

## OBSTETRICS

### Case Report

# Anaesthetic management of a parturient with the postural orthostatic tachycardia syndrome: a case report

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Postural orthostatic tachycardia syndrome encompasses a group of disorders characterized by orthostatic intolerance. We describe the anaesthetic management of analgesia for labour and of Caesarean section in a parturient suffering from this disorder. Worsening of her symptoms during pregnancy was managed with an increase in the dose of  $\beta$ -blockers taken by the patient. Epidural analgesia was instigated early to attenuate the stress of labour and avoid consequent triggering of a tachycardic response. Slow titration of epidural analgesia and anaesthesia after an adequate fluid preload was undertaken to minimize hypotension and subsequent tachycardia. Neuraxial opioid, combined with non-steroidal anti-inflammatory drugs and bilateral iliohypogastric and ilioinguinal nerve blocks were used to optimize postoperative analgesia.

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Postural orthostatic tachycardia syndrome (POTS) is a chronic form of orthostatic intolerance that primarily affects young women. Orthostatic intolerance is defined as the provocation of symptoms upon standing that are relieved when becoming supine. Patients with orthostatic intolerance often complain of exercise intolerance, extreme fatigue, light-headedness, diminished concentration, tremulousness, nausea, headache, near syncope and occasionally syncope.<sup>1</sup> POTS is defined as the development of symptoms of orthostatic intolerance accompanied by a heart rate increase of at least 30 beats  $\text{min}^{-1}$  or a rate that exceeds 120 beats  $\text{min}^{-1}$  that occurs within the first 10 min of standing or head-up tilt. A heart rate increase of more than 30 beats  $\text{min}^{-1}$  in response to an infusion of isoprenaline 1  $\mu\text{g min}^{-1}$  is also used to confirm the diagnosis.<sup>2</sup> In POTS, failure of the peripheral vasculature to vasoconstrict appropriately is compensated by an increase in heart rate and blood pressure. However, this mechanism may not fully compensate for the lack of vasoconstriction resulting in hypoperfusion of the brain and other organs. Furthermore, there may be overcompensation, resulting in uncontrolled tachycardia and hypertension.<sup>1</sup> The aetiology of POTS is unclear, but immune-mediated mechanisms<sup>3</sup> and underlying genetic abnormalities have been proposed.<sup>4</sup> The incidence of

POTS is unknown. One study found a 10% occurrence of vital sign changes diagnostic of POTS on autonomic testing (tilt table testing).<sup>5</sup> Robertson<sup>6</sup> reported that approximately 500 000 Americans may suffer from some form of POTS and orthostatic intolerance. Patients with POTS may have debilitating symptoms and experience frequent syncopal attacks as well as other symptoms of autonomic dysfunction. The most common subtype is partial dysautonomia in which the patients appear to have a mild form of peripheral autonomic neuropathy. The less frequent subtype, hyperadrenergic POTS, is characterized by  $\beta$ -adrenergic receptor hypersensitivity.<sup>7</sup> Because of the variability in presentation and subtype, and relative resistance to medical therapy, POTS represents a particularly difficult disease to manage. During labour, there is concern about triggering a tachycardic response and subsequent symptoms resulting from the pain and stress of labour. Furthermore, peripheral vasodilatation and hypotension from a regional block could also potentially trigger such a response.

Elective Caesarean section (CS) in two patients with severe POTS has been previously reported.<sup>8</sup> We describe the anaesthetic management of a prolonged trial of labour and CS in a woman with POTS and comment on the pathophysiology and anaesthetic implications of this complex disease.

**Table 1** Selected results from cardiovascular autonomic nervous system testing in this patient

Test	Result	Expected result for age and gender ( $\pm 2$ SD) <sup>15–17</sup>	Interpretation <sup>15–17</sup>
Sinus arrhythmia: heart rate change	26 beats min <sup>-1</sup>	24 beats min <sup>-1</sup> (13–38)	Normal
Valsalva manoeuvre			
Baseline vs late phase II pulse pressure (arterial line)	60 vs 27 mm Hg (i.e. <50%)	>50%	Consistent with POTS
Valsalva ratio (the ratio between the slowest heart rate after the manoeuvre to the highest heart rate during the manoeuvre)	1.56	2.1 (1.4–2.9)	Low–normal
Head-up tilt: heart rate in first 10 min	Increase from 78 to 118 beats min <sup>-1</sup> (51% increase)	Increase by 15–30%	Suggestive of POTS
Isoprenaline-graded doses (amount required to increase heart rate by $\geq 25$ beats min <sup>-1</sup> )	0.25 $\mu$ g	1.0 $\mu$ g	$\beta$ -receptor oversensitivity

