

Central Pontine Myelinolysis: A Case Study

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Abstract

Central Pontine Myelinolysis (CPM) commonly presents as a complication of treatment in patients with profound life threatening hyponatraemia. It occurs when the sodium level is corrected too rapidly. Hyponatraemia should never be corrected at a rate greater than 8-10mmol/L of sodium per day. Rapid correction causes extracellular tonicity and will continue to drive water out of the brain's cells leading to cellular dysfunction.

Frequent clinical signs include dysphagia, dysarthria, diplopia and acute para/quadruparesis. Patients can also experience locked in syndrome, where cognitive function is intact but all muscles are paralysed with the exception of eye blinking.

CPM gets its name as it occurs when cell dysfunction causes destruction of the myelin sheath of nerve cells in the brain stem, more specifically the pons. It is associated with poor prognosis and prevention is of primary importance.

Freddy is a 35 year old freelance graphic designer, fitness instructor and ultra-marathon runner. In October 2011 he competed in the Sahara Marathon in Morocco, a 6 day 255km ultra-marathon. At the end of the third day Freddy was found collapsed and vomiting. He was confused and was suffering severe leg cramps. The next morning Freddy suffered a single convulsive episode and was subsequently transferred to a hospital in Egypt.

Key Words: Central pontine myelinolysis, myelin, pons, hyponatraemia

Introduction

Central pontine myelinolysis (CPM) is also referred to as Osmotic Demyelination Syndrome. It was first identified approximately 50 years ago. Pontine refers to the stem of the brain. Myelin is a covering that protects the pontine nerve cells. CPM is a neurological disorder defined as a demyelination of the nerve cells, in the pontine area and in extreme cases it can extend into the extra-pontine area. CPM can occur from various reasons, but the most common cause is from osmotically induced demyelination, due to overly rapid correction of serum sodium in a hyponatraemic patient (Medline Plus, 2013).

Hyponatraemia

This is a common electrolyte imbalance. Sodium is one of the most important elements in the body that accounts for 90% of extracellular fluid cations. Hyponatraemia refers to a sodium deficiency in relation to the

amount of water in the body (Pradhan, Jha, Singh, Gupta, Phadke & Kher, 1995). The normal serum level of sodium is 135-145mmol/L. Common diagnostic tests in patients with hyponatraemia include:

- Serum osmolality less than 280mmol/L
- Serum sodium level less than 135mmol/L
- Urine specific gravity less than 1.010

Hypernatraemia

This is a less common problem and refers to an excess of sodium relative to the amount of water in the body. A patient is considered to have hypernatraemia if their serum sodium is above 145mmol/L. Sodium balance is maintained by Anti Diuretic Hormone (ADH) which is secreted from the pituitary gland into the blood stream. It can be corrected by lowering sodium or increasing body water (Stöppler, 2013).

Clinical presentation

According to the National Institute of Neurological Disorders and Stroke (2013), the typical symptoms of CPM usually begin 2-3 days after the over-correction of hyponatraemia

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has occurred. The most commonly observed symptoms of CPM are:

- acute quadraparesis
- dysphagia
- dysarthria
- diplopia
- loss of consciousness

The key features of the neurological exam include confusion, horizontal gaze paralysis and spastic quadriplegia. Increased limb tone, weakness, hyperactive reflexes and Babinski sign are all typical of lesions involving upper motor neurons.

In some instances, brain damage to the pons from rapid myelinolysis of the corticobulbar and corticospinal tracts in the brainstem leading to "Locked in Syndrome" or death. "Locked in Syndrome" is when an individual has full consciousness and cognitive function intact, but has severe paralysis of the voluntary motor system where movement and communication is not possible, however patients are able to blink or move their eyes vertically. Delirium and coma are extremely common in CPM (Hickey, 2003). This results from lesions in the pontine tegmentum and/or thalamus. Magnetic Resonance Imaging (MRI) is the modality of choice. MRI images demonstrate hyperintense or bright areas where demyelination has occurred (Hromanik, 2010).

