

Mechanical Thrombectomy of Large Vessel Occlusions in COVID-19 Related Stroke: Endovascular and Clinical Outcomes

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Short Report

Keywords: COVID-19, Stroke, Thrombectomy

Posted Date: July 29th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-49068/v1>

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Abstract

Background and Purpose

Stroke is a drastic complication and a poor prognostic marker of COVID-19 disease which emphasizes the importance of early identification and management of this complication. In this case series, we describe our experience of mechanical thrombectomy of large vessel occlusions (LVO) in patients with COVID-19.

Methods

We performed a retrospective study of a series of confirmed COVID-19 patients who underwent endovascular thrombectomy for acute cerebrovascular ischemic disease with large vessel occlusion. Patient demographics, presentations, lab values, angiographic and clinical outcomes were also reviewed.

Results

Three COVID-19 patients with large vessel occlusion who underwent endovascular thrombectomy were identified in our multi-center institution. Two patients had respiratory symptoms prior presentation and one patient presented initially with clinical deficits. Two patients had anterior circulation occlusion in the middle cerebral artery territory vs one had posterior circulation occlusion in the basilar artery. There was good angiographic outcome post thrombectomy in all patients, however poor clinical outcomes noted with no significant improvement in neurological manifestations in comparison with baseline at presentation. All patients developed critically severe symptoms during hospitalization requiring intubation and one patient died of COVID-19 related respiratory failure.

Conclusion

In this small case series, we noted worse clinical outcomes in COVID-19 related LVO stroke despite effective thrombectomy, which may be related to the underlying COVID-19 disease and/or the nature of clot in these patients.

Introduction

Severe acute respiratory syndrome coronavirus 2 (SARS-Cov-2) is a new strain of coronavirus family emerged in 2019 with its first case reported in Wuhan, China and initially known to present as severe acute respiratory illness in human subjects. The number of people affected by this virus grew exponentially to become a worldwide pandemic in a short time [1].

Our understanding of 2019-coronavirus disease (COVID-19) has evolved over time. Besides the typical respiratory symptoms, COVID-19 may present with various gastrointestinal, renal, neurological and

cardiovascular symptoms [2, 3]. Attention has been drawn lately to the thromboembolic sequelae of this disease, including ischemic strokes, due to the drastic outcome of these complication [4-6]. Though there is apparent significant reduction in stroke cases presenting to the hospitals during the pandemic [7, 8], it was shown that COVID-19 has a high incidence of acute cerebrovascular disease [9].

Recent literature tried to assess the characteristics of stroke among COVID-19 patients [10, 11]. In this case series, we will discuss the findings and thrombectomy outcomes of stroke patients with confirmed SARS-CoV-2.

Methods

Institutional review board approval was obtained for a retrospective study of COVID-19 positive patients with large vessel occlusions (LVO) who underwent endovascular intervention between March 1st and June 20th. Informed consent was waived. We studied patients' demographics, clinical presentations, symptoms to door time, door to treatment time, laboratory findings, National Institutes of Health Stroke Scale (NIHSS), CT angiography (CTA) and CT perfusion (CTP) findings, mechanical thrombectomy procedure and outcome, and clinical outcome assessed by modified Rankin Scale (mRS) as detailed in table 1.

All the 3 patients had a sizeable ischemic penumbra and were deemed candidates for neurovascular intervention, and subsequently underwent mechanical thrombectomy to restore cerebral blood flow.

Results

We have come identified 3 patients with findings consistent with acute stroke on non-contrast head CT, followed by CTA head and CT perfusion studies. All the 3 patients had a sizeable ischemic penumbra and were deemed candidates for endovascular thrombectomy (EVT) according to Endovascular Therapy Following Imaging Evaluation for Ischemic Stroke 3 (DEFUSE 3) criteria [12]. Two patients had anterior circulation LVO and one patient with posterior circulation LVO. Clinical presentation, treatment and outcome are detailed for each patient.

Patient 1

A 75-year-old female with multiple cardiovascular comorbidities and history of left carotid endarterectomy presented to the ER after a syncopal episode at home and was found to have atrial fibrillation (A-Fib) with rapid ventricular response (RVR) that is new for the patient. She stated feeling symptoms of chest tightness and shortness of breath for one week before the incidence of syncopal episode. Fifteen hours later during hospitalization, the patient became unresponsive with dilated pupils, and showed minimal response to noxious stimuli. Stroke protocol was initiated and CT head was significant for hyper-density in basilar artery and loss of gray white matter differentiation in right medial occipital lobe. CTP showed core ischemic changes with mismatch ratio of 4.3 (Figure 1a). CTA head demonstrated complete occlusion of distal basilar artery (Figure 1b). Patient was not a candidate for tPA

(tissue plasminogen activator). Decision was made to give the patient a chance with thrombectomy. Suction aspiration using ACE 64 penumbra catheter was performed and TIC13 flow reconstitution of the basilar artery was achieved (Figure 1 c and d). the patient did not demonstrate significant neurological recovery post procedure. Patient later passed away 4 days post procedure due to cardiac arrest related to hypoxemic respiratory failure secondary to COVID-19 pneumonia.