## Case report

A 30-yr-old G1P0 parturient presented at 39 weeks gestation with spontaneous rupture of membranes. She weighed 75 kg (booking weight=58 kg) and was 160 cm tall (BMI=29.3). Her past medical history included mitral valve prolapse and POTS. Mitral valve prolapse was diagnosed by echocardiogram done to evaluate an asymptomatic murmur found on routine examination at the age of 12. It was associated with trivial mitral regurgitation but no other structural or functional cardiac abnormalities. POTS was diagnosed after an otherwise uneventful operation for removal of a fibroadenoma from the left breast performed under T3–T5 paravertebral block and i.v. sedation with a propofol infusion 3 yr previously. On postoperative day 1, the patient developed symptoms of lightheadedness without syncope, palpitations, occasional dyspnoea on mild exertion and chest pain during periods of tachycardia, some of which were as high as 180 beats min<sup>-1</sup>. Her workup included a negative electrophysiology study, a normal ventilation–perfusion scan and a negative exercise stress echocardiogram. The diagnosis of POTS was finally made based upon formal cardiovascular autonomic nervous system testing. The results (Table 1) suggested the  $\beta$ -receptor oversensitivity (also called ‘hyperadrenergic’) form of this condition. After starting metoprolol 100 mg daily, the severity and frequency of symptoms were significantly reduced.

The first two trimesters of pregnancy were marked by increased fatigue, in addition to the regular POTS symptoms. Around 28 weeks the patient developed near-syncope when lying supine and had worsening exertional dyspnoea and lightheadedness. This was managed by increasing the dose of metoprolol to 150 mg daily. She was also advised to avoid the supine position.

The patient was referred to the obstetric anaesthetists for consultation during pregnancy. After discussion with the cardiologist, obstetrician and anaesthetist, the patient decided to undergo trial of labour. Early epidural analgesia to avoid pain-induced triggering of a tachycardic response, was planned. An adequate volume preload was suggested before placement of a slowly titrated epidural to abate the potential sympathetic surge associated with blood pressure decrease after the institution of the regional block.

On admission, telemetric monitoring was initiated, in addition to standard pulse oximetry, non-invasive blood pressure (NIBP) and fetal heart rate monitoring. After volume-loading with 500 ml of lactated Ringer’s solution given over 5 min, an epidural catheter was placed and gradually bolused with bupivacaine 0.1%, 20 ml+fentanyl 2  $\mu$ g ml<sup>-1</sup> in 5 ml increments. Patient-controlled epidural analgesia was then initiated with a continuous rate of 6 ml h<sup>-1</sup>, a demand dose of 6 ml and a lockout period of 8 min.

Labour was augmented with oxytocin and the patient continued to progress to 9 cm, at which point she had an active phase arrest requiring CS. The epidural provided satisfactory labour analgesia throughout this 28 h period. The patient remained asymptomatic without significant changes in blood pressure or heart rate (systolic pressure 117–137 mm Hg, diastolic pressure 59–86 mm Hg, heart rate 83–102 beats min<sup>-1</sup>).

In the operating theatre standard monitoring (ECG, pulse oximetry and NIBP measurement), was applied. We replaced the epidural catheter, as it had migrated out of the epidural space during transfer. A preload consisting of 2 litres of lactated Ringer’s solution and 500 ml of hydroxyethyl starch 6% was given. The new catheter was bolused with 100  $\mu$ g fentanyl followed by lidocaine 2%, 15 ml with sodium bicarbonate given in increments over 20 min until a sensory level up to and including T4, as tested by pinprick, was achieved bilaterally. A baby boy weighing 3560 g, with 1 and 5 min Apgar scores of 8 and 9, respectively, was born.

After delivery, the patient became increasingly uncomfortable with increase in her heart rate to 110–125 beats min<sup>-1</sup> and blood pressure to 150/100 mm Hg, despite bolusing the epidural catheter with a further lidocaine 100 mg, and the administration of i.v. fentanyl 150  $\mu$ g in increments and midazolam 2 mg. We therefore elected to proceed to general anaesthesia. Rapid sequence induction was performed with propofol 150 mg and succinylcholine 100 mg. Anaesthesia was maintained with isoflurane in a nitrous oxide/oxygen mixture. The patient was more cardiovascularly stable under general anaesthesia, with a heart rate of 80–88 beats min<sup>-1</sup> and blood pressure of between

98/62 and 115/75 mm Hg. At the end of surgery the patient's trachea was extubated after we placed bilateral iliohypogastric/ilioinguinal nerve blocks using ropivacaine 0.5%, 15 ml with 1:400 000 epinephrine on each side. Ondansetron 4 mg and ketorolac 30 mg were given towards the end of surgery. Epidural preservative free morphine 3 mg was also administered. The patient had no evidence of tachyarrhythmia and was comfortable in the recovery room. The recovery period was uneventful and the patient was discharged home on postpartum day 3.

## Discussion

To our knowledge, this is the first report of successful provision of epidural analgesia, with no occurrence of POTS symptoms, in a parturient with the hyperadrenergic subtype of POTS undergoing a trial of labour. CS under epidural anaesthesia has been previously reported in two parturients with severe POTS.<sup>8</sup> The details of the anaesthetic management were not described in that report. The authors, however, recommended that patients with POTS should undergo an elective CS to avoid the stress of labour and the resulting risk of triggering a tachycardic response.