Treatment of CPM

Once demyelination of the pons has started there is no cure or very little treatment that can be offered (Abbott, Silber, Felber & Ekpo, 2005). The only treatment is that of the symptoms alone.

These include:

- physical therapy, to improve balance and retain range of motion in limbs.
- a dopagenic medication such as Levodopa to increase dopamine and control tremors and the difficulties with swallowing and speech.

Nurses can assist in the treatment, mainly by keeping the patient comfortable. It is imperative to source an effective communication tool, to allow a patient to be involved in their care and keep some "normality" in their life. Nurses can provide family support and refer the patient to the necessary Allied Health teams for ongoing management.

Prognosis

Although CPM was considered to have the mortality rate of 50% or more, early diagno-

sis has led to better prognosis for many. Most individuals improve gradually but continue to live with significant deficits.

Case Study

Freddy (not his real name) is a 35 year old freelance Graphic Designer and a fitness enthusiast. In his spare time he is a fitness instructor and ultra-marathon runner. In 2011 Freddy went to Morocco to compete in the Marathon des Sables or the Marathon of the Sands which is a 6 day stage race which covers 250 km through the Sahara Desert. This multiday event is held every year and is considered the toughest foot race on Earth.

On day 3 of the event Freddy was acting normally and interacting with friends. Late in the evening Freddy was found near his tent suffering leg cramps, he was confused and it was evident that he had been vomiting. He was assessed by race doctors and given fluids, and it was recommended that he be transferred to the closest major hospital.

Whilst travelling to the base camp the next day Freddy had a single convulsive episode, and became more confused and agitated. Subsequently he was rushed by ambulance to a major hospital in Egypt. On arrival to the hospital it was reported that two other athletes were admitted to the same hospital with similar conditions. Freddy was admitted on 8th October 2011, his blood profile was:

- Serum Na⁺ was 108mmol/L
- Rest of electrolytes were normal
- Creatinine Kinase (CK) was 30,000u/L (<1,000u/L)

Elevated levels of the enzyme CK indicate muscle damage or muscle strain such as in the case of a heart attack or the muscles being overworked (Medical Health Tests, 2011). In this case the excessive running in the marathon done by Freddy could have contributed to his high CK levels.

Freddy's vital signs were as follows BP 125/53, HR 92bpm, RR 25bpm, central temperature was 42.9°C, and SpO₂ 99% on RA. His GCS was 13 (E4 V4 M5).

There was nothing obvious reported on both his CT and MRI. It was decided that treatment would start focusing on, the correction of electrolyte imbalance, treatment of rhabdomyolysis, the management of disturbed level of consciousness, and the treatment of fever. It was recommended that Freddy

stay in the ICU for closer monitoring.

An unknown IVF was infused at 200ml/hr and hypertonic saline was given at a rate of 20ml/hr to correct symptomatic hyponatraemia. Freddy was administered antipyretics to control fever and he was also started on antimicrobial and anti-viral medication to control possible infection, as well as anticonvulsants for his reported seizures.

On 9th October 2011, approximately around 36 hours after treatment had started it was documented that Freddy's CK levels had significantly declined but were still slightly elevated and his Na⁺ levels had started to rise 'gradually' reaching 138mmol/L. However Freddy's LOC did not improve, the medical staff mentioned he had become 'locked in', with no eye fixation, increased motor tone and spasticity, and an inability to walk or sit independently. He also had 2 or 3 generalised seizures around this time. The team decided that if Freddy's LOC didn't improve in the next few days they would do a spinal tap/lumbar puncture.

A MRI of the brain (Figure 1) was performed to exclude central causes, but showed that no abnormalities were detected. On October 10th 2011, Freddy's vital signs were - BP 110/50, HR 89bpm, RR 21bpm, SpO₂ 99% on RA, temperature 38.2°C, and urine output 200mls/hr.

