Multimodal CT imaging in ischemic stroke

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Citation

Wijngaard, I. R. van den. (2017, June 28). *Multimodal CT imaging in ischemic stroke*. Retrieved from https://hdl.handle.net/1887/51104

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Title: Multimodal CT imaging in ischemic stroke
Issue Date: 2017-06-28

CHAPTER 6

Intra-arterial treatment in a child with embolic stroke due to atrial myxoma

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SUMMARY

Arterial ischemic stroke is an important cause of morbidity in children. Timely diagnosis is necessary for acute stroke treatment but can be challenging in clinical practice. Due to a paucity of data there are no specific recommendations regarding the use of mechanical thrombectomy devices in current pediatric stroke guidelines. A 14-year-old-boy presented with a severe acute left hemisphere stroke, due to a proximal middle cerebral artery occlusion, caused by emboli from an atrial myxoma. No clinical improvement was seen after administration of intravenous thrombolysis. Subsequent mechanical thrombectomy with a second-generation stent-based thrombectomy device resulted in succesful recanalization and clinical improvement. To our knowledge, this is the first report of mechanical thrombectomy in a child with acute embolic stroke caused by atrial myxoma.

INTRODUCTION

The estimated incidence rate of arterial ischemic stroke in children ranges from 1.2 to 7.9/100000 per year.[1;2] Pediatric stroke is an increasingly recognized cause of long-term morbidity in the developing child and has an estimated case death rate of 6%.[3] No randomized controlled trials of treatment in acute childhood stroke have been performed. Current consensus guidelines do not recommend the use of thrombolytics outside of clinical trials in children age 14 and younger, although clinical practice in large centers differs.[4] Regarding the use of thrombolysis for older adolescents (age 15 and older) there is also no consensus in the AHA/ASA guidelines.[5]

Pediatric stroke can be caused by several conditions, such as cardio-embolism, vasculopathy and prothrombotic conditions. A rare cause of embolism is the atrial myxoma, which can spread emboli to the central nervous system. In adults with myxoma-related embolic ischemic stroke, there is a concern of a higher risk of hemorrhage after intravenous thrombolysis (IVT) due to concomitant intracranial micro-aneurysms and occult tumor emboli.[6;7] It has been argued to consider known myxoma a relative contraindication to intravenous thrombolytic therapy, however often ischemic stroke is the first presenting symptom of a myxoma.[7] Symptomatic intracranial hemorrhage after IVT has been reported in one of seven previously reported cases, although no micro-aneurysms could be demonstrated on cerebral angiography.[7-13] Successful and safe IVT has been described in younger adults with myxoma related stroke.[9-13] Uncomplicated intra-arterial thrombolysis (IAT) in an adolescent, as well as endovascular thrombectomy after IVT in 4 adults, with myxoma-related ischemic stroke have been reported, although with varying radiological and clinical outcomes.[14-17] We report a case of safe and successful recanalization with subsequent clinical improvement using mechanical thrombectomy after intravenous thrombolysis in a 14-year-old patient with a cardio-embolic stroke due to atrial myxoma. This case supports that mechanical thrombectomy may be considered in the treatment of acute large vessel pediatric ischemic stroke due to atrial myxoma.