Patient 2

A 71-year-old female with known history of hypertension, coronary artery disease status post CABG in 2012, asthma, heart failure with reduced ejection fraction, and type II diabetes mellitus who presented to the ER with sudden onset left-sided weakness, left facial droop, and altered mental status culminating in a fall. There were no COVID-19 related symptoms prior to this episode. Initial non-contrast head CT showed loss of gray white matter differentiation in the region of right inferior middle cerebral Artery (MCA) distribution. CTA head demonstrated paucity of the branches distal to the right M1 segment. CT perfusion showed core infarct in the right MCA territory. Patient was normal on the day before, however, the last known normal was uncertain, so she was not considered candidate for tPA. Cerebral angiogram demonstrated occlusion of the right inferior M2 and combined stent-aspiration EVT was performed using Solitaire stent retriever (4x40mm) and ACE 68 Penumbra aspiration catheter with successful TIC12b flow reconstitution (Figure 2a-c). Patient required mechanical ventilation during hospitalization due to COVID-19 related respiratory failure. She had persistent neurological deficit with left neglect and hemiparesis, score of 4 based on mRS at 1 month upon discharge with no significant improvement in comparison with initial presentation.

Patient 3

A 47-year-old female with no medical comorbidities, presented to the ER with right sided weakness, left gaze deviation, and loss of consciousness. Patient was reported to have upper respiratory tract infection symptoms for 4 days, and had been exposed to a COVID-19 positive family member in her household. Patient was candidate for tPA on presentation. Initial non-contrast Head CT demonstrated loss of left insular ribbon and dense left MCA. CT perfusion showed core infarct in the left MCA territory and large ischemic penumbra (Figure 3a). CTA was evident for an abrupt cutoff of the distal M1 segment of left MCA (Figure 3b). She underwent combined stent-aspiration EVT using Solitaire stent retriever (6 mm x 25 mm) and ACE 68 Penumbra aspiration catheter with successful TIC12b flow reconstitution of left MCA (Figure 3 c-e). Patient had persistent aphasia, apraxia, imbalance and dysphagia requiring percutaneous gastrostomy tube for feeding, score of 5 based on mRS at 2 months follow up.

Discussion

COVID-19 pandemic has been shown to have direct and indirect impacts on acute cerebrovascular disease. Prothrombotic state leading to arterial and venous thrombosis is a known complication of this disease with stroke being the most reported neurological presentation [4, 6]. Additionally, SARS-CoV-2 pandemic has led to a significant decrease in the number of stroke cases presenting to the hospitals,

prolonged time from symptoms to hospital arrival and reperfusion [7, 8, 13]. Furthermore, protocols have been suggested to ensure the safety of stroke team personnel during the pandemic but there is no change in the criteria for mechanical thrombectomy [14, 15].

In our series of 3 patients, 2 of them had respiratory symptoms 7 and 4 days prior to presentation and one patient presented initially with neurological deficits and developed respiratory symptoms during hospitalization. All patients had elevated D-dimer on presentation. One of the patients had new onset A-fib with RVR after 7 days of respiratory symptoms with elevated troponin I, which could be a sequelae of COVID-19 related myocardial injury [16, 17], illustrating exacerbation of underlying conditions and COVID-19's prothrombotic state. COVID-19 related myocardial arrhythmia with elevated Troponin may be yet another potential etiology of ischemic stroke, independent from the hypercoagulable state. The two patients with anterior circulation LVO had NIHSS score of 12 and 17, which are comparable to EVT trials with NIHSS range 14-20 [18], in comparison to NIHSS score of 40 in patient with basilar occlusion. All patients eventually developed respiratory failure requiring intubation, consistent with previous reports of acute cerebrovascular events noted in patients with severe COVID-19 disease outcome [10, 19].

