CASE REPORT

Headache during haemodialysis in a patient with shunt: a cause for concern?

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SUMMARY

A 20-year-old woman with a functioning ventriculoperitoneal (VP) shunt consistently reported unbearable vertex headaches and nausea during the last hour of her haemodialysis (HD) sessions. After one particularly severe episode, which was associated with vomiting, restlessness and blurred vision, her team suspected that she was developing dialysis disequilibrium syndrome. She improved fully on cessation of HD, requiring simple analgesia only, and continued dialysis three times per week. Several more distressing episodes of nausea and headaches compelled us to give intravenous mannitol during HD, resulting in temporary improvement. Subsequently, shorter and more frequent dialysis sessions along with intravenous mannitol resulted in satisfactory clinical response.

BACKGROUND

In general, it is important to have an understanding and be cognisant of complications of haemodialysis (HD). Patients with ventriculoperitoneal (VP) shunts undergoing dialysis represent a particular group where there may need to be a lower threshold of concern when otherwise innocuous symptoms arise. In view of this concern and the paucity of literature surrounding this unique scenario, it is important to highlight this case to illustrate the course of management of one particular patient with shunt on dialysis over an 18-month period.

CASE PRESENTATION

A 20-year-old woman was referred to the neurosurgery service with severe, generalised headache, restlessness, nausea, vomiting and blurred vision towards the end of an evening HD session. This settled soon after cessation of HD with simple analgesia. Predialysis blood pressure had been 132/72 mm Hg and heart rate 108 bpm. Postdialysis blood pressure was 99/65 mm Hg and heart rate 100 bpm. The patient's cranial nerve examination was unremarkable and there was no papilloedema. She displayed no cerebellar signs. She had no new focal neurological deficits in upper limbs. She had long-standing paraplegia with lower limb hyporeflexia secondary to congenital myelomeningocele and a VP shunt had been placed in the neonatal period for obstructive hydrocephalus secondary to this as well as an associated Arnold-Chiari type II malformation (figure 1). The shunt was revised when the patient was 13 years of age and had never caused her any problems after that.

She had been on HD for the previous 6 years because of severe chronic kidney disease secondary

to vesicoureteric reflux and neurogenic bladder. She was on a renal transplant waiting list. HD took place three times per week, each course lasting 3.5 h. Predialysis and postdialysis urea and electrolyte measurements took place routinely once per month. Dialyser surface area was 1.5 m² and blood flow was 250 mL/min. As the patient had been asymptomatic during dialysis for the past 6 years, this particular episode of severe neurological deterioration prompted an urgent CT of the brain.

The CT of the brain (figure 2) performed immediately after completing HD showed acute hydrocephalus with significant dilation of ventricles, trans-ependymal oedema and effacement of sulci and gyri. It also showed a right parietal ventriculostomy catheter in good position. Interestingly, a CT of the brain 2 years earlier, with mild self-resolving headaches, had not shown any findings suggestive of hydrocephalus (figure 3).

On review by the neurosurgical team, after brain CT scan, the patient was completely asymptomatic. Her VP shunt reservoir was emptying and refilling well with manual pressure. She had no new neurological findings and there was no papilloedema. She was asked to undergo further investigations as an inpatient, but she refused and opted to be discharged and followed up as an outpatient, as she was completely asymptomatic. She also refused to have a repeat CT of the brain on that day.

Figure 1 T1 sagittal MRI demonstrating stigmata of Chiari malformation with crowding of the foramen magnum and peg-shaped tonsils protruding into the upper spinal canal.

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Figure 2 Non-contrast CT of the brain at initial presentation demonstrating acute hydrocephalus with right ventriculostomy catheter in situ.

She was reviewed at the outpatient department a few months after this event and reported ongoing but less severe headaches during dialysis. She continued to undergo dialysis three times per week. There was no change made to her dialysis treatment regime at the time and her symptoms were managed with simple analgesia.

OUTCOME AND FOLLOW-UP

Approximately 6 months later, the patient presented with an acute abdomen. CT of the abdomen revealed an inflammatory pseudocyst around the distal shunt, which necessitated externalisation and subsequent ventriculoatrial shunt insertion. This intervention did not improve the patient's symptoms during HD.

With the patient's persistent, self-limiting HD-related headaches and variable degrees of agitation, visual dysfunction and nausea, it was decided to administer mannitol during dialysis. 250 mL of 20% mannitol was administered intravenously during the first 30 min of dialysis and a further 250 mL of 20% mannitol was given over 30 min after 90 min of dialysis. The patient's headache symptoms responded well to this regime but returned after 2 weeks, however, less severe. At that point, the duration of dialysis was reduced to 3 h, and frequency increased to four times per week. Together with the mannitol regimen, the patient's headaches responded satisfactorily. She has since received a renal transplant and is reportedly headache free. This is supported radiologically in [figure 4](#).