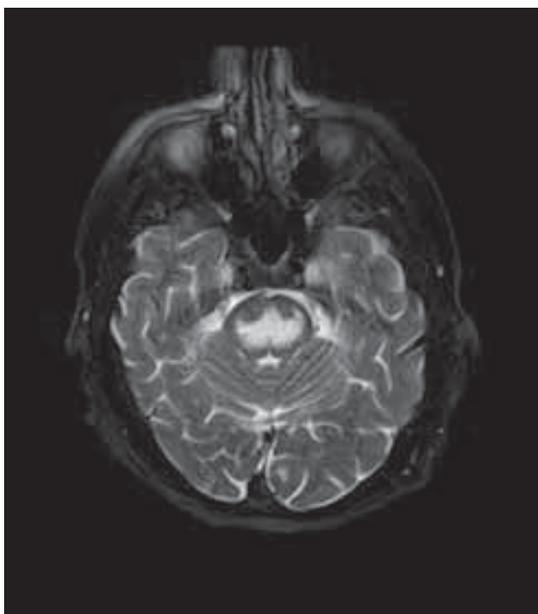


Figure 1 (Above): Freddy's MRI on presentation at Westmead Hospital.

It was documented that Freddy's current diagnosis was symptomatic hyponatraemia, heat stroke, and rhabdomyolysis. The team

were unsure of what was happening to Freddy, a reporting medical officer said... "I cannot explain his elevated enzymes...and although they have dropped, they still remain in the thousands.....I am unclear of what is going on. The low Na⁺ and the dehydration have been corrected, and there is nothing obvious in the brain neither on his CT or MRI. There are no signs of infection, his breathing is normal, his chest is clear, and his abdomen is soft.....I am treating him conservatively without any specific diagnosis at hand." The medical staff decided that Freddy had treatment to the level of care able to be provided and that it would be beneficial for him to travel to a higher level of care for re-evaluation and second opinion. A German hospital answered the call and agreed to accept Freddy under their care.

Freddy arrived in Germany 12th October 2011, ninety-six hours after initial onset. Primary reports state that "the patient is awake but unresponsive with present mutism, the general muscle tone of his extremities and torso are increased, his neural tension tests were positive, and he showed negative Babinski signs bilaterally."

Initial MRI showed abnormalities in the left corpus callosum, para-hippocampal gyrus and left occipital lobe, his EEG was abnormal and suggestive of subcortical dysfunction, without potentials for epilepsy, and CSF results from spinal tap/lumbar puncture showed only a minor disturbance of the barrier function, and no indications for an inflammatory infection of the CNS. Given these results and the patient history the medical staff in Germany decided to initiate anti-epileptic therapy in the form of Levetiracetam. Freddy tolerated this and the dose was gradually increased to 2000mg daily with no further seizures occurring. Freddy was also prescribed a dopagenic medication to help facilitate activation of his muscles, and a muscle relaxant to reduce his increased limb tone.

After thirty-six hours, Freddy's limb tone decreased with right sided emphasis, and there was a positive right-sided Babinski sign. With these medications and intensive physio and occupational therapy Freddy progressively began to communicate more and became more aware of his surroundings. He also began tracking and his eyes started to fixate on persons speaking when he was addressed. Although Freddy was becoming more responsive, he still suffered from mutism or being 'locked in'. This proved difficult for

communication. Also difficult was swallowing and due to his dysphagia, a PEG tube was inserted without complications, to help with nutritional support.

A repeat MRI was attended and showed generalised changes consistent with metabolic or hypoxic brain injury. However the team recorded that 'the reason for the patient's actual status could not be clarified at this time.' It was decided that Freddy's 'brain damage' is likely due to him suffering from major fluctuations of electrolyte balance at an early stage, where his severe hyponatraemia was promptly corrected. It was decided that Freddy would require long term neurological rehabilitation, preferably in his home country Australia. This could be done immediately as Freddy was safe to fly on a commercial flight as long as he had a medical escort with him.

Freddy arrived at Westmead Hospital in Australia 1st November, 2011. The medical teams' initial plan for Freddy on admission was for a physiotherapy and occupational therapy assessment, a speech pathology assessment re: speech and diet, rehabilitation referral, social worker review, and dietitian review.