Stent-aspiration combination therapy was utilized in the anterior circulation LVOs and aspiration thrombectomy was utilized in the posterior circulation. Though successful revascularization was achieved following all the procedures, persistent neurological deficits were noted in the patients and one patient succumbed to death. The clinical outcomes were noted to be worse in our COVID patients who underwent EVT in a timely manner in comparison with non-COVID patients [18]. These findings could be related to sequelae of clot fragments and migration of microemboli as described by Wang et al. and suggested to be related to the clot composition in COVID-19 patients [15], in addition to the severity of the underlying COVID-19 disease that in conjunction with stroke indicates a worse overall prognosis [6].

It has been reported in the recent literature that the incidence of stroke among COVID-19 patients ranges between 1.1% and 5.7% [5, 6, 9, 19, 20]. However, patients with multiple cardiovascular risk factors are more likely to develop severe COVID-19 disease and also more likely to develop acute cerebrovascular disease [21, 22], which may complicate the potential association between COVID-19 and stroke. Therefore, future studies with multi-institutional cohorts studying a larger patient population will be required to establish a causal relationship and characterize LVOs related to COVID-19.

Declarations

Institutional review board approval was obtained for a retrospective study of COVID-19 positive patients with large vessel occlusions (LVO) who underwent endovascular intervention between March 1st and June 20th. Informed consent was waived.

Competing Interests:

The authors declare no competing interest

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Tables

Table 1: Patient demographics, clinical presentations, laboratory work-up, endovascular and clinical outcomes

Characteristics	Patient 1	Patient 2	Patient 3
Demographics			
Age	75	71	47
Gender	F	F	F
Comorbidities			
	HTN, HLD with **** carotid endarterectomy 2020, New A-fib with RVR	HTN, CAD s/p **** 2012, HF rEF, Asthma, DM type II	None
Symptoms/Presentation			
**** symptoms before presentation	Intermittent chest tightness, dyspnea on exertion, dizziness	None	cough, shortness of breath
**** between onset of COVID **** and Stroke onset	1 week	Not applicable	4 days
Symptoms ** presentation	Syncope, loss of consciousness 15 hours after **** presentation	Left sided weakness *** left facial droop, altered mental status	Right sided weakness, left gaze deviation, loss of consciousness
Respiratory status during hospitalization	Acute **** respiratory failure secondary ** COVID-19 pneumonia requiring intubation	Severe respiratory **** secondary to COVID-19 pneumonia shortly after hospitalization **** intubation.	Acute hypoxemic respiratory failure secondary ** COVID-19 **** intubation
Initial Management			
**** ** door time	Unknown	Unknown	40 minutes
tPA	Ineligible	Ineligible	Yes
Door ** treatment time	15 hours	80 minutes	159 minutes
Laboratory findings			
PT/INR	10.7/1.03	11.8/1.14	10.9/1.05
APTT	29	26.5	21.8
D-dimer(normal <0.50mg/L)	8.21	16.77	2.47
C-Reactive protein (normal <5mg/L)		95	52.9
Interleukin-6 (**** <6)			8
LDH (140-271 U/L)		325	
Ferritin (11-306.8 ng/ml)		98.1	10.4
Troponin I (range 3-17	23	25	

ng/L)			
***** III activity (78-130)		92%	
Fibrinogen (186-466 mg/dL)		600	
Von-***** ***** (60-153)		>300%	
Cardiolipin IgM (***** <15)		20.30%	
***** Scale Rating			
NIHSS at onset	40	12	17
Imaging Findings			
CTA findings	Occlusion distal basilar artery	Occlusion of ***** inferior M2 and paucity of the branches distally	Occlusion of distal M1 segment of left MCA
CT ***** findings	35ml Core infarct ** *** right PCA territory	58ml Core infarct in right *** territory	37 ml **** infarct in **** *** territory
Intervention and Outcome			
Mechanical ***** procedure and outcome	TICI3	TICI2b	TICI2b
Clinical Outcome	Death d/t cardiac arrest from hypoxemic ***** failure secondary to COVID-19 pneumonia.	Persistent neurological ***** ** left ***** and left hemiparesis	Persistent aphasia, weakness, apraxia and imbalance, dysphagia requiring PEG for feeding
Score on mRS scale at final follow-up	-	4	5

Abbreviations: ER (Emergency Room); HTN (Hypertension); HLD (Hyperlipidemia); A-Fib (Atrial Fibrillation); RVR (Rapid ventricular response); CAD (coronary artery disease); CABG (Coronary artery bypass grafting); HFrEF (Heart failure with reduced ejection fraction); DM (Diabetes Mellitus); tPA (tissue plasminogen activator); PT (Prothrombin time); INR (International normalized ratio); APTT (activated partial thromboplastin time); LDH (lactate dehydrogenase); MCA (middle cerebral artery); PEG (percutaneous endoscopic gastrostomy); mRS (Modified Rankin Scale), NIHSS (National Institute of Health Stroke Scale).

