Acute Ischaemic Stroke –
Ischaemic Stroke Acute Thrombolysis with or without Thrombectomy

Acute Ischaemic Stroke Successfully Treated with Thrombolytic Therapy and Endovascular Thrombectomy with Non-Contrast Computed Tomography and Computed Tomography Angiogram Protocol

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Keywords

Mechanical thrombectomy · Non-contrast computed tomography · Computed tomography angiogram · Alberta Stroke Programme Early Computed Tomography Score

Abstract

Early endovascular thrombectomy leads to improved outcomes for patients with proximal occlusions when started within 6 h from onset of symptoms. We present a case illustrating the flow of events for a patient who underwent endovascular thrombectomy in our centre after conventional imaging – a brain non-contrast computed tomography (NCCT) and CT angiogram (CTA) – achieving a door-to-groin time of 195 min. The patient is a 65-year-old who presented with signs and symptoms of a left middle cerebral artery (MCA) territory infarct. His National Institute of Health Stroke Scale (NIHSS) score was 15 on presentation and his brain NCCT showed an Alberta Stroke Programme Early CT Score (ASPECTS) of 8. His CTA showed a left MCA distal M1 occlusion with focal calcification and stenosis of the proximal left internal carotid artery. He was subsequently thrombosed and underwent thrombectomy successfully, with a door-to-groin-puncture time of 195 min. A TICI 2b reperfusion was achieved. His NIHSS

score improved to 9 over the next 2 days. For cases with straightforward NCCT and CTA with no contraindications, endovascular thrombectomy should be pursued without delay. A review of the current available literature for the usage of NCCT and CTA as well as the importance of ASPECTS scoring in patient selection for endovascular thrombectomy was included.

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Introduction

In recent years, significant evidence has surfaced to emphasize the beneficial effects of endovascular thrombectomy (EVT) for the treatment of acute ischaemic stroke due to large vessel occlusion, with time from stroke onset <6 h all the way up to 24 h in selected patients. For stroke patients presenting early within the intervention window, the decision to proceed to EVT should be rapid, aiming for fast revascularization. Early EVT leads to improved outcomes for patients with proximal occlusions when started within 6 h from onset of symptoms [1]. We present a case illustrating the flow of events for a patient who underwent EVT in our centre with conventional imaging, which included brain non-contrast computed tomography (NCCT) and CT angiogram (CTA), achieving an onset to recanalization time of approximately 5 h.

Case Report

The patient is a 65-year-old gentleman, an ex-smoker who had had diabetes mellitus type 2 and hypertension for more than 10 years. His symptoms started at 7:45 p.m. with drooling of saliva and stammered speech, followed by right-sided body weakness and difficulty in speech production. Upon arrival to the Emergency Department of the University Malaya Medical Centre at 9 p.m., he was assessed by our neurology team, revealing a blood pressure of 150/75 mm Hg with a capillary sugar level of 7.7 mmol/L. His National Institute of Health Stroke Scale (NIHSS) score at that time was 15, with right-sided body weakness, expressive aphasia and neglect. There were no carotid bruit or cardiac murmurs detected. The electrocardiogram showed sinus rhythm with no arrhythmia.

A brain CT showed an Alberta Stroke Programme Early CT Score (ASPECTS) of 8 with hypodensities on M4 and M6 areas. A CTA showed complete occlusion of the left distal M1 with increased collateral over the left M2 territory (Fig. 1). He was subsequently thrombosed with intravenous alteplase at 10:02 p.m., with a door-to-needle time of 62 min. The interventional radiologist was informed regarding the case midway through the thrombolysis and the decision for mechanical thrombectomy was made. His NIHSS score was 13 upon the completion of thrombolysis and he was pushed to the procedure room for cerebral angiogram. With the aid of the Terumo guide wire and a 5-Fr-long vertebral catheter, an angiogram of bilateral internal carotid arteries (ICAs) was performed showing a left distal M1 complete occlusion with collaterals seen from the left anterior and posterior cerebral artery (PCA) (Fig. 2). Using a Transcend 0.014-inch guidewire, Marksman catheter, Flowgate 8 Fr × 9 cm balloon and a SOLITAIRE retriever, percutaneous balloon-assisted aspiration thrombectomy of the left middle cerebral artery (MCA) was performed successfully, showing thrombolysis in cerebral infarction (TICI) 2b reperfusion of the left MCA at 12:50 a.m. The door-to-groin-puncture time