Initial assessments included-

- Physiotherapy (PT):
 - * Freddy refused to cooperate and wanted to return to bed to sleep
 - * Able to stand and walk independently Freddy was not compliant with the PT staff.
 - * Freddy showed no strength deficits
 - * Throughout the exchange he was unable to communicate verbally and showed inconsistent eye contact.
- Dietitian:
 - * Commence on bolus feeds through the PEG tube
 - * 6 times a day with 4 hourly water flushes of 150ml.
- Speech Pathology (SP):
 - * Communication: Auditory comprehension - Freddy was not following commands, not responding to yes/no questions, and not looking at objects. Verbal expression- Freddy was only making minimal eye contact. He had no facial expressions, made no gestures and gave no verbal output.

- * Functional impression: Patient presents with significant cognitive impairment, including severe communication impairment. He is unable to understand simple commands.
- * It was documented Freddy suffered from severe global aphasia, and would benefit from intensive communication rehabilitation.
- Occupational Therapy (OT):
 - * Freddy has non-purposeful upper limb active movement.
 - * He reaches out, grasps, seeks stimuli but not to command.
 - * Patient inconsistently fixing on OT's initial entry to room and he is fixed on the OT's face mimicking their gestures eg: smile.
- Social Work (SW):
 - * Noticed the family had been through a 'roller coaster ride' of emotions to which the SW provided supportive counselling and education.
 - * Freddy's mum is the primary carer for her husband and has applied to be Freddy's carer.

It was confirmed by the neurology team 2nd November 2011, that Freddy's condition was due to the rapid correction of hyponatraemia hence giving the diagnosis of central pontine myelinolysis. Despite the new diagnosis, Freddy continued to improve. Within 1 week of arriving at Westmead he was making eye contact and smiling at the staff, mobilising up to 300m independently only requiring directional assistance, tolerating an oral puree diet with pudding and thickened fluids, attempting some yes/no responses, and speaking in jumbled sentences with some coherent words.

Freddy was seen by the Rehabilitation Team as a 2 week trial to see if he would be suitable for rehabilitation in the Brain Injury Unit (BIU). Initially Freddy was unable to complete simple tasks such as combing his hair. It was noted whenever Freddy became tired he became increasingly agitated. So it was decided short sessions would be most beneficial for Freddy. At the end of the 2 week rehabilitation trial Freddy significantly improved cognitively. After 10 weeks and 3 hospitals, it was decided that Freddy would be transferred to the BIU 14th December 2011, to continue his extensive rehabilitation.

Freddy spent 16 weeks in the BIU at Westmead Hospital he was discharged home under the care of his parents 5th April 2012, after several successful home trials. On discharge Freddy was able to reliably indicate yes/no using a non-verbal thumbs up or down in response to direct questions, use an increased portion of real and non-real words, and he was able to understand and follow simple routine spoken commands such as 'sit down'. Freddy was able to use some routine gestures in a functional manner such as pointing to a comb and gesturing brushing his hair, understand the spoken function of most daily objects, reliably follow conversations with staff and family, demonstrate active listening skills such as looking at the other person, nodding his head and using fillers such as 'yeah' or 'okay'.

Conclusion

Freddy now lives at home with his parents who are his guardians. Although he will never be able to live independently by himself reports from his family are that his sense of humour remains the same, as he constantly is playing tricks on his family which he finds amusing. He does have good and bad days but his family report that he is a pleasure to be around and most pleasing of all for Freddy is that he has joined a running club which he attends three times a week which he enjoys immensely.

From the case study and the demonstrated evidence, it is clear that patients presenting with hyponatraemia should be closely monitored whilst sodium correction is taking place. CPM symptoms can mask other neurological conditions so it is imperative that the 'over correction' of sodium does not take place, and that the replacement of sodium does not exceed 8-10mmol/l in a 24 hour period, which is the recommended rate of replacement. It is also advised to consider CPM as a diagnosis when patients display signs and symptoms, such as diplopia and a decreased level of consciousness. This early detection can ensure that the patient receives adequate treatment and that appropriate rehabilitation can take place.

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