Figures

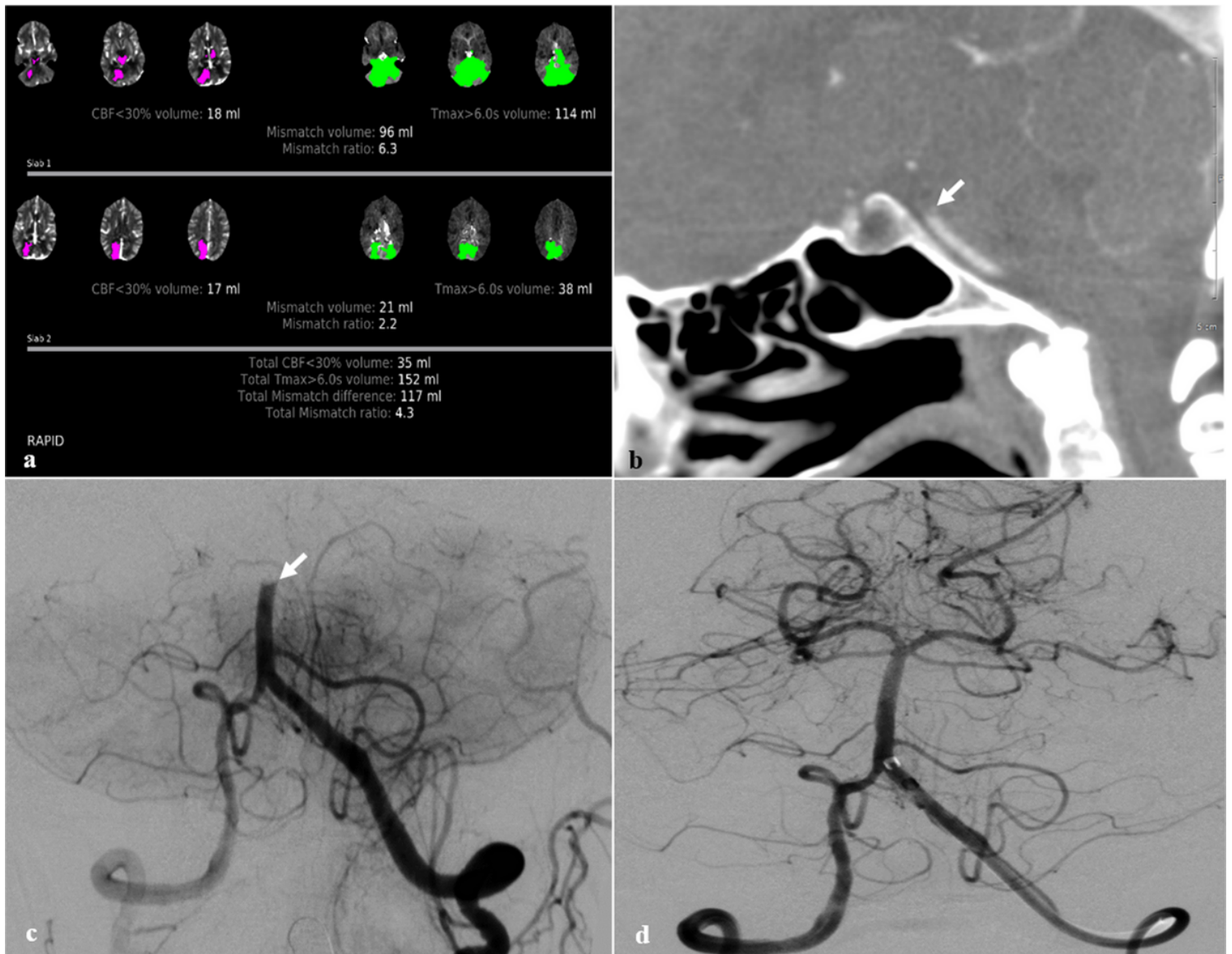


Figure 1

Images obtained for patient No. 1 according to our stroke protocol. 1a CT perfusion demonstrates a core infarction of 35 ml and mismatch ration of 4.3. 1b CTA shows occlusion of the distal basilar artery (arrow). 1c Left vertebral angiogram again reveals basilar artery occlusion. 1d Post thrombectomy angiogram reveals TIC13 perfusion