6

CASE REPORT

A 14-year-old, right handed boy was presented to our hospital after sudden-onset severe aphasia, left gaze deviation and right-sided hemiplegia, resulting in a Pediatric National Institute of Health Stroke Scale (PedNIHSS) score of 21 suggesting a severe Middle Cerebral Artery (MCA) Stroke. His family history of stroke was negative and he did not use recreational drugs. Prior to his admission he had noticed typical skin lesions. His symptoms started a year before when he noticed purpuric macules on the palms of his hands, the soles of his feet, and calves. The macules seemed to appear after exercise and exposure to cold. Non contrast computed tomography (figure 1A) showed no early ischemic changes except some hypo-attenuation and effacement in the striatum on the left side. CT angiography (CTA, figure 1B-1E) showed an occlusion of the left MCA as well as non-opacification of the left internal carotid artery (ICA) above the carotid bulb, which was interpreted as probable pseudo-occlusion.[18] Good collateral supply of the occluded MCA territory was demonstrated by pial retrograde backfilling almost to the level of the occlusion. CT perfusion (CTP, figure 2) showed an extensive area of the left MCA territory with increased mean transit time (MTT) and time-to-peak (TTP) (figure 2A/2B), while only a limited area showed a decreased cerebral blood volume (CBV) and flow (CBF) (figure 2C/2D), indicating a favorable penumbral pattern.[19]
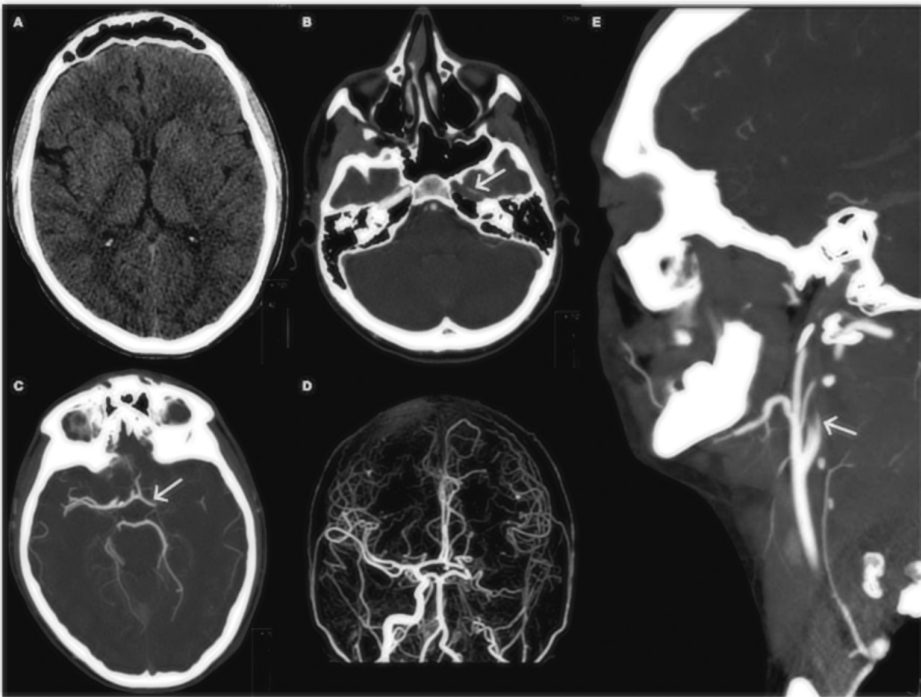

Figure 1: (A) Axial non contrast CT scan without early ischemic changes except some effacement in the striatum on the left side. (B) Axial CT-angiography at the level of the cavernous segment shows absence of contrast at the left internal carotid artery (arrow). (C+D) CT-angiography with maximum intensity projection images of the intracranial arteries shows an occlusion of left middle cerebral artery. (E) Sagittal CT-angiography image shows non-opacification of the left internal carotid artery above the carotid bulbus.
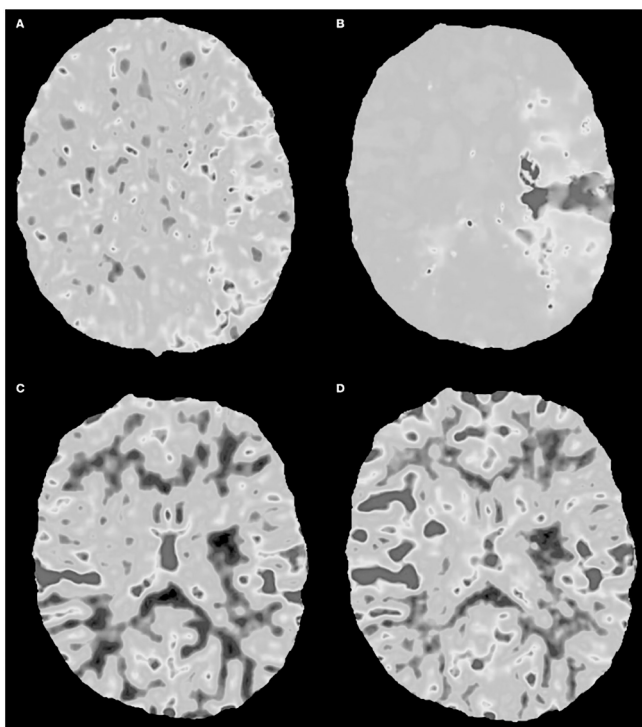
Figure 2 : Axial CT perfusion shows an extensive area of the left middle cerebral artery territory with increased mean transit time (A) and time-to-peak (B), while only a limited area shows a decreased cerebral blood volume (C) and flow (D), indicating a favorable penumbral pattern.

