Management of altered mental status—Hyperventilation due to panic in a child with juvenile diabetes—A case report

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Abstract  Altered mental status (AMS) is a symptom complex that has various causes and treatments, many of which require timely intervention. Hyperventilation as a component of panic attack may give rise to AMS as it causes a chemical imbalance in the blood. Pediatric dentists must be able to recognize symptoms of AMS which result from hyperventilation and panic attacks and be able to differentiate them from hypoglycemia or diabetic ketoacidosis which may be exhibited in children with both panic attacks and diabetes mellitus.

Introduction
Alteration in the level of consciousness of a dental patient is a frightening experience for dentist and patient alike. When the patient is a child and has an underlying metabolic disorder such as diabetes mellitus, prompt diagnosis and emergency management becomes critical.

Consciousness consists of content and arousal. Content relies on the communication of the cerebral hemispheres to integrate and organize information and processes, while the reticular activating system (RAS) and upper brain stem govern arousal. Disturbances in consciousness occur when disease processes interrupt the functioning of content, arousal, or the communication between them. Presence of an underlying pathology or chemical imbalance may therefore exacerbate altered mental status.

Hyperventilation is often a compensatory mechanism to overcome fear however persistent hyperventilation can cause changes in the acid base balance, which in turn affects consciousness. It has been suggested that hyperventilation is a cause, a correlate, or a consequence of panic attacks seen in patients with panic disorder.

A panic attack is defined as a period of intense fear or discomfort, in which of four or more of the following symptoms develop and reach a peak within 10 minutes:

- Palpitations, pounding heart, or accelerated heart rate
- Sweating
- Trembling or shaking
- Sensation of shortness of breath or smothering
- Feeling of choking
- Chest pain or discomfort
- Nausea or abdominal distress
- Feeling dizzy, unsteady, light headed, or faint
- Derealisation (feelings of unreality) or depersonalisation (being detached from oneself)
- Fear of losing control or going crazy
- Fear of dying
- Parasthesis (numbness or tingling sensations)
- Chills or hot flushes

Panic disorder is defined as the presence of recurrent, unexpected panic attacks followed by at least 1 month of persistent concern about having another panic attack, worry about the possible implications or consequences of the attacks, or a significant behavioral change related to the attacks.

The presentation of hyperventilation during a panic attack may mimic either hypoglycemia or diabetic ketoacidosis, making the diagnosis very difficult.
difficult in a child with diabetes mellitus\textsuperscript{10,11}.

**Case Report**

An 8 year-old female with a history of type I or insulin dependent diabetes mellitus (IDDM) was referred by her physician to the clinic with a history of pain in the upper left posterior tooth. The patient was moderately built and nourished and showed no gross physical abnormality. The child was 125 cm tall and weighed 25 kg. She was taking 8U porcine insulin in the morning and 16U porcine insulin at night and Fasting Blood glucose (FBG) and Post Prandial blood glucose were within the normal range. The Hb1Ac level of the patient (measured two weeks before the appointment) was 6.2%. The patient had eaten 15 minutes before the scheduled appointment.

A family history showed that the child was the youngest of five children. Behavioral history revealed that the child was prone to temper tantrums and what her mother described as “attention seeking behavior”.

An examination of the patient showed that there was deep dental caries in the upper left primary second molar (tooth no. 65) (Fig. 1) with the x-ray photograph suggestive of pulpal involvement (Fig. 2).

The tooth was tender on percussion. A pulpectomy was planned on the tooth and buccal infiltration anesthesia (1.8 ml of 2% lignocaine with 1 : 100,000 of adrenaline) was given and a rubber dam placed.

Five minutes into the procedure the child began to sob and started breathing heavily. The child complained of difficulty in breathing and tried to remove the rubber dam. A temporary restoration was placed and the procedure was stopped. When the rubber dam was removed the child’s behaviour appeared to improve but the child began to take rapid breaths. She complained of dizziness and then became unresponsive to verbal commands.

Given the history of insulin use, a hypoglycemic attack was assumed. However capillary blood glucose measured using a glucometer (One Touch Ultra\textsuperscript{™} LifeScan, Inc., Milpitas, California, USA) showed a reading of 185 mg/dl which simultaneously ruled out diagnoses of Hypoglycemia and Ketoacidosis.

