Stroke from cervicocephalic arterial dissection in Saudi children

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ABSTRACT

Cervicocephalic arterial dissection (CCAD) is an important, but rarely recognized, cause of stroke in children. We describe 3 cases of CCAD who were diagnosed during a study on childhood stroke which included 104 patients. A high index of suspicion and targeted investigations are needed for the diagnosis and management of CCAD in childhood.

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Cervicocephalic arterial dissection (CCAD) as a cause of stroke is rarely recognized in children, especially if there is no direct trauma to the head or neck. It is implicated in the etiology of approximately 5-20% of ischemic stroke during childhood.[1-4] In our report, we describe 3 cases of childhood CCAD who were diagnosed during a 2-year-prospective (February 2001 - March 2003), and retrospective (July 1992 - February 2001) combined study on childhood stroke which spanned 10 years and 7 months.

Case Reports. ***Patient One.*** A 9-year and 2-month-old girl was referred to the Division of Pediatric Neurology (DPN) at King Khalid University Hospital (KKUH) for the evaluation of right-sided facial palsy and hemiparesis. Two months earlier, she had been admitted to the intensive care unit (ICU) of a regional hospital shortly after developing right-sided hemiparesis while she was playing at the beach on a slider. The parents noticed her to be staring and unresponsive for 5 minutes, aphasic and confused with minimal response to stimuli. After one hour, she regained full motor power in upper and lower limbs and was talking normally. However, she again became aphasic, was confused, and lost her power in the upper and lower limbs. She was afebrile. History revealed that she sustained a fall on her head from a height of 3 meters 5 years earlier, followed by loss of consciousness and convulsions. She was admitted then for one week and discharged without sequelae. Examination in the ICU showed stable vital signs. She was started on carbamazepine and a loading dose of phenytoin with the impression that she could have had post-ictal hemiparesis. Several biochemical and hematologic investigations were normal. Plain cranial CT was normal. Contrast-enhanced brain MRI showed hyperintensity and mass effect in left basal ganglia and parietal cortex; and magnetic resonance angiography (MRA) was reported to be normal. When seen at KKUH, she was well, walking with hemiplegic gait and had right-sided facial weakness and hemiparesis. Brain MRI (**Figures 1a & 1b**) showed old infarction in the area of left lentiform nucleus, also involving the posterior part of the left external capsule and extending up to the periventricular deep white matter. The MRA of the neck vessels showed small caliber of the left internal carotid artery (ICA) compared to the right one (**Figure 1c**). Duplex scan was reported to show no stenosis in either of the extracranial carotid arteries. Hematologic, biochemical and serologic investigations, which were either negative or revealed normal results, included complete blood

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count (CBC), prothrombin time (PT), activated partial thromboplastin time (APTT), protein C, protein S, antithrombin III, hemoglobin (Hb) electrophoresis, liver function tests (LFT), urea and electrolytes (U&E), blood for amino acids, serum ammonia, lipid profile, mycoplasma IgM antibodies, brucella antibody titre, antinuclear antibodies (ANA) and anti-double-stranded DNA. Electrocardiography and echocardiography were also normal. Subsequently, arch aortogram and bilateral common carotid arteriograms were arranged for her 7 months after onset of stroke. These revealed findings similar to MRA. Otherwise, the study was unremarkable.

Patient 2. A 17-month-old boy was admitted in December 2002, through the Pediatric Accident & Emergency (A&E) Unit of KKUH, with history of an episode of left-sided convulsions a few hours earlier. He was well until one week prior to admission, when he fell down while he was riding his tricycle and became drowsy thereafter. The parents took him to a hospital where cranial CT scan was carried out, and they were informed that it was normal. Two days later, he was noted to have weakness of the left side of his body, which spontaneously started to improve gradually. On the day of admission, he started to have frequent attacks of convulsions (8-10 times with brief duration), each lasting for a few seconds followed by weakness of the left upper and lower limbs. He was not febrile then, but had a history of one episode of febrile convulsion at the age of 9 months. On examination, he was drowsy and had left-sided hemiparesis associated with left facial nerve palsy. Examination of other systems revealed no abnormality. Initial unenhanced cranial CT showed a low-attenuation lesion in the right periventricular area associated with mass effect, suggestive of a resolving hematoma. There was no evidence of either fresh bleeding or bone injury. Two days later, brain MRI (**Figure 2**) showed an area of resolving subacute hemorrhage in the posterior limb of the right internal capsule and the right deep periventricular white matter. Hemosiderin deposition was seen in the right frontal lobe. Twenty-four days later, MRA **(Figure 2d)** showed normal caliber and flow in the whole course of the common carotid arteries in the neck, as well as the internal carotid branches bilaterally. However, there was relative reduction in the number of the terminal branches of the right middle cerebral artery (MCA). The vertebro-basilar circulation was unremarkable. The various hematologic, biochemical and serologic investigations, which were either negative or revealed normal results included, CBC, PT, APTT, Hb electrophoresis, protein S, antithrombin III; serum lactate, pyruvate and amino acids; anticardiolipin antibodies (ACA), mycoplasma IgM antibodies, ANA and anti-double-stranded DNA. Protein C was marginally reduced at 68% (N = 70-140%). Electrocardiography revealed normal results.

