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Case Report

CASE REPORT

Stroke in Pediatric Diabetic Ketoacidosis: Case Series

by Chandrika Azad,[1] Ravinder Kaur,[2] Dharmendra Kumar Singh,[2] and Adhi Arya[1]

[1]Department of Pediatrics, Government Medical College and Hospital, Chandigarh 160030, India
[2]Department of Radiodiagnosis, Government Medical College and Hospital, Chandigarh 160030, India
Correspondence: Chandrika Azad, Department of Pediatrics, Government Medical College and Hospital, Chandigarh 160030, India.
E-mail <Chandrika_azad@yahoo.co.in>.

ABSTRACT

Diabetic ketoacidosis (DKA) can present with various neurological complications, but stroke is rare. Here, we present three children with recent-onset diabetes with DKA, two of them had deep coma not responding to standard DKA regimen and the third one had seventh nerve palsy noted after recovering from coma. Computed tomography scan of head showed hemorrhage in the area of mid-brain in one patient and infarcts in two patients. In any child of DKA with severe neurological impairment, possibility of stroke should be entertained.

KEYWORDS: diabetic ketoacidosis, stroke, children

INTRODUCTION

Diabetes ketoacidosis (DKA) is a common pediatric emergency. It is a state of severe insulin deficiency presenting with severe hyperglycemia, ketosis and metabolic acidosis. Usual neurological complication of DKA is cerebral edema, which occurs in about 6.8 per 1000 DKA cases and is associated with 24% mortality [1]. Apart from cerebral edema, ischemic and hemorrhagic stroke can also occur rarely. Here, we present three cases of patients with type 1 diabetes mellitus who presented with stroke.

CASE REPORT

Case I

A 6-year-old child presented with polyuria and polydypsia for 2–3 days, vomiting and altered sensorium for 1 day and brief and spontaneously aborted single-episode generalized tonic-clonic seizure few hours back. He was taken to a private hospital for these complaints where intravenous fluids were given for dehydration. At admission, heart rate was 90 beats/min, respiratory rate was 30 breaths/min, breathing was deep and ataxic, oxygen saturation was

99%, blood pressure was 106/70 mmHg and peripheral pulse volume was good. There were signs of dehydration. There was no pallor, icterus, cyanosis or rash. The child had a Glasgow Coma Scale (GCS) of 5 (E1V1M3). Pupils were dilated (right > left). Intermittent decorticate posturing was observed. There were no signs of meningeal irritation. Provisional diagnosis of new-onset diabetes in DKA with cerebral edema was made. In view of poor sensorium, the patient was intubated and put on ventilatory support. Initial investigations were suggestive of DKA (Table 1). Hemogram showed Hb of 13.1 g/dl, platelet count of 1.6×10^5/cmm and total leukocyte count (TLC) of 16 200/cmm, with 81% neutrophils. Initial serum electrolytes and renal function tests (SERFT) were within normal limits, but after 12 h, serum sodium increased to 189 mEq/l. Liver function tests and coagulogram were within normal limits. Cerebral computed tomography (CT) scan was performed, showed hemorrhage in the midbrain area with obstructive hydrocephalus (Fig. 1A and B). Patient was managed on the lines of DKA. In view of raised intracranial pressure (ICP), hypertonic saline was started. For persistent raised ICP, a frontal external ventricular drain (EVD), from which clear cerebrospinal fluid was drained, was placed by a neurosurgeon. Despite the EVD, raised ICP did not improve and, ultimately, the patient died at the 27th hour of admission.

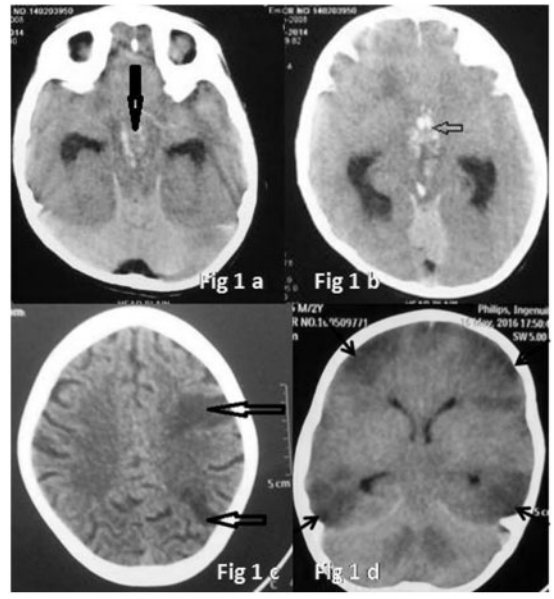

FIG. 1. (**A** and **B**) Axial section of plain cerebral CT scan shows hyperdensities in the midbrain (arrow in Fig. 1A) and along internal cerebral veins (arrow in Fig. 1B) due to haemorrhage and thrombosis. (**C**) Axial section of plain cerebral CT scan shows hypodensities in high frontal and posterior parietal region (arrows) on left side due to infarction. (**D**) Axial section of plain cerebral CT scan showing multifocal infarcts (arrows) involving cortical and subcortical regions of the frontal and temporal lobes.