was 195 min and onset-to-recanalization time was 305 min. The procedure was uneventful, and the patient subsequently improved further with an NIHSS score of 9 over the next 2 days. The repeat CT of the brain showed a frontotemporal infarct with a small haemorrhagic transformation.

Discussion

For eligible stroke patients with straightforward NCCT, CTA and no contraindications, EVT should be pursued without delay. The case here is an example of a patient who presented early and the decision for EVT was made solely based on the timing from onset and simple imaging modalities, namely NCCT with ASPECTS and CTA showing large vessel occlusion. Many large-scale trials for EVT were released over the recent years, two of which, MR CLEAN [2] and ReVASCAT [3], have shown that it is safe to perform EVT with basic imaging modalities such as NCCT and CTA. These studies recruited patients within 6 and 8 h after stroke onset, respectively, and were able to obtain a 13.5–15.5% increase in patients achieving a better functional outcome with no significant increase in intracranial haemorrhage. These trials justify the need to further study the possibility of selecting patients for EVT using simpler imaging techniques. Not only does this approach reduce the time to revascularization, it is also much more readily available and accessible. It may allow a significant reduction in the time-to-groin puncture by bypassing more complex and time-consuming imaging methods [4].

Current guidelines recommend that patients with large vessel occlusion demonstrated on imaging undergo EVT as soon as possible within 6 h [5, 6]. The association between rapid recanalization and better patient outcome is well established. The phrase “Time is brain” strongly emphasizes the concept where neuronal death occurs with every second of delay in the race to reperfusion in acute stroke. Not only that, the proportion of patients eligible for recanalization also declines over time. Post hoc analysis of the Interventional Management of Stroke (IMS) III trial and the Solitaire FR Thrombectomy for Acute Revascularization (STAR) trial has proven that achieving faster reperfusion is associated with a better functional outcome [7, 8]. The dependence of good clinical outcomes on the speed of reperfusion has been emphasized in the HERMES time-to-treatment meta-analysis, and for every hour of reperfusion delay, the absolute risk difference for chances of a good outcome is reduced by 6.7% [1]. A similar trend was also seen in the DAWN trial where the likelihood of achieving a modified Rankin Score of 0–2 at 90 days declined with time since last known normal [9].

When using only NCCT and CTA to decide on EVT, the ASPECTS is invaluable to give an estimate on the amount of salvageable brain tissue. Previous studies suggest that ASPECTS in NCCT may be safely used to select ischaemic stroke patients for EVT [10]. The inter-rater reliability in the analysis of early ischaemic changes in NCCT using ASPECTS is good across the entire scale with most inter-rater differences being within 1–2 points and it has also been shown to improve with increasing time from stroke symptom onset [11]. However, the agreement value drops to moderate for ASPECTS dichotomized at 7 for treatment selection [11]. The cut-off number for salvageable ASPECTS in considering EVT is still under much debate. Both the AHA and Australian Clinical Guideline for Stroke uses the ASPECTS cut-off of 6 and above [5, 6]. A recent study, however, has shown that even in patients with large vessel occlusion and initial low ASPECTS (≤ 5), vessel recanalization was associated with favourable effects on clinical endpoints with a decreased rate of malignant infarctions and an improved

modified Rankin Score [12]. Whether or not the recommended ASPECTS for thrombectomy would be adjusted again in the future, only time will tell.