Patient 3. A previously healthy one-year-old boy was admitted in December 2002 to the Pediatric A&E Unit because of left-sided weakness, which he developed one day prior to admission. A day earlier, he sustained a minor trauma when he fell down from the seat of the family's car to its floor. There was no immediate loss of consciousness, vomiting or abnormal movements. On examination, he looked well, attentive and had no abnormalities detected in the chest, cardiovascular system, or abdomen. Examination of the central nervous system showed left-sided facial weakness and hemiplegia, associated with increased tone and brisk tendon jerks. Cranial CT (**Figure 3**) showed a low-attenuation area in the right caudate head with no midline shift. Brain MRI and MRA (**Figure 3**) revealed infarction of the right cerebral hemisphere particularly within the right basal ganglia, as well as the right parietal lobe. There was narrowing of the right ICA with occlusion of the right MCA. Transcranial Doppler showed severe stenosis of the right MCA (V mean = 300.7 m/sec). Duplex scan of the carotid arteries depicted normal extracranial portions of ICA bilaterally with no signs of arterial dissection. Electroencephalography revealed asymmetry of background with continuous delta activity (1-2 Hz) in the right electrodes, suggesting a structural lesion in the right hemisphere. On the second day of admission, he developed convulsions and was subsequently well controlled on carbamazepine. Investigations showed unremarkable CBC apart from slightly raised platelet count of 517 x 10^9/L. Other hematologic, biochemical and serologic investigations revealed normal PT, APTT, Hb electrophoresis, protein C, antithrombin III, LFT, U&E, serum lactate, pyruvate and amino acids; anti-double-stranded DNA and urine for neurometabolic screening. Protein S was slightly reduced (72%, N=80-140%) whereas ACA was raised. The levels for IgG and IgM ACA were 18 GPL/ml (N=6-12) and 13 MPL/ml (N=6-12). Electrocardiography and echocardiography were both normal.

Discussion. Three children had stroke following anterior circulation arterial dissection (ACAD) at ages ranging between 1-9 years. Dissection of the extracranial and intracranial portions of the carotid (or ACAD) and vertebrobasilar arteries (which constitute the posterior circulation) is an important risk factor for stroke in children.[5-8] In a study by Schievink et al,[9] 18 of 263 (6.8%) consecutive patients with spontaneous cervicocephalic arterial dissections were 18 years of age or younger.

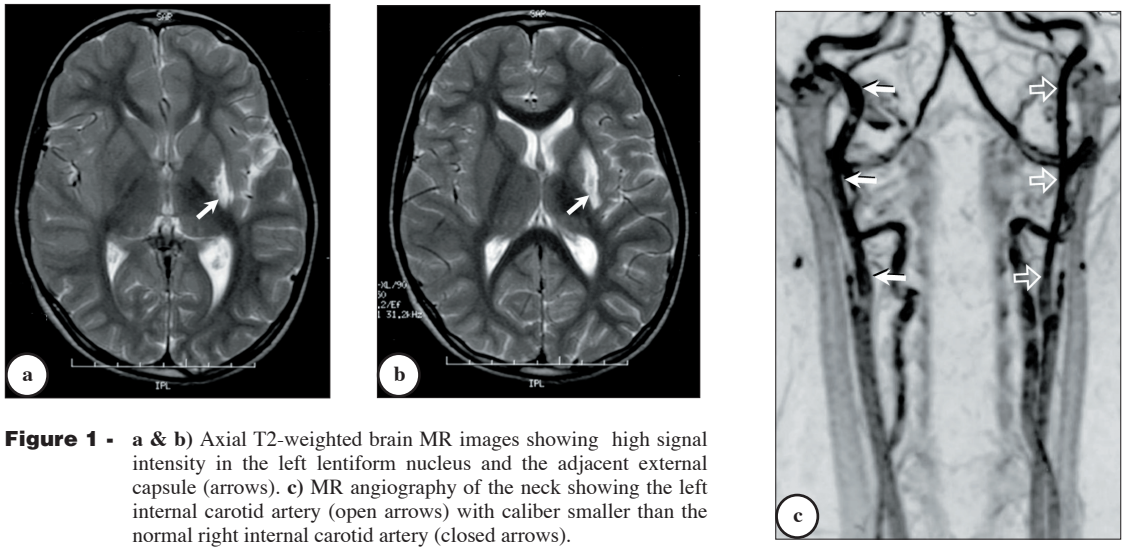

Figure 1 - **a & b)** Axial T2-weighted brain MR images showing high signal intensity in the left lentiform nucleus and the adjacent external capsule (arrows). **c)** MR angiography of the neck showing the left internal carotid artery (open arrows) with caliber smaller than the normal right internal carotid artery (closed arrows).