After the patient and his family were informed in detail about the risks, it was decided to treat the patient with IVT 4 hours after onset of symptoms (0.9 mg/kg recombinant tissue plasminogen activator). Because this treatment did not result in rapid improvement of symptoms and based on careful analysis of imaging features showing only a small area of decreased CBV with good collateral supply, our patient underwent subsequent endovascular treatment 5 hours after stroke onset. After puncture of the right common femoral artery, catheterization of the left common carotid artery was performed using a 5F Guider Softip Guide Catheter (Boston Scientific, Natik, MA, USA). Digital subtraction angiography (DSA) confirmed the left MCA occlusion and also showed three small fusiform M3 aneurysms (Figure 3A). The left ICA was catheterized without any signs of occlusion or dissection, which confirmed our diagnosis of an ICA pseudo-occlusion[18]. Mechanical thrombectomy with the Solitaire Flow Restoration device (Covidien/EV3, Dublin, Ireland) was performed, which required only one pass and resulted in successful recanalization, TICI (Thrombolysis in Cerebral Infarction) grade 2b (Figure 3B). The puncture site was treated with 10 minutes of manual compression.
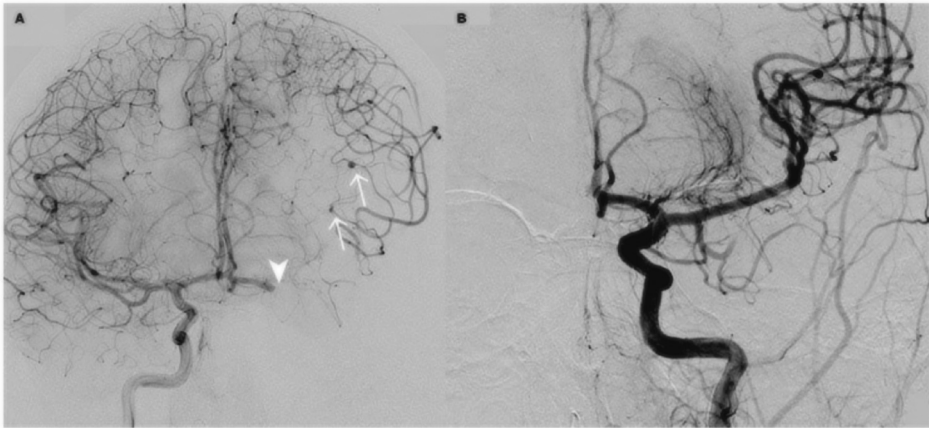
Figure 3: (A) Digital subtraction angiography of the right internal carotid artery shows a left middle cerebral artery occlusion (arrow head) as well as distal middle cerebral artery micro-aneurysms (arrows) (B) Digital subtraction angiography after mechanical thrombectomy, TICI grade 2b.