Previous studies have shown that more advanced and multimodal imaging such as CT perfusion or MRI causes significant delay in time to reperfusion compared to NCCT, with no difference in clinical outcomes, haemorrhage rates, or final infarct volumes [4]. Furthermore, the increased time spent in the selection process may lower the beneficial effects of reperfusion, especially for those with poor collaterals who will benefit the most from the fast timing. Hence for patients without contraindication for EVT, a NCCT and CTA should be used to select patients to save precious minutes in reperfusion. Only if uncertainties are present from conventional imaging would a perfusion scan undoubtedly be helpful to enable more patients who will otherwise be excluded to receive reperfusion therapy.

The vessel occlusion for our patient was in distal M1 of the left MCA. Current guidelines recommend EVT in M1 occlusions and extend the recommendation to M2/M3 in selected cases [5].

The devices used in the EVT in this case included stent retriever as well as aspiration pump. Stent retrievers combines 2 mechanisms of action, namely restoring blood flow with deployment and retrieval of clot using mesh [13]. Stent retrievers, however, have their potential drawbacks including anterior cerebral artery emboli (when treating middle cerebral artery or internal carotid artery occlusions), vessel wall damage, and challenges associated with tortuous aortic arches, cervical, or intracranial arteries [13]. Application of aspiration pump or vacuum syringe during retrieval of the stent has been performed in most case series with the benefit of reducing the number of distal emboli and increasing the amount of clot harvested [13].

Another consideration for this case we presented would be the possibility of going for primary thrombectomy without thrombolysis. Currently it is still unclear if intravenous thrombolysis before EVT gives additional benefits and this question will be assessed in two upcoming randomized-controlled studies (SWIFT DIRECT, MR CLEAN NO IV) [14]. The arguments for pre-EVT thrombolysis include higher reperfusion rates with fewer passes [15], theoretical thrombus softening and reperfusion of distal occlusion after EVT. Furthermore, the rates for reperfusion after intravenous thrombolysis alone is also substantial, ranging from 13 to 52% depending on the artery involved [16]. On the other hand, arguments against pre-EVT thrombolysis include the potential increase in rate of intracranial haemorrhage and thrombus migration [14]. As conclusive evidence is still unavailable, current guidelines recommend that patients eligible for IV alteplase should receive IV alteplase even if EVT is being considered, with neither treatment delaying the other [5, 6].

There is increasing evidence for the usage of NCCT and CTA-based imaging protocols for EVT selection, not only in those less than 6 h, but also in those with late presentation or even wake-up strokes [17]. EVT was found to have similar rates of successful recanalization, intracranial haemorrhage, favourable 3-month outcome, and 3-month mortality in patients beyond 6 h from last seen well, selected based on NCCT and CTA when compared to those <6 h [17]. This again reiterates the beauty of simple imaging modalities to select cases for EVT. Given the overall benefit and influence of time to treatment on outcome, it is important to simplify the imaging modalities used for patient selection in order to achieve a better time to reperfusion.

Statement of Ethics

The authors have no ethical conflicts to declare.

Conflict of Interest Statement

The authors declare that there is no other potential conflict of interest regarding the publication of this paper.

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Author Contributions

Tsun-Haw Toh: acquisition, interpretation of data for the work, drafting, critical revision.
Khairul Azmi Abdul Kadir: substantial contributions to the conception or design of the work, critical revision.

Mei-Ling Sharon Tai: substantial contributions to the conception or design of the work, critical revision.

Kay Sin Tan: substantial contributions to the conception or design of the work, analysis, or interpretation of data for the work, critical revision, final approval.

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Fig. 1. CT angiogram shows complete occlusion of the left distal M1 segment with increased collateral over the left M2 territory.

Fig. 2. **a** There is complete occlusion of the left distal M1 segment on angiogram (blue arrow). **b** Pial-to-pial collaterals (blue arrow) seen from the left ACA and left PCA supplying the left MCA in the delayed phase of cerebral angiogram. **c** Post-thrombectomy shows TICI 2b reperfusion of the left MCA.