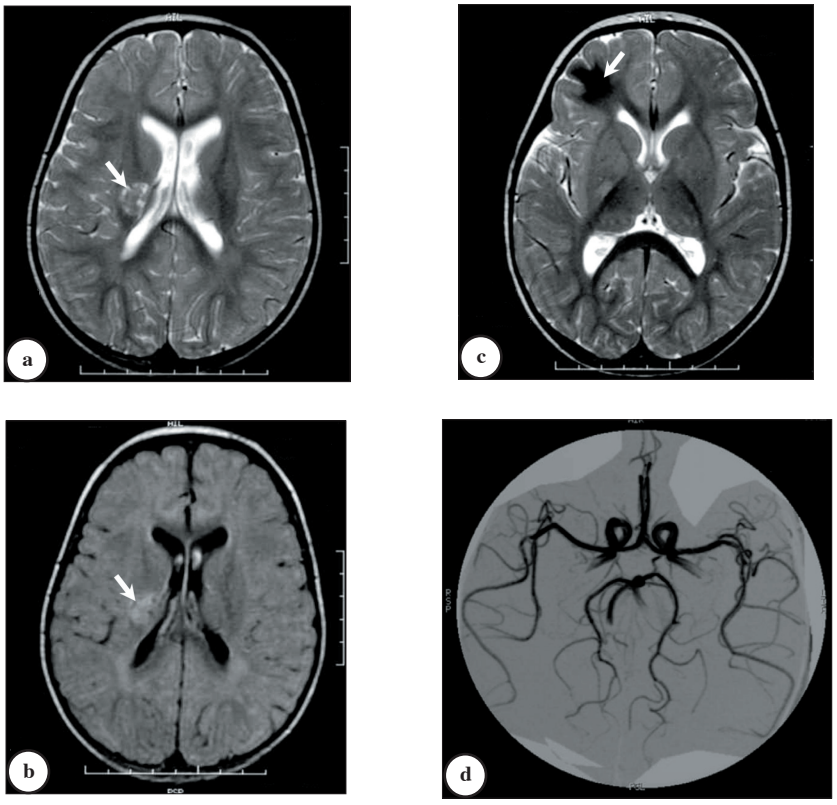

Figure 2 - **a)** Axial T2-weighted brain MR image showing an area of heterogeneous signal intensity (evolving infarct) in the right paraventricular region involving the superior part of the thalamus and the posterior limb of the internal capsule (arrow). **b)** Axial fast fluid-attenuated inversion-recovery (FLAIR) image of the brain at the same level of (a) showing faint high signal intensity in the region of the infarct (arrow) indicating its subacute nature. **c)** Abnormal hemosiderin deposition in the right frontal lobe (arrow) due to old parenchymal bleeding manifesting as remarkably low signal intensity on this axial T2-weighted MR image of the brain. **d)** MR angiogram study of the brain demonstrating relative reduction in the number of branches of the right middle cerebral artery.

