Case Report

Do We Know When to Stop The Endovascular Stroke Treatment?: A Case Report With Flat-Detector CT Cerebral Blood Volume Study

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Summary

It is important to know when to abort further attempts in endovascular stroke therapy during the perioperative period to prevent potential complications of late recanalization. Futile recanalization may be due to infarct growth during endovascular stroke therapy and may contribute to poor outcomes. It is possible to select appropriate cases for endovascular stroke therapy with current neuroimaging modalities; however, it is not feasible to evaluate infarct growth during endovascular stroke procedure. Herein we present a case with right middle cerebral artery (MCA) occlusion for which three attempts of thrombectomy with a stent retriever failed to recanalize the MCA. We aborted further attempts at revascularization after assessment of FDCT-CBV, which showed a large MCA territory CBV abnormality during procedure, and transferred the patient for decompressive surgery. The measurement of CBV within the neuro-angiography suite is a promising method that may facilitate patient selection for endovascular treatment and may also guide decision making regarding when to abort or to continue further attempts.

Key words: Stroke, Flat detector, angiography

Endovasküler İnme Tedavisi Ne Zaman Durduracağımızı Biliyormuyuz? Flat-Detektör BT Serebral Kan Volümü Çalışması ile Yapılan Vaka Sunumu

Özet

Endovasküler inme tedavisiyle elde edilen geç rekanalizasyonun komplikasyonunu engellemek için perioperatif dönemde tedaviyi ne aşamada sonlandıracağını bilinmesi önemlidir. İşlem sırasında infarktin büyümesi yararsız rekanalizasyonun sebebi olabilir. Şu andaki mevcut Nörogörüntüleme metodlarıyla anjiyografik müdahale sırasında infarkt gelişimin progresyonunu göstermek mümkün değildir. Sağ hemisferik MCA infarkti gelişen ve üç kez geri çekilen stentle trombektomiye rağmen rekanalize olmayan hastamızda anjiyografi cihazının FDCT-CBV parametresi ile yapılan değerlendirmeye geniş infarkt saptanması üzerine rekanalizasyona ikincil komplikasyon olmasına için işleme son verilmiştir. Hasta dekompresif cerrahiye gönderilmiştir. Peri-operatif anjiyografik CBV ölçümü akut inme endovasküler tedaviyi yönlendirdi ve umut vadedi bir görüntüleme metodu olabilir.

Anahtar Kelimeler: İnme, flat detektör, anjiyografi
INTRODUCTION
Flat-panel detector-equipped angiography systems are increasingly used in institutions for different purposes. The new flat-panel CT-like (FDCT) image application may allow assessment of cerebral blood volume (CBV) in acute ischemic stroke patients and thereby may predict final infarct volume\textsuperscript{4}. Patients with rapid infarction growth may have sustained a larger volume of irreversible injury. To determine the extent of infarction with cerebral blood volume, measurement during endovascular ischemic stroke procedure may guide us for the management of these patients. We, herein, present a case with right middle cerebral artery (MCA) occlusion in which three attempts of thrombectomy with stent retriever failed to recanalize the MCA. We aborted further attempts at revascularization after assessment of flat detector computer tomography –cerebral blood volume (FDCT-CBV) that showed a large MCA territory CBV abnormality during procedure.

