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European Stroke Organisation (ESO) – European Society for Minimally Invasive Neurological Therapy (ESMINT) Guidelines on Mechanical Thrombectomy in Acute Ischaemic Stroke

Endorsed by Stroke Alliance for Europe (SAFE)

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Abstract

Background: Mechanical thrombectomy (MT) has become the cornerstone of acute ischaemic stroke management in patients with large vessel occlusion (LVO). The aim of this guideline document is to assist physicians in their clinical decisions with regard to MT.

Methods: These Guidelines were developed based on the standard operating procedure of the European Stroke Organisation and followed the Grading of Recommendations, Assessment, Development, and Evaluation (GRADE) approach. An interdisciplinary working group identified 15 relevant questions, performed systematic reviews and meta-analyses of the literature, assessed the quality of the available evidence, and wrote evidence based recommendations. Expert opinion was provided if not enough evidence was available to provide recommendations based on the GRADE approach.

Results: We found high quality evidence to recommend MT plus best medical management (BMM, including intravenous thrombolysis whenever indicated) to improve functional outcome in patients with LVO-related acute ischaemic stroke within 6 hours after symptom onset. We found moderate quality of evidence to recommend MT plus BMM in the 6-24h time window in patients meeting the eligibility criteria of published randomized trials. These guidelines further detail

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aspects of prehospital management, patient selection based on clinical and imaging characteristics, and treatment modalities.

Conclusions: MT is the standard of care in patients with LVO-related acute stroke. Appropriate patient selection and timely reperfusion are crucial. Further randomized trials are needed to inform clinical decision making with regard to the mothership and drip-and-ship approaches, anesthaesia modalities during MT, and to determine whether MT is beneficial in patients with low stroke severity or large infarct volume.

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Due to space constraints, the print version of this guideline only incorporate the abstract and the synoptic table summarizing the evidence-based recommendations and the expert opinions (table 1). The full guideline document is available online at https://journals.sagepub.com/doi/full/10.1177/2396987319832140

Table 1. Summary of PICO questions, evidence-based recommendations, and expert opinion

PICO Question	Recommendations	Expert opinion
PICO 1: For adults with LVO-related acute ischaemic stroke within 6 hours of symptom onset, does MT plus BMM compared with BMM alone improve functional outcome ?	In adults with anterior circulation LVO-related acute ischaemic stroke presenting within 6 hours after symptom onset, we recommend MT plus BMM, including IVT whenever indicated, over BMM alone to improve functional outcome. Quality of evidence: High ⊕⊕⊕⊕ Strength of recommendation: Strong ↑↑	There is a consensus among the guideline group (11/11 votes) that patients with M2 occlusion fulfilled the inclusion criteria in most randomized trials and therefore mechanical thrombectomy is reasonable in this situation. There is a consensus among the panel (11/11 votes) that in analogy to anterior circulation LVO and with regard to the grim natural course of basilar artery occlusions, the therapeutic approach with IVT plus MT should strongly be considered.
PICO 2: For adults with LVO-related acute ischaemic stroke 6 to 24 hours from time last known well, does MT plus BMM compared with BMM alone improve functional outcome ?	In adults with anterior circulation LVO-related acute ischaemic stroke presenting between 6 and 24 hours from time last known well and fulfilling the selection criteria of DEFUSE-3* or DAWN**, we recommend MT plus BMM over BMM alone to improve functional outcome. Quality of evidence: Moderate ⊕⊕⊕ Strength of recommendation: Strong ↑↑	Patients should be treated with MT plus BMM up to approximately 7 hours 18 min after stroke onset, without the need of perfusion imaging-based selection. 10/11 experts agree that patients can be treated in the 6-12 hour time window if they fulfill the ESCAPE criteria, notably ASPECTS ≥6 and moderate-to-good collateral circulation. However, such patients should preferably be treated in the context of clinical studies. Also, concurrent software applications utilizing similar perfusion algorithms and rendering equivalent volumetry results as those used in the DAWN and DEFUSE-3 trials may be options, as well as simple volumetry on a high quality DWI scan for core volume when applying DAWN criteria. Therefore we advocate further research, inclusion of patients into late window trials, and implementation of institutional imaging standard operating procedures.

(continued)

Table 1. Continued.