Case II

A 9-year-old girl presented with complaints of polyuria and polydypsia for 1 week, vomiting and abdominal pain for 2 days and altered sensorium and breathing difficulty for few hours. There was no history of fever, rash, loose stool, recent or chronic drug intake or trauma. Past history and family history were non-contributory, and neurodevelopmentally, the child was normal. At admission, heart rate was 146 beats/min, breathing was deep and acidotic, respiratory rate was 20 breaths/min with features of severe respiratory distress, blood pressure was 100/62 mmHg and oxygen saturation with pulse oximeter was 98% on face mask oxygen. GCS score was 11 (E3V3M5); no focal neurological deficit or meningeal signs were there. Blood sugar measured with glucometer was 500 mg%. Provisional diagnosis of DKA was made. In view of severe respiratory distress, child was intubated and put on a ventilator. Blood gas and SERFT findings are shown in Table 1. Her hemoglobin was 12.5 g/dl, TLC was 5000/cmm with 82% lymphocytes and platelet count was 190×10^5/cmm. Glycosylated hemoglobin was 13.8%. Lipidogram was normal. Patient was started on therapy for DKA as per standard protocol. She required ventilatory support for 9 h, and was thereafter extubated. Around 48 h of admission, she became alert, but aphasia and right complete hemiparesis were noted. Cerebral CT scan was performed, which suggested presence of an infarct in the left frontal and parietal area (Fig. 1C). Electrocardiography, echocardiography and Doppler ultrasonography results of carotid vessels were normal. Coagulogram was within normal limits. Patient was started on subcutaneous insulin and aspirin on Day 3. Her weakness gradually improved over next 3 weeks, and she was discharged.

Table 1. Investigation findings

Investigations	Case I	Case II	Case III
Random blood sugar (mg/dl)	329	500	762
Urinary ketones (dipstick)	4+	4+	4+
pH	7.28	6.86	7.29
pCO2(mmHg)	28.2	63.2	20.3
pO2 (mmHg)	52.6	81.6	43.4
HCO3 (mmol/l)	13.7	10.8	9.6
Serum sodium (mEq/l)	138	129	142
Serum potassium (mEq/l)	4.2	3.8	6.1
Blood urea (mg/dl)	48	39	90
Serum creatinine (mg/dl)	1.0	0.6	0.9
Neuroimaging	Hemorrhage in midbrain area	Infarct in left hemisphere	Multifocal infarcts

Case III

A 2-year-old boy presented with fever and vomiting for 2 days and altered sensorium for 1 day. There was no history of rash, recent or chronic drug intake, trauma or ear discharge. Past history and family history were non-contributory. At admission, the child was sick, heart rate was 120 beats/min, respiratory rate was 48 breaths/min, temperature was 39°C and no features of shock were observed. GCS was E2V1M5. Pupils were bilaterally equal, 2–3 mm in size with poor reaction to light; doll's eye movement was sluggish. On neurological evaluation, there were no signs of meningeal irritation, tone was increased in left lower limb and deep tendon reflexes were brisk. Cranial nerves and fundus examination were normal. Rest of the systemic examination was non-contributory. Provisional diagnosis of febrile encephalopathy was made. Investigations supported diagnosis of DKA (Table 1). Hemoglobin was 12 g/dl, TLC was 16 000/cmm with 80% neutrophils. Rapid diagnostic test for malaria was negative. Because of poor GCS and severe respiratory distress, patient was intubated and put on a ventilator. He was started on therapy for DKA as per standard protocol. Broad-spectrum antibiotics were administered for fever. Despite treatment, sensorium did not improve, so the possibility of cerebral edema was considered, and the patient was started on mannitol at 6 h of admission. Non-contrast cerebral CT scan was performed, which showed presence of multifocal infarcts (Fig. 1D). At 16 h of admission, pupils became fixed and dilated. Because of lack of financial resources and grave prognosis, parents took the patient home against medical advice at 20 h of admission.

DISCUSSION

Approximately 10% of intracerebral complications of DKA are due to stroke [2, 3]. DKA is associated with systemic inflammation characterized by elevated levels of inflammatory markers (C-reactive protein) and cytokines [interleukin (IL) 6, IL-1β and tumor necrosis factor α)] and complement activation [4, 5]. A procoagulant state results due to vascular endothelial perturbation, abnormal levels and activities of several coagulation factors and platelets. In addition to it, disturbances in blood volume and viscosity, cerebral autoregulation, systemic hypoperfusion and cerebral edema contribute to vascular injury. Above factors operate in ischemic and in hemorrhagic stroke [3, 6]. In addition to this, disseminated intravascular coagulation can also contribute to hemorrhagic stroke. In a study on pooled data from pediatric DKA with stroke, 57% (16/28) of the patients presented with diabetes for the first time. In total, 36% (10/28) of the patients had hemorrhagic stroke and had poorer outcome (25% mortality) as compared with ischemic stroke (11%) [3].

In all of our patients, diabetes was diagnosed for the first time at admission only. Cases I and III showed features of neurological involvement even at admission in the form of poorer GCS, abnormal pupil size and response and focal neurological signs.

As stroke in DKA can easily be confounded to cerebral edema, high index of suspicion and early recognition are required for optimal management.

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