



## Case Report

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# Middle Cerebral Artery Dissection in Amusement Park: an Illustrative Case

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Neurological injuries after amusement rides are unusual, but potentially dangerous. Roller coasters have been linked with dissections of the carotid and vertebral artery resulting in strokes. But, middle cerebral artery (MCA) dissection as a cause of amusement park stroke is uncommonly described. We share a case of woman who developed headache and limb weakness after riding a tilt-a-wheel in amusement park. Magnetic resonance angiography (MRA) depicted the dissecting segment with vessel irregularity at the proximal left MCA. The patient treated with anticoagulants and later with antiplatelet agents. She had improved completely with early recanalization of the dissection in follow-up MRA. In conclusion, the riders could be informed the particular risk of cervicocephalic artery dissection (CCD) which occur under diverse contexts for amusement activities. Physicians must have a high index of suspicion for CCD when the riders note neurologic manifestations following violent motions for head and neck in amusement settings.

**Keywords:** Amusement ride, Dissection, Magnetic resonance imaging, Middle cerebral artery

## Introduction

Injuries while going on amusement park rides have become more common in recent years. Among them, the risk of various types of neurologic complications has had a substantial attention. There have been a few reports on case of intracerebral hemorrhage, cervicocephalic artery dissection (CCD), spine fracture, carotid artery thrombosis, subdural hematomas, subarachnoid hemorrhage, posttraumatic migraine, and cerebral infarction [1]. As a cause of amusement park stroke, CCDs associated with roller coaster have been presented in the relevant literature [2].

Arterial dissection (AD) is a relatively rare event; however, it stands as a prominent cause of strokes among young individuals [3]. Nevertheless, the etiologies, clinical features, and treatment for intracranial artery (ICA) dissection remain poorly understood. Furthermore, middle cerebral artery (MCA) dissection following amusement park activity is a rare clinical phenomenon, documented primarily through a limited number of reported cases [4]. Herein, we would like to present an extremely rare case of a young female who developed isolated MCA dissection after a tilt-a-wheel ride. Images are presented and published data are analyzed, in regard to accurate diagnosis and proper management for the patients with CCDs after amusement park visits.

