Case Report

Posterior reversible encephalopathy syndrome following elevated mean arterial pressures for cervical spinal cord injury

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Background: Increasing the mean arterial pressure (MAP) is an accepted treatment modality to minimize the risk for irreversible neurologic damage secondary to spinal cord ischemia. Posterior reversible encephalopathy syndrome (PRES) is a rare complication occurring after transplantation surgery, in persons having an autoimmune disorder or after abrupt increases in blood pressure of various etiologies.

Study Design: Case report.

Methods: Retrospective evaluation of medical records.

Results: A 68-year-old female with long-standing diabetes, and rheumatoid arthritis (treated with methotrexate) presented with bilateral upper extremity weakness and numbness developing several days after a motor vehicle accident. Physical examination confirmed decreased upper extremity motor strength and decreased sensation to light touch and pinprick in the C5–C6 dermatomal distribution. Magnetic resonance imaging (MRI) demonstrated C5–C6 subluxation with spinal cord compression. The patient had traction applied and mean arterial pressures were elevated greater than 85 mmHg. The following day the patient underwent anterior and posterior cervical spine fusion and decompression. Immediately post-operatively, the patient developed status epilepticus. Head MRI revealed areas of high T2 signal intensity in the bilateral occipital lobes, consistent with a diagnosis of PRES. Two weeks later, the patient had resolution of her symptoms and resolution of PRES on imaging.

Conclusion: This is the first report of posterior reversible encephalopathy syndrome secondary to therapeutic blood pressure increase in the setting of cervical spine fracture with neurological deficits. The patients had resolution of symptoms following discontinuation of the MAP goals.

Posterior reversible encephalopathy syndrome (PRES) is a life-threatening condition characterized by seizures, confusion, visual disturbance, and headaches alongside neuroradiological findings indicative of posterior cerebral hemispheric white matter edema.^{1,2} PRES has been described in association with abrupt blood pressure elevation, autoimmune disorders, or transplantation.^{1–4} In this case report PRES presented with typical status epilepticus⁵ but in an unexpected clinical setting, immediately after anterior cervical decompression and fusion (ACDF) and posterior cervical fusion (PCF) with laminectomy of C5–C6.

Keywords: Posterior reversible encephalopathy syndrome, PRES, Mean arterial pressure, MAP, Cervical fracture, Spinal cord injury, SCI

Case report

A 68-year-old woman with insulin-dependent diabetes mellitus (IDDM) and rheumatoid arthritis (RA) (treated 25 mg methotrexate) presented to the

Emergency Department (ED) after a motor vehicle accident. She had diffuse upper extremity and back tenderness with no neurological deficits. A day later, she developed diabetic ketoacidosis necessitating a hospitalization of 11 days.

Following discharge, she experienced left arm weakness which rapidly progressed to involve both upper extremities and was re-evaluated in the ED. Physical examination revealed decreased deltoid and biceps muscle strength, with diminished sensation to in the

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C5–C6 dermatomal distribution. Cervical spine magnetic resonance imaging demonstrated C5–C6 subluxation with spinal cord compression. The patient was placed in Gardner-Well traction, admitted to the intensive care unit and the following day underwent ACDF and PCF of C5–C6 (Fig. 1). During the peri-operative

Figure 1. (A) Unrecognized widening of the right C5–C6 facet (arrow); (B) Patient presents with C5–C6 subluxation and cervical stenosis on sagittal T2-weighted MRI and sagittal CT demonstrates the left C6 perched facet (arrow); (C) Anteroposterior and lateral radiographs one year following C5–C6 anterior cervical discectomy and fusion with instrumentation and C5–6 posterior fusion and laminectomy.

period (1 day before to 2 days after surgery), the patient's mean arterial pressure (MAP) was maintained at 85 mm Hg or higher (Fig. 2) to ensure adequate spinal cord perfusion. In several instances the MAPs were in the 90 and 100 plus range. We evaluated MAPs before and after surgery. Pre-surgery average MAPs were 92.13 ± 8.06 mm Hg (N=24) and post-operative average MAPs were 83.65 ± 8.50 mm Hg (N=20). The pre-operative MAPs were significantly higher than post-operative MAPs ($P = 0.0015$).