Based on the breathing pattern and the signs of altered mental status an empirical diagnosis of hyperventilation due to panic attack was made. The patient was asked to breathe into a paper bag and within 5 minutes she was responding to verbal commands, though her level of consciousness remained depressed.

Meanwhile a temporary restoration was placed and she was transferred to the care of the emergency team who had been called at the onset of the attack. She was shifted to an emergency room where a capnograph showed an Alveolar CO\textsubscript{2} (PACO\textsubscript{2}) level of 31 mmHg with oxygen levels at 100 mmHg confirming a diagnosis of hypocapnea due to hyperventilation. The patient was made to lie down and was made to breathe into an Ambu Bag without oxygen to increase the blood CO\textsubscript{2} levels and reverse the alkalosis. Within an hour the patient had regained full consciousness and was released from the emergency room. She was referred to a psychiatrist who
then made a probable diagnosis of panic disorder and advised cognitive behavior therapy sessions with a psychologist.

Discussion

Hyperventilation causes a decrease in the blood CO₂ levels. The subsequent acute hypocapnia has a progressive effect on membrane permeability, metabolism oxygen consumption and cardiac function12), as well as exciting the central nervous system through the hypopolarization of the neurons13,14).

There are different opinions about the role of hyperventilation in panic disorders. The most widely accepted is the theory put forward by Klein15) which states that hyperventilation is protective against panic reactions16). While this view explains the taking of “deep breaths” by people who are feeling anxious it does not take into account the effect that the hypocapnia induced by this voluntary hyperventilation has on the sympathetic nervous system. Psychotherapists point out that individuals misinterpret the sensations caused by decreased levels of CO₂ as being indicative of life threatening danger17). This phenomenon has been explained by Austin et al. as a “panic cycle”18). This theory explains how the voluntary hyperventilation may actually induce a feeling of shortness of breath causing the individual to take in more oxygen thus worsening the hypocapnea.

Green et al.19) have pointed out that the incidence of phobic disorders is higher in individuals with Diabetes Mellitus. They show that the phobia may range from a simple fear of hypoglycemia to agora phobia and panic disorder in severe cases19). Hyperventilation in a diabetic patient who is experiencing a panic attack presents a diagnostic challenge for the dentist. It has been shown that the feeling of confusion associated with hyperventilation cannot be distinguished from those that are seen in patients experiencing a hypoglycemic episode11). Treasure et al. have pointed out that diabetic ketoacidosis may be misdiagnosed as hyperventilation syndrome thus delaying effective treatment12). The measurement of capillary blood glucose levels using a glucometer serves as a useful chair side test to rule out either of the above mentioned possibilities.

While the discussion on whether hyperventilation is the cause or the result of a panic attack is beyond the scope of this paper it is certain that an anxious patient in the dental chair will experience hyperventilation that is far in excess of the metabolic needs of the body20). Breathing into a paper bag the most recommended way to increase CO₂ levels and reverse the effects of hypocapnea20–22). This may not be possible in all situations as breathing into a paper bag may increase the anxiety of patients who are already anxious21,23). In such situations intravenous diazepam rapidly reverses the symptoms however it must be used with caution as it is often accompanied by angialgia and phlebitis21).

Although panic disorder is most commonly seen in late adolescence and early adulthood it is not uncommon in children and adolescents24,25). Articles in dental literature have focused on the link between panic disorder and Mitral Valve Prolapse (MVP) and stressed on the importance of antibiotic prophylaxis26,27). However little has been stated about the prevalence of hyperventilation and the emergency management of the resultant altered mental status.

Conclusion

Dental management of a child with juvenile diabetes is a challenge for the pediatric dentist. If the child has a history of behavioral problems, then in addition to the risk of hypoglycemia and diabetic ketoacidosis the dentist must keep a lookout for the signs of hyperventilation.

While the exact relationship between panic disorder and hyperventilation remains a topic of debate, the above mentioned case lends support to a possible correlation between the two. Given the paucity of literature on the topic further research into this subject would prove interesting.

References