The next day a central retinal artery occlusion was noted on the left side. Echo-cardiography showed a mass in the right as well as the left atrium, suspected for atrial myxoma (Figure 4).
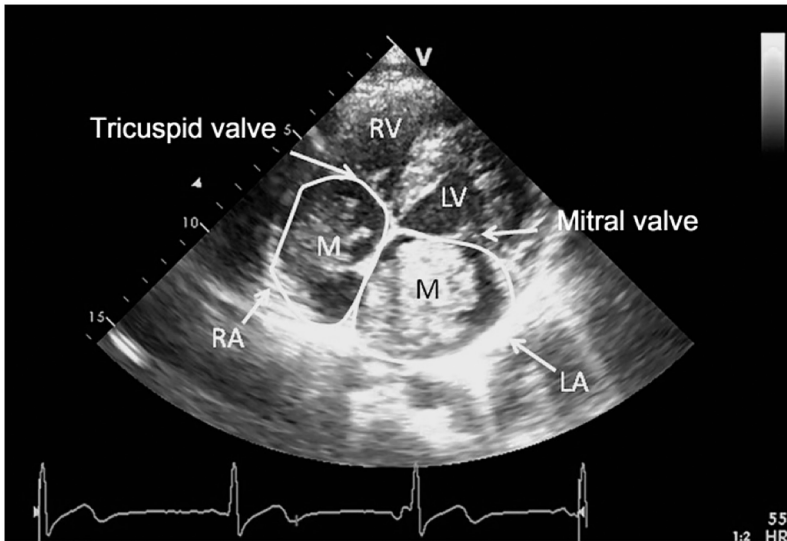
Figure 4: Cardiac Ultrasound, apical 4 chamber view, shows a mass in the right as well as the left atrium (M), which turned out to be a myxoma. (RV=right ventricle LV=left ventricle)

Follow up brain imaging showed a limited area of ischemia in the region of the basal ganglia, parietal cortex and mesencephalon on the left side, without evidence of hemorrhage (Figure 5).
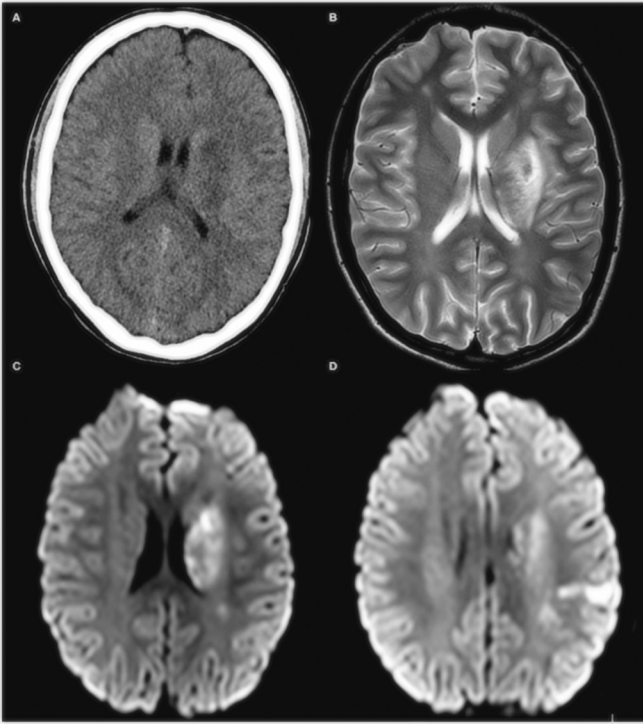
Figure 5: (A) Axial CT scan at day 1 shows a limited area of infarction in the left basal ganglia (B) T2 weighted and (C+D) diffusion weighted MRI at day 7: images show a limited area of infarction in the left basal ganglia and parietal cortex. A limited area of infarction was also noticed in the mesencephalon, not shown in this figure.

Twenty four hours after presentation our patient underwent open-heart surgery and the mass was successfully removed without further complications. Pathological examination confirmed the diagnosis of myxoma. Since the patient had patchy blue pigmented lesions on his foot, the Carney syndrome was suspected. Genetic analysis showed a (de novo) causative mutation of protein kinase A regulatory subunit-1-alpha gene (PRKAR1A) on chromosome 17, which resulted in the final diagnosis of Carney complex type 1, characterized by occurrence of atrial myxomas, skin abnormalities and endocrine tumors. Neurological improvement was noted after mechanical thrombectomy, in which the aphasia disappeared and there was only a mild remaining weakness of the right arm and leg. Visual loss of the left eye, however, persisted. The patient was referred to an ambulant rehabilitation program and later returned to school. At 3 month follow up the Pediatric NIHSS score was 5 and the modified Rankin scale was 2, corresponding with slight disability.