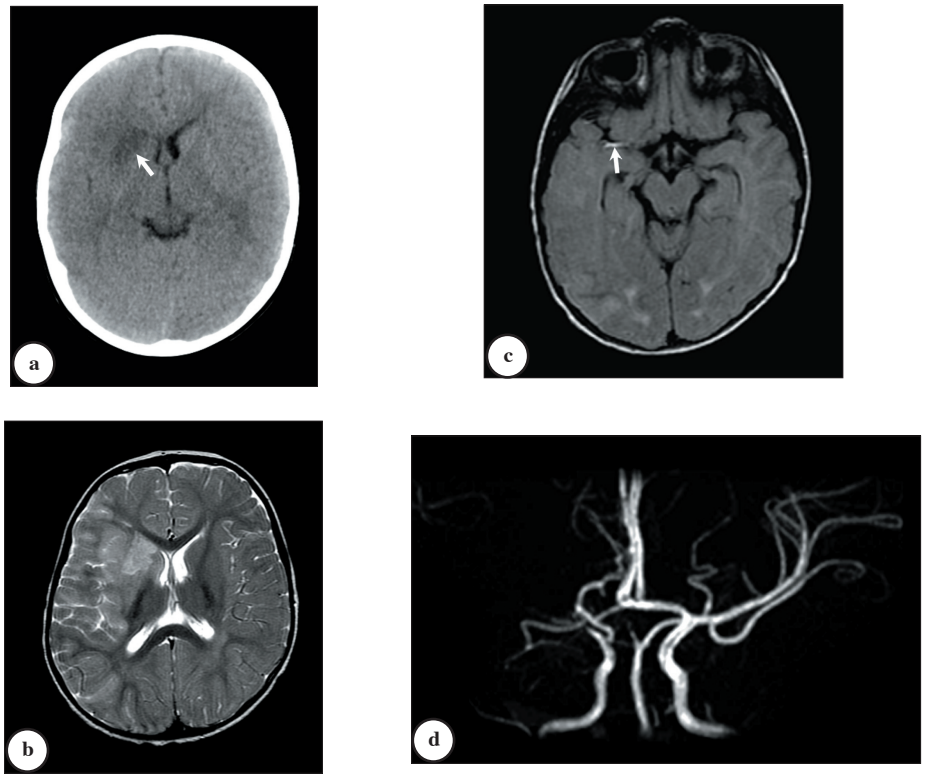

Figure 3 - **a)** Axial CT scan of the brain showing an area of low attenuation in the region of the right caudate head with mass effect on the adjacent right frontal horn (arrow). **b)** Axial T2-weighted MR image showing high signal intensity in the right basal ganglia in the territory of the right middle cerebral artery (MCA) including the anterior limb of the internal capsule. **c)** Axial fast fluid-attenuated inversion-recovery (FLAIR) MR image at the level of the circle of Willis showing linear high signal intensity along the M2 segment of the right MCA indicating intraluminal thrombus (arrow). **d)** MR angiography study showing occlusion of the right MCA and small caliber of the right internal carotid artery.

The 3 children in this series had a clear history of preceding trauma. It is noteworthy that arterial dissection has been reported following only minor mechanism of injury.[10,11] Neurologic symptoms in the 3 children developed either immediately or after 1-5 days following trauma. This conforms with observations that neurologic signs of dissection may be immediate or take hours, days, or weeks before they manifest.[3,11-13] The mechanism of arterial dissection starts with a traumatic or spontaneous rent of the intima allowing blood to penetrate layers of the arterial wall. Occlusion or narrowness of the vessel's lumen by the hematoma created within the arterial wall may lead to cerebral infarction distal to the lesion. In many instances, the trauma does not seem to be severe enough to cause serious damage, suggesting that the artery undergoing dissection may have already been structurally frail.[14,15] In this study, Patient one had probably sustained 2 traumatic events, the more serious of them occurred 5 years earlier. On the other hand, embolism from the site of dissection presents with either fluctuating clinical course or rapid deterioration.[14] Such fluctuating clinical course was clearly depicted in Patients one and 2. Basal ganglia infarcts were seen in Patient one and 3, similar to the observation of Dharker et al[16] in 23 children who developed basal ganglia infarction after minor head injury. Noninvasive diagnosis of ACAD depends on MRI and MRA.[5,11] Cranial CT scans may not be useful at time of clinical injury, as shown in Patients one and 2.[11,13] Conventional angiography remains the gold standard.[8,12] Narrowing of the arterial lumen for up to several centimeters "string sign" is diagnostic. However, tapering of the lumen to complete occlusion is more common.[17] Extension into the middle or anterior cerebral arteries of a carotid dissection has been reported.[18,19] A dissection may also be confined to these vessels; and complete resolution of the dissection on follow-up angiography has been observed in some individuals.[17] Recently,

the use of noninvasive contrast-enhanced MRA is replacing conventional angiography for evaluation of most carotid and vertebral artery diseases as it permits acquisition of high spacial resolution.[20] It is noteworthy that noninvasive MRA was helpful in the 3 patients since it showed narrowing of the left ICA in Patient one, reduction in the number of terminal branches of the right MCA in Patient 2 and narrowing of the intracranial portion of the ICA with occlusion of the right MCA in Patient 3. Conventional angiography, carried out in Patient one 7 months following her stroke, showed the left ICA to be smaller than the right one, and was compatible with the MRA carried out 5 months earlier. A healing process might have been working in this child, which ameliorated the degree of narrowing of the affected left ICA.

The risk for recurrent dissection (particularly occurring in the few months immediately following presentation) was 12% in a study spanning 10 years in children and adults.[9] In a recent review of 118 reported cases of arterial dissection in children,[6] posterior circulation dissection (15%) was more commonly associated with recurrent strokes than dissection of the anterior circulation (10%). Therapeutic guidelines for the prevention of such recurrences in CCAD have evolved through time. One approach was to start aspirin in children who are stable and heparin in those with worsening or fluctuating symptoms.[17] Another recommendation was to treat all children with arterial dissection with heparin for approximately one week until the risk of deterioration lessens.[17] Recently, 2 sets of guidelines have been published.[21] One of these recommended to consider anticoagulation until evidence of vessel healing or up to 6 months.[22] The other one recommended using heparin or low molecular weight heparin (LMWH) for 5-7 days and then treating with LMWH or warfarin for 3-6 months.[23]

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