## Case reports

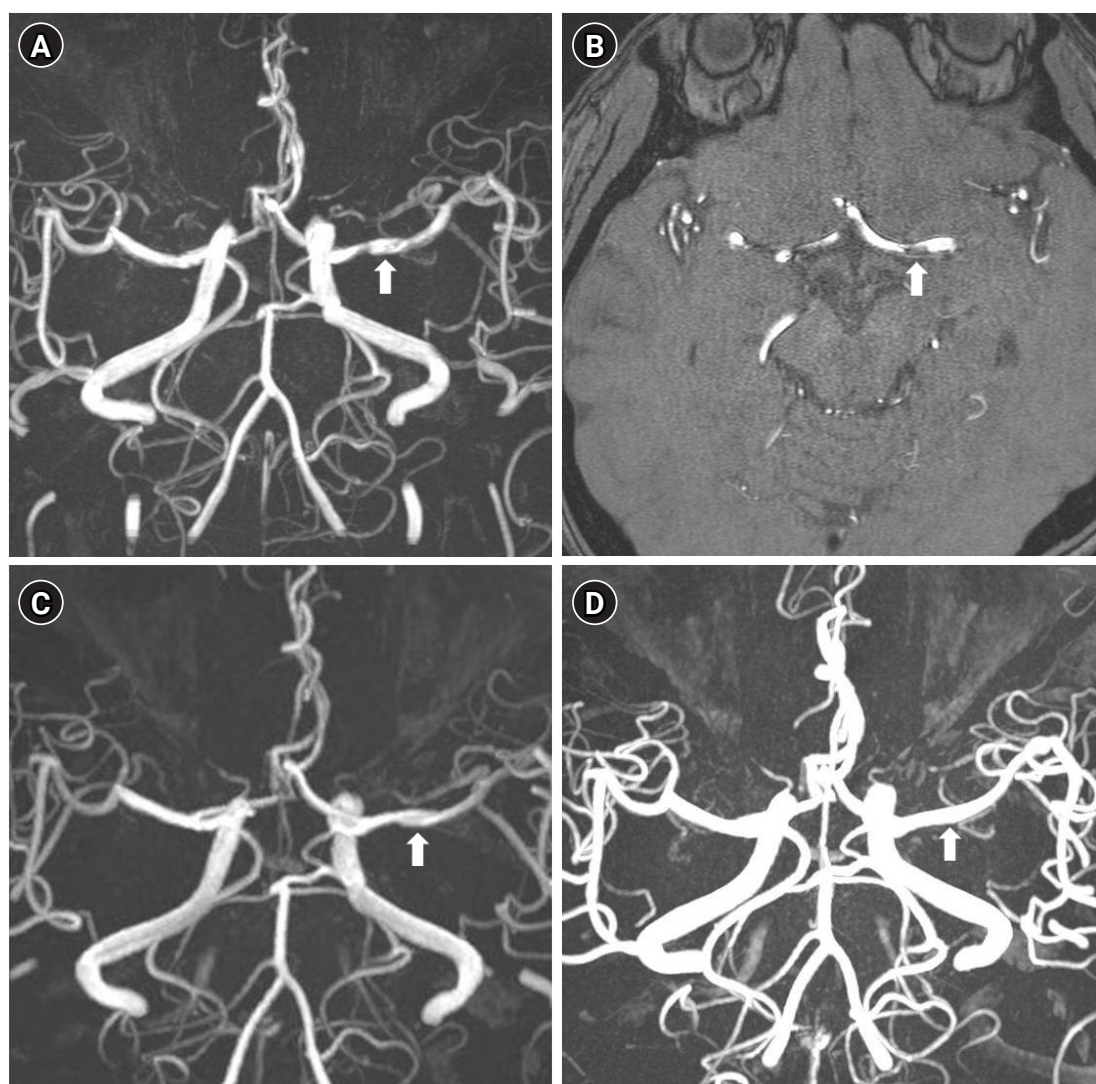
A 25-year-old female had a severe headache and limb weakness that started after tilt-a-wheel use. The spinning platform offered a twisting ride with repeti-

tive, violent jerking motions of her head and neck. She was immediately brought to a tertiary care hospital for therapy. This patient was not taking oral contraceptives and had suffered no recent trauma. There was no family history of thrombotic events or spontaneous AD.

This patient presented to emergency room within 40 minutes of symptom onset. She was oriented and cooperative. Our patient described her headache as a deep and stabbing pain in the left temple. The right upper and lower limbs were slightly flaccid. The vital signs remained stable. On physical examinations, no carotid bruits were audible. She displayed no discernible traits associated with a collagen vascular disorder.

Laboratory investigations yielded normal results, encompassing assessments for hematology, biochemistry, vasculitic markers, thyroid function test, pelvic sonogram, and echocardiogram.

Cervical spine radiography was normal. Head computed tomography (CT) revealed no signs of intracranial hemorrhage. Magnetic resonance image (MRI) including diffusion-weighted sequence was also done, which was unremarkable. Magnetic resonance angiography (MRA) verified that left MCA was narrowed, having a short segment of dilation in its proximal portion. There was an intimal flap within the involved vessel (Fig. 1A, 1B). The clinical history and imaging



**Fig. 1.** Magnetic resonance angiograms in a case of isolated middle cerebral artery dissection (arrows) after tilt-a-whirl ride in an amusement park. (A) It shows multifocal narrowings with intervening segmental dilation in initial part of the left artery. (B) A source image depicts a linear flap-like structure within the dissection. (C) Ten days later, repeat scan reveals the dissecting artery was significantly improved, and only slight dilatation remained. (D) An angiographic configuration in previously involved segment is totally restored at 3-month follow-up image.

findings indicated an isolated dissection in the stem of the MCA.