DISCUSSION

The current treatment for children with acute ischemic stroke is difficult because of age-related differences in the coagulation and fibrinolytic systems, different stroke pathophysiology compared to adults and lack of randomized controlled trials in the young population.[4;20] Based on a review of the scarce literature covering endovascular acute ischemic stroke therapy in children, mechanical approaches seem safer than treatment with intra-arterial tissue plasminogen activator because of a lower hemorrhage rate.[21] Recently published cases of pediatric acute ischemic stroke treated with mechanical endovascular therapies suggested that the use of endovascular treatment can be beneficial.[22;23] Successful and safe bridging therapy with IV tPA followed by mechanical thrombectomy in pediatric stroke has also been reported previously.[24] Until data from randomised trials are available to support the use of endovascular thrombolytic therapies in children with ischemic stroke, the management of these challenging cases must be individualized[21], taking into consideration the stroke etiology, the natural history of the disease, the clinical status, imaging features and the experience of the neurointerventional team.

Cardiac disease, which constitutes a potentially modifiable risk factor, is identified in almost 1/3 of children with acute ischemic stroke.[25] Often the diagnosis of cardiac embolism is not made before acute stroke treatment is started. Patients with cardiac myxoma usually present with one or more of the triad of embolism, both cerebral and peripheral, intracardiac obstruction, and constitutional symptoms like fever and weight loss. Recurrent multiple purpuric patches on the palms or soles can be an important clue to the diagnosis of a cardiac myxoma[26], which allows for early diagnosis if recognized. Neurologic manifestations of atrial myxomas are frequent and have been reported in 25-45% of cases, of which embolic stroke is the most common manifestation.[27;28] Emboli from atrial myxoma are composed of thrombus, neoplasm, or a composite of both. Thrombotic emboli are rich in fibrin, similar to other cardiac sources and are likely to be amenable to thrombolysis. The response of a myxomatous embolism to thrombolysis is unpredictable[14 and t]umor emboli from myxoma are unlikely to lyse with thrombolytic therapy[7]. In general prompt resection of a myxoma is required because of the risk of embolization or cardiovascular complications, including sudden death. The results of surgical resection are generally good, with low peri-operative mortality rates.[29;30]

Our patient was almost 15 years old, had severe neurological deficits with an acute large vessel occlusion of undetermined cause at presentation, good collateral status and a suggestion of a large area of salvageable brain. Since there is no consensus in the guidelines[5] regarding the use of thrombolysis for older adolescents, we employed IVT in accordance to the eligibility criteria as used in adults. Because of failure of intravenous thrombolysis and the presence of a favorable imaging pattern, endovascular treatment with a second-generation stent-based thrombectomy device was initiated.

In the present case, the central retinal artery occlusion was likely not related to the endovascular treatment because of a more than 4 hour time difference between procedure and event. Moreover follow up MR-angiography excluded carotid artery dissection. The

visual loss could have been a result of subsequent cardiac embolization [12;31] suggesting a high recurrent stroke risk and in the absence of cerebral haemorrhage an indication for urgent cardiac surgery.

Finally our report confirms the previously documented association between atrial myxoma in younger patients and the formation of multiple cerebral micro-aneurysms.[6] The distal location, fusiform shape and multiplicity are typical for myxomatous aneurysms.[32] To our knowledge, this is the first report in which safe IVT has been described in the presence of multiple micro-aneurysms associated with cardiac myxoma. The presence of myxoma-related micro-aneurysms and the composition of myxomatous emboli could argue against treatment with thrombolytics, while mechanical thrombectomy may carry less risk and have potentially more benefit in such cases. To further investigate the efficacy and safety of thrombolysis and thrombectomy in acute pediatric stroke, collaboration across institutes is needed.

6

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6