Figure 2

Multiple cerebral angiograms of patients No. 2. 2a Right internal carotid angiogram demonstrates occlusion of right inferior M2 (arrow). 2b Selective microangiogram of right inferior M2 after thrombectomy shows good opacification. 2c Right internal carotid angiogram shows TIC12b post thrombectomy perfusion

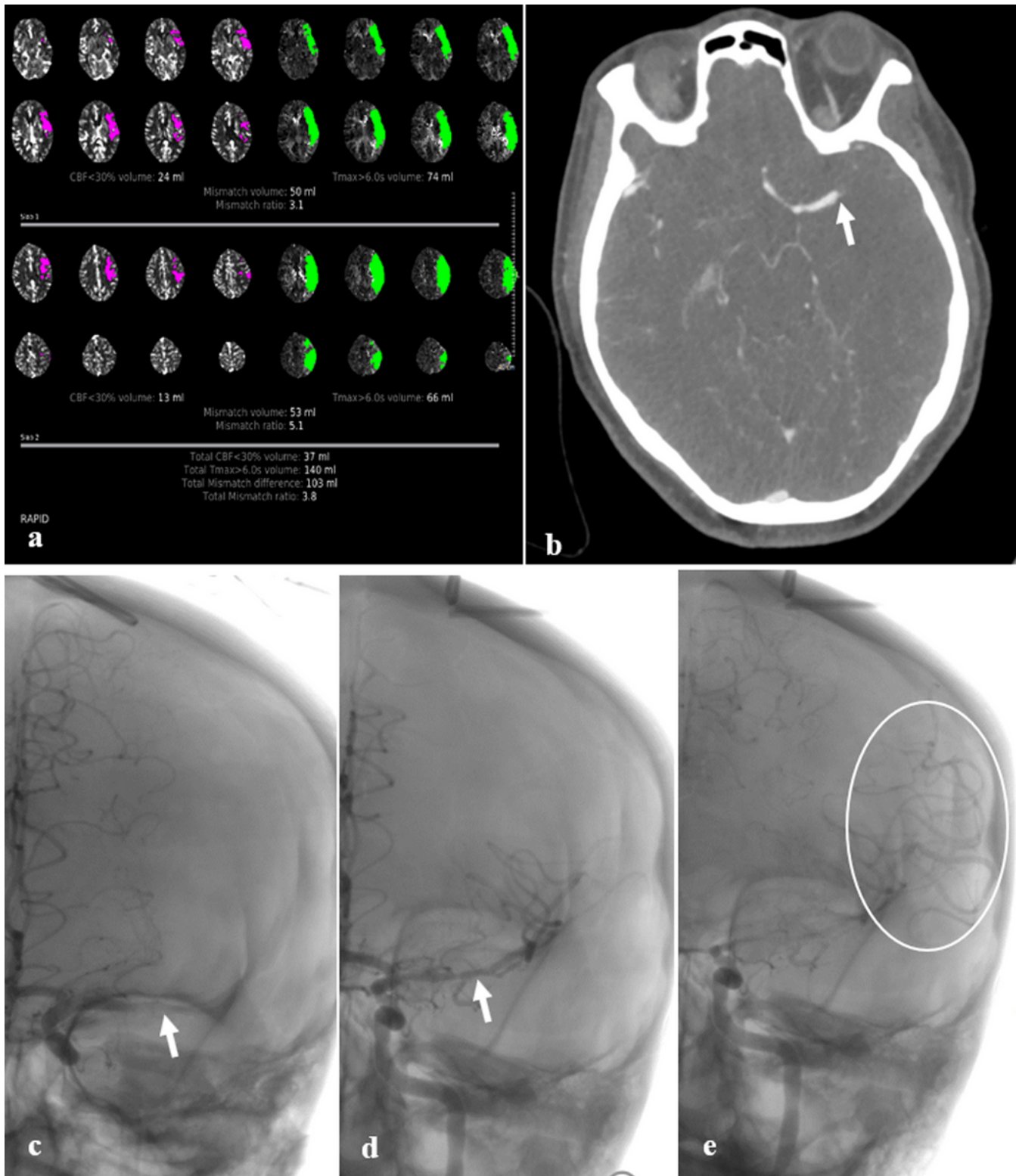


Figure 3

Images obtained for patient No. 3 according to our stroke protocol. 3a CT perfusion demonstrates a core infarction of 37 ml and mismatch ration of 3.8. 3b CTA shows occlusion of the M1 segment of the left middle cerebral artery (arrow). 3c Left internal carotid angiogram demonstrates the left M1 occlusion. 3d and e Post thrombectomy angiograms reveal opacification of the middle cerebral artery (arrow) and TIC12b perfusion (circle)