We admitted this patient to the stroke unit for critical monitoring. Conservative therapy was administered for the patient following assessment of the initial brain images. Medical management included intravenous hydration, analgesics, and antithrombotic agents. Short-term anticoagulation with low molecular weight heparin was initiated, followed by the transition to daily aspirin for this case. Eight hours after treatment, her motor weakness had resolved completely. After a 10-day of uneventful hospital course, she was discharged on antiplatelet therapy. A follow-up MRA revealed recanalization with slight dilatation in the previously dissected vessel (Fig. 1C). She was neurologically intact at outpatient cares after hospital discharge. Three months after her amusement ride, repeated MRA depicted complete restoration of the dissecting segment in the left proximal MCA (Fig. 1D).

## Discussion

The excitement of amusement racings is derived from abrupt and complex changes in body postures. These wild movements have the potential to put the individuals at risk for injury to the arteries of head and neck. CCDs and strokes in amusement parks are highly uncommon, but leave numerous sequelae or might be fatal [5].

For pathogenesis in AD, the traditional thought is the tear between the intima and the internal elastic lamina which cause leak of bloods into the media. Subintimal penetration of blood with subsequent extension of hematoma cause narrowing of the true lumen that may progress to complete occlusion, aneurismal dilation, or both. This is an important etiology for stroke in pediatric and young adults with potential treatment implications [3]. CCDs are usually classified as spontaneous lesions, because patients often do not attribute minor traumas as significant contributors to their conditions. Identifying triggers preceding the stroke is important for comprehending the pathogenesis of ADs. The events comprise of activities like cough, body-wash, laugh, sexual intercourse, and jogging during which straining of the neck may induce injury to the cervical arteries [6]. Furthermore, some selected patients, such as those with collagen vascular disease, inherited angiopathy, fibromuscular dysplasia, arteritis, extreme vessel tortuosity, cervical spine abnormality, pharyngeal infection, atherosclerosis, or cystic medial necrosis, could be more susceptible to ADs [7].

Physical activities related to CCDs included swimming,

scuba diving, skateboarding, backward somersault, jump rope, go-karting, roller coasters, water sliding, yoga, cross-fit, and body-building exercise [8]. Therefore, Inquiring about a history of exertion or trauma can aid in the causative diagnosis of stroke, particularly for individuals without known risk factors. There have been reports on acute CCDs resulting in cerebral strokes attributed to various amusement excitements for adults and children [9]. Following their experiences on high-speed vehicles that capable of a wide array of motions, the riders exhibited neurologic symptoms and signs. The varying directions of high gravitational forces can induce dissection in the cervical arteries, consequently leading to strokes [2]. For adults, from a pathophysiological perspective, rotation and extension of the neck can cause stretching the cervical vessels against the bony structures of the vertebrae, including their bodies or transverse processes [10]. Conversely, pediatric cases are at greater risk of injury during amusement racings because of the physical instability of their neck bones. Due to larger head, ligament laxity, shallow facet joints, immature spine bodies, and weaker paraspinal muscles, hypermobility of the neck is possible in pediatric groups [11].

Among CCDs, MCA dissection is a rare clinical entity that can contribute to the stroke burden of young patients. Moreover, as a cause of amusement park stroke, its occurrence is exceptionally unusual [12]. This implies that MCA is not as likely to be damaged during the amusement park rides, compared to the neck arteries. In theory, MCA dissection appears less commonly than dissection of the extracranial arteries in the neck, because of reduced mobility of MCA, decreasing the risk of damage by contact with an adjacent structure [13]. To date, a case of isolated MCA dissection has not been reported in the setting of a tilt-a-wheel ride for amusing. Our patient had been spun in a circular direction on a table at high speed that jerked her head and neck. Anatomically, previous studies have showed that a stem of the MCA lies proximate to the dorsal portion of the lesser wing in the sphenoid bone, with a measured distance of approximately 10 mm [14]. Subsequently, an acceptable mechanism is the impact of the MCA against the bony edge which caused its dissection in our patient after tilt-a-wheel riding involved repeated head movements.