PICO Question	Recommendations	Expert opinion
PICO 3: For adults with LVO-related acute ischaemic stroke, does IVT plus MT compared with MT alone improve functional outcome ?	• In LVO-related ischaemic stroke patients eligible for both treatments, we recommend IVT plus MT over MT alone. Both treatments should be performed as early as possible after hospital arrival. MT should not prevent the initiation of IVT, and IVT should not delay MT. Quality of evidence: Very low ⊕, Strength of recommendation: Strong ↑↑ • In LVO-related ischaemic stroke patients not eligible for IVT, we recommend MT as standalone treatment. Quality of evidence: Low ⊕⊕, Strength of recommendation: Strong ↑↑	In LVO-related ischaemic stroke patients eligible for IVT before MT, 7/11 experts suggest the use of tenecteplase (0.25 mg/kg) over alteplase (0.9 mg/kg) if the decision on IVT is made after vessel occlusion status is known.
PICO 4: For adults with suspected acute stroke does the use of a prehospital scale compared with no prehospital scale: • improve identification of patients eligible for MT? • reduce time to reperfusion ?	In patients with suspected stroke, we cannot make a recommendation on the use of a prehospital scale for improving identification of patients eligible for MT. We suggest enrolling patients in a dedicated randomized controlled trial, whenever possible. Quality of evidence: Very low ⊕, Strength of recommendation: -	• 11/11 experts concluded that there is currently not enough evidence to use a clinical scale in routine care to help triage potential thrombectomy candidates in the prehospital field. • All patients suspected of having an acute stroke, irrespective of the time of onset, should undergo emergency imaging of the brain, including vascular imaging.
PICO 5: For adults identified as potential candidates for MT in the prehospital field, does the mothership model, compared with the drip-and-ship model, improve functional outcome?	We cannot make recommendations on whether for adults identified as potential candidates for MT in the prehospital field, the mothership or the drip-and-ship model should be applied to improve functional outcome. Quality of evidence: Very Low ⊕, Strength of recommendation: -	– As there is lack of strong evidence for superiority of one organizational model, the choice of model should depend on local and regional service organization and patient characteristics (vote: 11/11 experts agree). • The mothership model might be favored in metropolitan areas, with transportation time to a comprehensive stroke center of less than 30-45 minutes and the use of the drip-and-ship model when transportation times are longer (vote: 11/11 experts agree). • As there is limited experience with the other two models (drip-and-drive and mobile stroke unit) no expert opinion can be provided when to use these models (vote: 11/11 experts agree).
PICO 6: For patients aged 80 years or more with LVO-related acute ischaemic stroke, does MT plus BMM compared with BMM alone improve functional outcome?	• We recommend that patients aged 80 years or more with LVO-related acute ischaemic stroke within 6 hours of symptom onset should be treated with MT plus BMM, including IVT whenever indicated. Application of an upper age limit for MT is not justified. Quality of evidence: Moderate ⊕⊕⊕, Strength of recommendation: Strong ↑↑ • We suggest that patients aged 80 years or more with LVO-related acute ischaemic stroke between 6 and 24 hours from time last known well should be treated with MT	

(continued)

Table 1. Continued.