DISCUSSION

In a prospective study of 123 patients, headache during dialysis occurred in almost 71% of patients.¹ This case met each of the diagnostic criteria for dialysis headache given the code 10.2 in the 3rd edition of the International Classification of Headache Disorders (ICHD-3) under *Headache attributed to disorder of homeostasis*.² The additional symptoms of nausea, restlessness, blurred vision and striking feature of acute hydrocephalus on brain CT scan, despite an in situ functioning VP shunt, led us to

suspect dialysis disequilibrium syndrome. The only other reported case of disability determination services (DDS) in similar circumstances to our patient is that of a 19-year-old woman, who had spina bifida, hydrocephalus and a functioning shunt, and who developed severe headache, vomiting and diplopia followed by tonic-clonic seizures during initial dialysis treatment at an adult unit, where the dialysis settings were different from those at her previous paediatric dialysis unit.³ However, in our case, the patient had been undergoing HD for the previous 6 years without any problem and there was no change made in her dialysis regime.

We did not consider performing intracranial pressure (ICP) monitoring, which was used by the authors of the previous case report, because our patient had radiological evidence of hydrocephalus during HD, despite an in situ VP shunt ([figure 1](#)). In addition, we assumed, based on our patient's clinical status (being asymptomatic between HD sessions) and radiological investigations, that her VP shunt was fully functional. The aforementioned group used ICP monitoring to guide therapy during haemodialysis in a post-traumatic brain-injured patient in an intensive care unit (ICU) setting.⁴ However, this was neither necessary nor feasible in our case, since our patient was otherwise well, and probably suffering from the early features of DDS. We side with other authors, who have utilised their clinical judgement and radiological investigations to diagnose DDS.^{5–8}

In the available literature, manifestations of DDS have been varied. Papilloedema,⁹ sudden sensorineural hearing loss, focal neurological deficit,¹⁰ respiratory failure in an ICU setting,¹¹ neoplastic meningitis,⁵ and central pontine and extrapontine myelinolysis¹² have all been reported in association with or as a direct consequence of DDS. DDS was reported to be the presenting feature of medulloblastoma in a child,¹³ and there is a single case of brain death in an acidotic patient following haemodialysis for metabolic acidosis and acute kidney injury.⁶ Several reviews of the patient have also emerged in the last decade or so.^{14–18}

Figure 3 Non-contrast CT of the brain 2 years prior to presentation demonstrating ventriculomegaly with a normal sulcal pattern.

Figure 4 Approximate three-level comparisons between the brain CTs performed posthaemodialysis at initial presentation (left), at inpatient review 6 months later (centre) and approximately 1 year thereafter (right), each demonstrating ventriculomegaly. There is also sulcal effacement in each, consistent with cerebral oedema.

Treatment of DDS is predominantly achieved through vigilance and prevention, taking care with patients who are initiating HD⁶ and the paediatric population, presumably due to the smaller volume of distribution of urea in children.¹⁴ Ensuring slow removal of urea from the plasma, adjusting dialysis duration, blood flow and dialyser surface area, as well as adding osmotic agents to the blood such as sodium, mannitol or glucose are other methods to treat DDS.¹⁴ We judge that peritoneal dialysis, though not known to be associated with DDS, would not be an appropriate alternative in this patient's case because of the risk of cerebrospinal fluid malabsorption arising from her previous known shunt revision surgeries.

Attempts to delineate the pathophysiology of headache during dialysis over the past 40 years have involved numerous different putative factors. These include renin, aldosterone and 18-II-deoxycorticosterone,¹⁹ individual patient characteristics, the dialysers, biochemical profiles and physiological parameters occurring during dialysis,²⁰ urea and electrolytes as well as changes in arterial blood pressure levels,²¹ Substance P, cyclic guanosine monophosphate second messenger levels²² and nitric oxide.²³ None of these studies have yielded definitive treatments for dialysis headache, yet there are single case reports describing success with intravenous magnesium supplementation²⁴ and ACE inhibitors²⁵ to this end.

Learning points

- ▶ The literature suggests that developmental dysplasia of the hip typically occurs in the early days of dialysis or soon after changing dialysis regime. However, in our case, it occurred after 6 years on dialysis. Therefore, we suggest that continuous surveillance is needed of dialysed patients with spina bifida and Arnold-Chiari malformation. A functioning ventriculoperitoneal shunt alone may not be sufficient during dialysis, if such risk factors are present.
- ▶ Dialysis disequilibrium syndrome is considered to stem from a concentration gradient created during HD where there are higher levels of urea remaining in the cerebral interstitium relative to the dialysed blood. As a result, water moves osmotically into the cerebral interstitium, causing cerebral oedema and the symptoms of DDS.
- ▶ Literature suggests that DDS typically occurs in the early days of dialysis or soon after changing dialysis regime. However in our case, it occurred after 6 years on dialysis. Therefore we suggest that a continuous surveillance is needed on dialysed patients with spina bifida and Arnold-Chiari Malformation. A functioning VP shunt alone may not be sufficient during dialysis, if such risk factors are present.
- ▶ Mannitol administration during dialysis as well as alteration of dialysis duration and frequency may be considered.

Contributors PO wrote the case report and performed the literature review. JS proofread the case report drafts, edited the intellectual content and provided further direction for background research into the case. SA performed detailed chart review and researched historical dialysis settings of the patient. CM was the neurosurgeon responsible for the patient's care and reviewed the manuscript for its intellectual content prior to submission.

Competing interests None.

Patient consent Obtained.

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