with Acute Ischemic Stroke due to Middle Cerebral Artery Occlusion: A Clinical-Histological Analysis of Retrieved Thrombi. Cell Transplant. 2019;28:684-690.
103. Chalos V, LeCouffe NE, Uyttenboogaart M, et al. Endovascular treatment with or without prior intravenous alteplase for acute ischemic stroke. J Am Heart Assoc. 2019;8 (11):e011592.
104. Vidale S, Romoli M, Consoli D, et al. Bridging versus Direct Mechanical Thrombectomy in Acute Ischemic Stroke: A Subgroup Pooled Meta-Analysis for Time of Intervention, Eligibility, and Study Design. Cerebrovasc Dis. 2020;49:223-232.
105. Young-Saver DF, Gornbein J, Starkman S, et al. Magnitude of Benefit of Combined Endovascular Thrombectomy and Intravenous Fibrinolysis in Large Vessel Occlusion Ischemic Stroke. Stroke. 2019;50:2433-2440.
106. Powers WJ, Rabinstein AA, Ackerson T, et al. 2018 guidelines for the early management of patients with acuteischemic stroke: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. Stroke. 2018;*49* (3):e46–e110.
107. Hao Y, Zhang Z, Zhang H, et al. Risk of intracranial hemorrhage after endovascular treatment for acute ischemic stroke:systematic rewiew and meta-analysis. Interv Neurol. 2017;6:57-64.