PICO Question	Recommendations	Expert opinion
	plus BMM if they meet the eligibility criteria of the DEFUSE-3* or DAWN** trials. Quality of evidence: Low ⊕⊕, Strength of recommendation: Weak↑?	
PICO 7: For adults with LVO-related acute ischaemic stroke, does selection of MT candidates based on a particular NIHSS score threshold compared with no specific threshold improve functional outcome ?	• We do not recommend an upper NIHSS score limit for decision-making on MT. We recommend that patients with high stroke severity and LVO-related acute ischaemic stroke be treated with MT plus BMM, including IVT whenever indicated. These recommendations also apply for patients in the 6-24h time window, provided that they meet the inclusion criteria for the DAWN* or DEFUSE-3** studies. Quality of evidence: High ⊕⊕⊕⊕, Strength of recommendation: Strong ↑↑. • We recommend that patients with low stroke severity (NIHSS 0-5) and LVO-related acute ischaemic stroke within 24 hours from time last known well be included in randomized controlled trials comparing MT plus BMM versus BMM alone. Quality of evidence: Very Low ⊕, Strength of recommendation: -	In patients with a low NIHSS score (0-5) who are not eligible for a dedicated randomized controlled trial, we suggest that treatment with mechanical thrombectomy in addition to intravenous thrombolysis (or alone in case of contraindication to intravenous thrombolysis) may be reasonable: • in patients with deficits that appear disabling (e.g. significant motor deficit or aphasia or hemianopia) at presentation (vote: 9/11 experts) • in the case of clinical worsening despite intravenous thrombolysis (vote: 9/11 experts) • we did not reach a majority vote to suggest mechanical thrombectomy in patients with deficits that appear non-disabling (e.g. mild hypoesthesia) at presentation (vote: 5/11 experts)
PICO 8: For adults with LVO-related acute ischaemic stroke, does selection of MT candidates based on a particular ASPECTS or infarct core volume threshold compared with no specific threshold: – improve identification of patients with a therapy effect of MT on functional outcome ? – decrease the risk of symptomatic intracerebral hemorrhage ?	• In the 0-6 hour time window, we recommend MT plus BMM (including IVT whenever indicated) over BMM alone in LVO-related anterior circulation stroke patients without evidence of extensive infarct core (e.g. ASPECTS ≥6 on non-contrast CT scan or infarct core volume ≤70 ml). Quality of evidence: High ⊕⊕⊕⊕, Strength of recommendation: Strong ↑↑. • In the 6-24 hour time window, we recommend MT plus BMM (including IVT whenever indicated) over BMM alone in LVO-related anterior circulation stroke patients fulfilling the selection criteria of DEFUSE-3* or DAWN**, including estimated volume of infarct core. Quality of evidence: Moderate ⊕⊕⊕, Strength of recommendation: Strong ↑↑. • We recommend that anterior circulation stroke patients with extensive infarct core (e.g. ASPECTS <6 on non-contrast CT scan or core volume >70 ml or >100 ml) be included in RCTs comparing mechanical thrombectomy plus best medical management versus best medical management alone. Quality of evidence: Very Low ⊕, Strength of recommendation: -	If inclusion of the patient in a dedicated randomized controlled trial is not possible, we suggest that treatment with MT may be reasonable on an individual basis in selected cases with ASPECTS <6 or core volume >70 ml (11/11 experts agree). Patient selection criteria might include age, severity and type of neurological impairment, time since symptom onset, location of the ischaemic lesion on plain CT scanner or MRI, and results of advanced imaging, notably perfusion-core mismatch.

(continued)

Table 1. Continued.

PICO Question	Recommendations	Expert opinion
PICO 9: For adults with LVO-related acute ischaemic stroke, does selection of MT candidates based on advanced perfusion, core, or collateral imaging compared with no advanced imaging: • improve identification of patients with a therapy effect of mechanical thrombectomy on functional outcome ? • decrease the risk of symptomatic intracerebral hemorrhage ?	• In adult patients with anterior circulation LVO-related acute ischaemic stroke presenting from 0-6 hours from time last known well, advanced imaging is not necessary for patient selection. Quality of evidence: Moderate ⊕⊕⊕, Strength of recommendation: Weak ↓? • In adult patients with anterior circulation LVO-related acute ischaemic stroke presenting beyond 6 hours from time last known well, advanced imaging selection is necessary. Quality of evidence: Moderate ⊕⊕⊕, Strength of recommendation: Strong ↑↑	
PICO 10: For adults with LVO-related acute ischaemic stroke, does MT performed in a comprehensive stroke center compared with MT performed outside of a comprehensive stroke center: • improve functional outcome? • reduce time to reperfusion? • reduce the rate of symptomatic intracerebral haemorrhage?	• In adult patients with LVO-related acute ischaemic stroke, we recommend treatment in a comprehensive stroke center. Quality of evidence: Very low ⊕, Strength of recommendation: Strong ↑↑	
PICO 11: For adults with LVO-related acute ischaemic stroke, does reperfusion TICI Grade 3 compared with reperfusion TICI Grade 2b improve functional outcome?	For adults with LVO-related acute ischaemic stroke, we recommend that interventionalists should attempt a TICI Grade 3 reperfusion, if achievable with reasonable safety. Quality of evidence: Low ⊕⊕, Strength of recommendation: Strong ↑↑	
PICO 12: For adults with LVO-related acute ischaemic stroke, does MT using direct aspiration compared with a stent retriever: – improve functional outcome? – increase the rate of complete reperfusion?	• There is currently no evidence that contact aspiration alone improves functional outcome compared with BMM in patients undergoing MT. • There is currently no evidence that contact aspiration alone increases the rate of reperfusion over thrombectomy using a stent retriever. • Therefore, we suggest the use of a stent retriever over contact aspiration alone for MT in patients with acute ischaemic stroke. Quality of evidence: Very low ⊕; Strength of Recommendation: Weak↑?	9/11 experts believe that ADAPT may be used as standard first-line treatment, followed by stent retriever thrombectomy as rescue therapy if needed. Besides, • We did not reach a majority vote on that distal aspiration should be used only in combination with a stent-retriever (3/11 experts) • 8/11 experts believe that any MT procedure should be performed preferably in conjunction with a proximal balloon guide catheter.
PICO 13: For adults with LVO-related acute ischaemic stroke undergoing MT, does conscious sedation compared with general anaesthesia improve functional outcome?	We cannot provide recommendations to use general anesthesia or conscious sedation in patients undergoing MT, due to a low quality of evidence and conflicting results between 3 small single-center randomized clinical trials and the best available observational evidence. Therefore, we recommend the enrollment of	We suggest that further randomized multicentric data with less bias should be generated. However, if inclusion of the patient in a randomized controlled trial is not possible, 11/11 experts suggest that local anesthesia or conscious sedation may be favored over general anesthesia, if the patient is able