CASE PRESENTATION
A 50-year-old man with a history of cigarette smoking presented to Regional Stroke Center with acute onset of left-sided hemiplegia, pronounced left facial drop, neglect, and marked right-sided gaze preference, with a National Institutes of Health Score Scale (NIHSS) of 18. His symptom onset was 9.00 am. A diffusion-weighted (DWI) Magnetic Resonance Imaging (MRI) showed an insular, parietal, and frontal small hyperintense lesions in the right MCA territory (Figure 1A-1C). A Transcranial Doppler (TCD) ultrasound demonstrated a Thrombolysis in Brain Ischemia (TIBI) grade 0 waveform suggesting a right MCA proximal occlusion. Intravenous t-PA therapy was started at 12.00. TCD examination was repeated 30 minutes after the bolus t-PA and showed persistent occlusion of proximal MCA. The patient was transferred to neuro-angiography Suite for the endovascular stroke therapy at 12.45 pm. An arteriogram of the right common carotid artery revealed proximal occlusion of the right M1 segment of MCA. Mechanical thrombectomy was performed with Revive device that is a European-conformity-marked self expanding stent retriever system. The Revive device was positioned to cover the entire length of the occlusion. The device was withdrawn under continuous aspiration through the 6F Envoy XB guiding catheter. Despite three passes with the thrombectomy device, no recanalization was achieved (Figure 2A). At 14.15 pm, 60 minutes after the replacement of microcatheter, FDCT-CBV was performed on a monoplane flat detector angiographic system (Axiom Artis Zee, Siemens). As previously described in the literature, the FDCT–CBV imaging and flat-panel CT procedures and postprocessing were performed\textsuperscript{6}. FDCT-CBV measurement showed a marked CBV decrease in the right MCA territory (Figure 2B-D). Due to a possible large infarct size, we aborted further attempts at revascularization, and decompressive craniotomy was performed. A control CT scan confirmed the similar extension of MCA infarction with petechial hemorrhage in the basal ganglia region (Figure 2E-G). The patient was discharged with a moderate disability (modified Rankin scale 3).
Figure 1A-C: Preinterventional MRI imaging by using diffusion-weighted imaging depict small multiple parietal and frontal lobe diffusion restrictions.

Figure 2: A DSA reveals persistent occlusion of right MCA despite thrombectomy. B-D, Periprocedural FDCT CBV, was performed after unsuccessful recanalization and showed a large area of CBV abnormality. E-G, CT image that was performed after the decompressive surgery showed a large infarction on right MCA territory corresponding FDCT-CBV abnormality and small petechial hemorrhage on basal ganglia region.
DISCUSSION

Despite better recanalization rates in endovascular treatment compared with standard IV rtPA, no clinical improvement was observed in recent randomized trial\(^1\). Hussein et al. introduced the idea of "futile recanalization" and defined as recanalization with no improvement in functional outcome\(^2\). Both extent of irreversible brain injury before treatment and infarct growth during endovascular treatment may hamper the beneficial effect of successful recanalization. Furthermore, treating patients with severe irreversible brain infarctions may increase the risk of symptomatic hemorrhage and can directly offset the benefits of effective reperfusion therapy\(^3\). Hence, it is important to assess the final infarct with different imaging modalities. It is possible to demonstrate pretreatment infarct core with multimodal MRI or CT imaging. However, it is not practical and feasible to evaluate further lesion growth during endovascular acute stroke treatment with standard neuroimaging modalities. FDCT imaging techniques are capable of obtaining high-quality 3D vascular imaging, CT-like-cross-sectional soft-tissue imaging. The new FDCT application may also allow assessment of CBV in acute stroke patients with intravenous application of contrast agent\(^4\). A recent study performed FDCT-CBV immediately after endovascular stroke treatment in 16 patients and demonstrated a high correlation of CBV lesion volume and final infarct volume on follow-up CT\(^4\). Wagner et al. evaluated the cerebral PBV maps immediately before the endovascular thrombectomy and compared them with final infarct volume. In 15 of 20 patients, areas of decreased PBV corresponded to final infarct volume on CT\(^5\). There are also some limitations in the FDCT-CBV studies. Concomitant measurement of CBF and mean transit time (MTT) with CBV is not possible. In addition, in 25% of these patients, FDCT-CBV may overestimate the final infarction\(^5\). Overestimation of PBV abnormality might be most likely related to adequate bolus timing. In intravenous study, imaging acquisition should be started when a contrast is observed in large venous sinus\(^5\). In our case, we observed large sinuses before imaging acquisition and do not consider there to be any problems related to bolus timing. In the present case, thrombectomy was repeated three times, however, no recanalization was observed after 60 minutes of microcatheter replacement. FDCT–CBV imaging was performed and showed a marked, large CBV decrease on right MCA territory, suggesting rapid infarction growth. Due to the possibility of futile recanalization and intracerebral hemorrhage related to large infarction, we aborted our procedure and transferred the patient for decompressive surgery. Our case demonstrates, once again, that the ability to measure CBV with FDCT may show us where to stop endovascular ischemic stroke procedures, especially when treatment has gone on for some time without effective recanalization.

CONCLUSION

Despite some limitations, measurement of CBV within the neuro-angiography suite is a promising tool that might facilitate patient selection for endovascular treatment, and may also guide us in decision making regarding when to abort or to continue further attempts.

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