Upon awakening from anesthesia the patient became apneic and unresponsive with facial myoclonus and fixed downward gaze deviation. Immediate cervical spine and head CT was normal. In the ICU, electroencephalogram (EEG) revealed status epilepticus with a left posterior focus and her seizures were treated with medications. Her weekly dose of methotrexate was held. MRI of the brain revealed areas of high T2 signal intensity within the bilateral occipital lobes consistent with PRES (Fig. 3A). Following the diagnosis of PRES the MAP goals were discontinued (Fig. 2).

Over the next few days, the patient remained seizure-free, and her mental status gradually improved. Two weeks after surgery, repeat brain MRI demonstrated near-complete resolution of the previously described T2 FLAIR in the occipital lobes, consistent with improving PRES (Fig. 3B). Follow-up EEG showed no focal or epileptiform abnormalities and no seizures. Her motor strength and paresthesia improved post-operatively and were not affected by the lowering of the MAPs to treat PRES. At two-years follow-up she had 5/5 bilateral upper extremity strength with intact sensation.

Figure 2. Mean arterial blood pressure (MAP; mm Hg) around the time of surgery. Solid bar indicates intraoperative period. Before surgery, each point represents hourly MAP measurements, after surgery, each point represents every 6 hourly measurements.

Figure 3. (A) T2-weighted axial MRI of the brain demonstrating increased signal in the occipital lobe consistent with PRES (arrow) (B) T2-weighted axial MRI demonstrating a majority of the PRES has resolved two weeks following treatment.

Discussion

Posterior reversible encephalopathy syndrome can occur in a number of different clinical settings, most notably, in the presence of abruptly elevated blood pressure.² PRES can occur at any age,⁶ and there is no specific blood pressure level which is thought to trigger its occurrence.⁷ The current recommendation to elevate MAPs greater than 85 mm Hg in the setting of spinal cord injury may be temporally associated with PRES.⁸ Lowering blood-pressure is the mainstay of PRES treatment and contributed to the patient's rapid recovery within 5–7 days.² On repeat MRI of our patient (Fig. 3) there's still some residual increased signal present although clinically the patient had improved.

Maintaining MAPs greater than 85 mmHg has become a common practice following acute spinal cord injury.^{8–11} Initial studies on elevating MAPs in spinal cord injury were retrospective.^{9,10} The goal is to decrease ischemia related second hits to the spinal cord. Systematic review have found weak evidence to support the use of MAPs following SCI.^{12,13} However, in aortic aneurysm surgery the neuroprotective value of elevating MAPs has been identified.^{14,15} In the setting of penetrating injuries elevating MAPs has not been useful.¹⁶ A correlation but not a causal relation has been established between increasing MAP values and neurological recovery with the key being minimizing the duration of hypotension.¹⁷ In our institution we no longer use high dose steroids and use MAP elevation along with prompt decompression for the management of spinal cord injury.

Although the etiology of PRES is unknown, endothelial cell injury has been implicated as an important underlying pathophysiologic mechanism.² Cytotoxic drugs in anti-cancer regimens^{18,19} or to treat autoimmune diseases are strongly associated with PRES. Methotrexate is an anti-inflammatory, anti-metabolite, anti-angiogenic medication effective in reducing proliferation in the rheumatoid synovium.²⁰ Both oral and intrathecal methotrexate have been associated with PRES.^{21,22}

To date there has been one report of PRES in the setting of cervical spine trauma.²³ This was due to a traumatic carotid artery injury and not associated with any interventions for the cervical spine fracture. There have been several reports of autonomic dysreflexia and associated hypertension resulting in PRES in patients with spinal cord injury.^{24–26} A recent report from the vascular surgery literature parallels some of the findings of our case.²⁷ Induced hypertension was used intraoperatively. MAPs were maintained greater than 90 mmHg while performing thoracoabdominal aortic aneurysm (TAAA) repair and similar to our case as the patient awoke from anesthesia seizures were noted. Subsequently MRI of the head demonstrated PRES.

Conclusion

In this case report we highlight a patient with two risk factors for PRES (increased MAPs for spinal cord perfusion and methotrexate use). Following surgical management of a cervical spine fracture the patient developed a seizure and MRI confirmed the presence of PRES. The patient made an excellent recovery after MAPs were lowered and methotrexate held. In clinical scenarios where MAPs are being elevated PRES should be a complication to be aware of.

Disclaimer statements

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Conflict of Interest None.

Ethics approval None.

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