POTS encompasses a heterogeneous group of disorders that share similar clinical characteristics. The hallmark of these disorders is orthostatic intolerance, defined as the provocation of symptoms on standing.<sup>9</sup> The symptoms of POTS may be triggered by immunizations, surgery (as in our patient), acute febrile illness (especially mononucleosis), sepsis, trauma and pregnancy. Symptoms may begin quite abruptly, again, as observed in our patient. The age of onset ranges from 15 to 50 yr and shows a 5:1 female:male predilection.<sup>1</sup>

Patients with POTS typically present with palpitations, lightheadedness, extreme fatigue, exercise intolerance, blurred vision, leg weakness and cognitive impairment.<sup>1</sup> It is evident that the complex of signs and symptoms called 'POTS' may result from a variety of pathophysiological mechanisms and that attempts at classification may be considered arbitrary. Among the subtypes described are partial dysautonomia and hyperadrenergic POTS.<sup>1</sup>

The majority (90%) of patients with POTS are described as having a partial dysautonomia, with the predominant pathophysiology being an inability to increase peripheral vascular resistance when moving to an upright posture, resulting in an excessive compensatory postural tachycardia.<sup>10</sup> Disproportionate venous pooling leads to an exuberant baroreceptor response with increased sympathetic stimulation and a persistent tachycardia. Less commonly, patients such as the one described in this report have a form of the disease characterized by heightened sensitivity to  $\beta$ -adrenergic agonists. This results in additional symptoms of tremulousness and anxiety on standing, although symptoms during recumbency may also occur. Diagnosis of this subset is based on the patient's exaggerated response to isoprenaline during autonomic testing. These patients

typically respond well to  $\beta$ -adrenergic blocking agents, which is in contrast to patients with the partial dysautonomia subtype of POTS.<sup>11</sup>

POTS-like physiology secondary to other conditions may exist. Cardiovascular autonomic nervous system testing may help discriminate these conditions from primary POTS. Some patients with mitral valve prolapse are known to be highly sympathotonic and may have a clinical picture compatible with POTS. Whether or not they have secondary POTS may be only a matter of definition. Although our patient had mitral valve prolapse, she did not show the greatly exaggerated heart rate variability during respiratory sinus arrhythmia, Valsalva manoeuvre, or head-up tilt table testing typical of the dysautonomia of mitral valve prolapse.<sup>12</sup> Hence, we believe our patient to have primary POTS.

POTS can have several anaesthetic implications for the parturient. Even when not challenged by upright posture, the hyperadrenergic character of these patients must be considered. Avoidance of the stress of labour and the subsequent triggering of a tachycardic response are important goals in the management of these patients. In order to avoid such stress, we elected to initiate early epidural analgesia. For both labour analgesia and the CS, we bolused the epidural catheter incrementally to avoid any sudden haemodynamic changes. We elected to replace the epidural catheter, rather than performing a subarachnoid block for the CS, as an epidural produces more gradual haemodynamic changes. In contrast, spinal anaesthesia could cause a sudden decrease in systemic vascular resistance with a subsequent increase in baroreceptor activated sympathetic discharge. Such a discharge would likely produce symptoms from the resultant tachycardia in hyperadrenergic POTS patients. Adequate hydration with fluid boluses is imperative to ensuring adequate preload, limiting the decrease in blood pressure sensed by the carotid baroreceptors. While we were able to successfully manage this patient using frequent NIBP monitoring, invasive monitoring with an arterial line may be of value in the management of POTS patients attributable to the potential for rapid haemodynamic changes.

We performed bilateral ilioinguinal/iliohypogastric nerve blocks, in addition to giving 3 mg epidural morphine in order to optimize postoperative analgesia.<sup>13</sup> In retrospect however, we should have avoided the use of epinephrine in the local anaesthetic used for the block, as this had the potential to cause tachycardia. For the treatment of hypotension, it is probably best to avoid ephedrine in those patients with a hypersensitive response to adrenergic stimulation. Ephedrine's indirect norepinephrine release and weak  $\beta$ -1 receptor agonist effects could also aggravate symptoms and be poorly tolerated. In some POTS patients the peripheral  $\alpha$  receptors remain sensitive, if not hypersensitive, to  $\alpha$ -agonists.<sup>10</sup> Careful titration of phenylephrine would therefore be preferable for the treatment of hypotension. As suggested earlier, the avoidance of epinephrine-containing local anaesthetics or agents that

trigger tachycardia would also be advisable in these patients. While the use of  $\beta$ -blockers during pregnancy might be associated with an increased risk of small for gestational age infants,<sup>14</sup> we believe that the benefits in our patient clearly exceeded the risks.

In conclusion, we have described the anaesthetic management for a trial of labour and CS in a patient with POTS. An understanding of the pathophysiology of this condition is imperative for the successful management of labour analgesia and CS in this patient population.

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