(continued)

Table 1. Continued.

PICO Question	Recommendations	Expert opinion
	patients in multicenter randomized controlled trials addressing this question. Quality of evidence: Very low ⊕, Strength of recommendation: -	to undergo MT without general anesthesia. On the other hand, general anesthesia does not need to be avoided if indicated. The decision for or against general anesthesia should be made rapidly and delays to induction of general anesthesia should be minimized. We suggest that, according to the three randomized controlled trials, a specialized neuro-anesthesiological or neurocritical care team should perform the general anesthesia procedure, whenever possible. Excessive blood pressure drops should be avoided (see PICO question 14). Adequate monitoring of vital parameters of patients under conscious sedation or local anesthesia is also advised.
PICO 14: For adults with LVO-related acute ischaemic stroke undergoing MT, does maintaining blood pressure to a particular target compared with an alternative target improve functional outcome?	• We suggest to keep blood pressure below 180/105 mmHg during and 24 hours after MT. No specific blood pressure-lowering drug can be recommended. Quality of evidence: Very low ⊕, Strength of recommendation: Weak ↑? • During MT, systolic blood pressure drops should be avoided. Quality of evidence: Very low ⊕, Strength of recommendation: Strong ↓↓	11/11 experts think that the degree of reperfusion should be taken into account in the choice of a blood pressure target after MT, with a lower blood pressure target in case of complete reperfusion.
PICO 15: For adults with LVO-related acute ischaemic stroke and high-grade ipsilateral extracranial carotid stenosis, does cervical stenting in addition to MT compared with MT alone improve functional outcome?	• No recommendation can be provided regarding which treatment modality should be favored in patients with LVO-related acute ischaemic stroke and associated extracranial carotid artery stenosis or occlusion. We recommend the inclusion of such patients in dedicated randomized controlled trials. Quality of evidence: Very low ⊕, Strength of recommendation: -	9/11 experts suggest that if inclusion in a dedicated randomized controlled trial is not possible, patients with high-grade stenosis or occlusion may be treated with intra-procedural stenting if unavoidably needed.

Abbreviations: IVT: intravenous thrombolysis; LVO: large vessel occlusion; MT: mechanical thrombectomy. DEFUSE-3: Endovascular Therapy Following Imaging Evaluation for Ischemic Stroke. DAWN: DWI or CTP Assessment with Clinical Mismatch in the Triage of Wake-Up and Late Presenting Strokes Undergoing Neurointervention with Trevo. PICO: Population, Intervention, Comparator, Outcome.
*DEFUSE-3: 6 to 16 hours since time last known well:
– Age ≤90 years and NIHSS ≥6: infarct core volume <70 ml and penumbra volume >15 ml and penumbra volume/core volume >1.8.
**DAWN: 6 to 24 hours since time last known well:
– Age <80 years: infarct core ≤30 ml if NIHSS ≥10; infarct core ≤ 51 ml if NIHSS ≥20.
– Age ≥80 years: infarct core ≤20 ml and NIHSS ≥10

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GT and JF drafted the PICO questions, which were refined by all authors (GT, PB, UF, PK, KL, MM, PDS, DT, JdV, PW, JF). GT and JF conducted the literature search. GT conducted data extraction and performed meta-analyses. All authors (GT, PB, UF, PK, KL, MM, PDS, DT, JdV, PW and JF) participated in the writing of the first draft of the manuscript. All authors reviewed and edited the manuscript for important intellectual content and approved the final version of the manuscript.

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