Radiography plays a crucial role in confirming the diagnosis, since ADs can present with a wide range of appearances depending on the site, degree, and onset of the dissection. Early examination with MRI and CT at emergency department is highly valuable for identifying MCA dissection. For younger cases of minor trauma, the presence of hyperdense MCA sign on unenhanced CT suggests ADs rather than sole-

ly embolic occlusions [15]. Diagnosis of CCDs is typically established through MRI and/or MRA in the head and neck, with its accuracy and minimalism, is often preferred for this purpose. A mural hematoma, steno-occlusion, intimal flap, pearl and string sign, double lumen, pseudoaneurysm formation, and retention of the contrast are typical features [16]. CT angiography can be utilized for diagnosing CCDs with comparable specificity and sensitivity to MRA. However, catheter angiogram still remains the gold standard, and is often reserved for cases with a higher level of neurological suspicion, where a definitive diagnosis is essential. Indeed, this modality should be considered for symptomatic patients who have inconclusive findings in another diagnostic tool [17]. Practically, the serial scans with ultrasonography, CT angiogram, MRI, MRA, or conventional angiography are beneficial in selected cases of CCDs [3]. Hopefully, dynamic regressions in serial MRA appearance of the dissecting MCA were clearly found in this patient. However, follow-up studies with angiographies might reveal variable imaging results, contingent upon the original features of CCDs [16,17].

Twenty-one cases of CCDs linked to amusement rides have been reported as follows: ten patients manifested involvement of the carotid system, nine pertained to the vertebra-basilar system, and two exhibited concurrent impact on both circulation systems [4]. Adults less than 41 years of age accounted for 12 cases, while pediatric patients made up the remaining nine. They encompassed head and neck pains, dizziness, Horner's syndrome, visual blurring, tinnitus, audible bruit, cranial neuropathies, orbital pain, cervical radiculopathy, or more generalized presentations such as ischemic and hemorrhagic stroke [10,12,18]. In clinical setting, it is important to differentiate between other disorders of the cranial-cervical pains and regional neurologic conditions such as migraine, cerebral hematoma, reversible cerebral vasoconstriction syndrome, subarachnoid hemorrhage, and thunderclap headache. Typically, hemorrhagic events occur in 50% to 60% of ICA dissection cases, while ischemic events are observed in 38% to 70% of instances [6]. Dissections presenting with brain ischemia carry a higher rate of future ischemic events, but a lower rate of further hemorrhage. Conversely, dissections in ICA causing cerebral hemorrhage have a higher risk of rebleeding, if the lesions are left unrepaired. In the reports, those of ICA dissections had unfavorable outcomes compared to cases with extracranial lesions, especially among the victims experiencing subarachnoid hemorrhage [19]. We also identified that early confirming ICA involvement is crucial, as there was risk of major infarcts in 30% of cases in the adults,

occurring within a few days even for patients suffering minor symptoms [17,20]. In addition, it is noteworthy that evolution of radiologic findings over time adversely affected the clinical course in seven cases, with challenges to treatment decision-making [3,6,13,15].

There is still no consensus on the treatment for patients with ICA dissections so far. Initially, as in our case, the patients having headaches can often find relief with acetaminophen. Supportive measures such as hydration, control of blood pressure, lowering intracranial pressure, and seizure prophylaxis are complemented with the use of antithrombotic medication. Essentially, the logic behind employing the anti-thrombotics for those of ICA dissections is to minimize symptom recurrence and cerebral infarcts. However, anticoagulants or thrombolytic therapy might pose the risks in cases of MCA dissections due to the potential for oozing within the infarct or exacerbation of dissection [17,19]. In this case of MCA dissection, the patient exhibited a frangible flap in the endolumen of the proximal MCA, which could potentially serve as an origin of further embolizations. Consequently, we initially injected a low molecular weight heparin only in 3 days for early stage, after that it was successfully replaced with an antiplatelet therapy. Our therapeutic strategy appeared to be safe and effective for an unusual case of amusement park stroke. Several endovascular and surgical interventions can be planned for patients in proper clinical condition who develop recurrent stroke despite medical therapy [18]. This approach is also employed to lower the risk of hemorrhage by clamping the proximal vessel or remodeling the dissecting segment, particularly in cases involving larger artery.

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## Ethics approval

This case was reviewed and approved by the Institutional Review Board of Keimyung University Dongsan Hospital (IRB No. 2024-03-029). The requirement for informed consent was waived by the board.

## Conflict of interest

The author has nothing to disclose.



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