Case report

Anaesthesia for appendicectomy in a patient with postural orthostatic tachycardia syndrome

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Summary

Postural orthostatic tachycardia syndrome is a poorly understood disorder of the autonomic nervous system. The syndrome is defined by the development of orthostatic intolerance associated with a heart rate increment ≥ 30 beats per minute or increase in heart rate to ≥ 120 beats per minute within the first 10 minutes of standing without hypotension. Symptoms of orthostatic intolerance are a combination of cerebral hypoperfusion and sympathetic overactivation. This report describes the anaesthetic management of a 41 year old female patient with postural orthostatic tachycardia syndrome presenting for emergency appendicectomy. Management focused upon ensuring stable haemodynamics during surgery. The patient had an uneventful anaesthetic for appendicectomy and was discharged home 48 hours later.
Introduction

Postural orthostatic tachycardia syndrome (POTS) is a rare and perplexing disorder of the autonomic nervous system that is characterised by orthostatic intolerance. A distinguishing feature of the condition is that, on standing, blood pressure is maintained or only falls minimally, whilst heart rate increases dramatically. Patients usually complain of a myriad of symptoms (Table 1). Although the cause of POTS is unknown, several pathophysiologic models have been described including neuropathic, hyperadrenergic, genetic and hypovolaemic dysfunction, and impaired cerebral autoregulation.

Here we report the case of a 41 year old female with POTS presenting out of hours for an emergency appendicectomy, and describe the pathophysiology and anaesthetic implications of this obscure syndrome.
Case report

A 41 year old female patient presented with a two day history of nausea and vomiting, chills and abdominal pain, and was scheduled for emergent laparoscopic appendicectomy in May 2009. She weighed 62 kg and was 170 cm tall (BMI=21.5). In 2007 she was diagnosed with POTS using invasive tilt testing and suffered with recurrent palpitations (2-3 times weekly) and syncopal episodes (1-2 episodes fortnightly). She had developed these disabling symptoms in 2001 and had undergone extensive cardiac evaluation with five cardiac electrophysiology studies including two attempted radiofrequency ablations.

In 2007, the patient had shoulder reconstruction in the sitting position under general anaesthesia with interscalene nerve block. During this surgery, she had several episodes of hypotension which required aggressive intravenous fluid therapy, pressor support and repositioning. In the recovery room, she developed florid pulmonary oedema necessitating urgent intubation and transfer to another hospital for intensive care management. Transthoracic echocardiography at this time showed severe impairment of left ventricular systolic function with an ejection fraction of 15% due to anteroseptal hypokinesis and severe hypokinesis of other wall regions. She improved dramatically and was extubated within 12 hours following a large diuresis. Repeat transthoracic echocardiogram 48 hours later showed almost complete resolution of her left ventricular dysfunction. The valves appeared structurally normal, with trivial aortic regurgitation, trivial mitral regurgitation, and mild tricuspid regurgitation.

Her usual medications included dihydroergotamine mesylate (15 mg t.d.s.), fludrocortisone (100 mcg o.d.), atenolol (25 mg o.d.), and sertraline (75 mg o.d.) with mersyndol forte
(paracetamol 450 mg, codeine 30 mg, doxylamine 5 mg) and temazepam (10 mg) taken when required.

Prior to presentation she was nauseated and vomiting for two days, with decreased oral intake. In the emergency department, intravenous access was obtained and the patient rehydrated with 2L of normal saline over approximately 5 hours.

Upon arrival to theatre, the patient appeared extremely anxious, with an unremarkable cardiorespiratory examination. The pre-operative supine blood pressure (BP) was 155/65 mmHg and heart rate (HR) 74 beats per minute (beats.min⁻¹).

The patient was given midazolam, 1 mg i.v., and 500 mL compound sodium lactate, after which a radial arterial line was inserted. Central venous access was obtained through the right internal jugular vein with ultrasound guidance whilst supine. The opening central venous pressure was 10 mmHg. Automated pneumatic compression stockings were applied to both lower limbs. In the operating theatre, standard monitoring was applied, in addition to invasive central venous and arterial pressure monitoring. After preoxygenation, anaesthesia was induced with fentanyl (100 mcg), propofol (150 mg), and suxamethonium (100 mg) and the trachea intubated with cricoid pressure maintained. Post-induction BP was 110/55 mmHg and the HR 78 beats.min⁻¹.

Anaesthesia was maintained with sevoflurane (end-tidal 2.2-2.3%) in an air/oxygen mixture. Intraoperative analgesia included fentanyl (100 mcg), morphine (6 mg), parecoxib (40 mg), and paracetamol (1 gm i.v.). Tidal volume and respiratory rate was titrated to end-tidal CO₂ and core temperature was maintained between 36.2 and 36.0°C with a forced air warmer. Intraoperatively, the patient required four (50 mcg) boluses of phenylephrine to
maintain her blood pressure in the normal range and received in total 1500 ml of compound sodium lactate. Haemodynamic parameters remained unremarkable during anaesthesia and in the recovery room with HR and BP values ranged between 56-84 beats.min\(^{-1}\) and 108/55 to 155/65 mmHg, respectively. Intraoperative central venous pressure (CVP) ranged between 10 to 15 mmHg.

Post-operatively the patient was transferred to the high dependency unit and remained stable until her discharge 48 hours after presentation. Informed consent was obtained from the patient prior to writing this report.
Discussion

POTS is a poorly understood disorder of the autonomic nervous system which was named and identified by Schondorf and Low in 1993. A unique feature of POTS, unlike many forms of syncope, is that the arterial blood pressure is maintained or falls minimally whilst heart rate increases dramatically. POTS is defined as orthostatic intolerance associated with a heart rate increase of 30 beats.min⁻¹ (or HR that exceeds 120 beats.min⁻¹) that occurs within the first 10 minutes of standing or upright tilt, not associated with other chronic debilitating conditions such as prolonged bed rest or the use of medications known to diminish vascular or autonomic tone.

The symptoms of POTS are non-specific and a variety of alternative names highlight the diversity of opinion about this perplexing disorder. These include mitral valve prolapse syndrome, idiopathic hypovolaemia, hyperadrenergic syndrome and more recently in the lay press and world wide web “yellow wiggle syndrome.” POTS is a disorder of unknown aetiology, and several pathophysiologic models have been described, including neuropathic, hyperadrenergic, genetic and hypovolaemic dysfunction and impaired cerebral autoregulation. Indeed POTS may be regarded as a heterogenous syndrome with several subtypes, including neuropathic POTS, hyperadrenergic POTS, and POTS with deconditioning.

Orthostatic symptoms may be aggravated by heat or exercise, and worse at the time of menses. Symptoms are predominantly syncopal (lightheadedness, dizziness, weakness), and those of sympathetic overactivity (palpitations, tremulousness, nausea). Commonly described symptoms are listed in Table 1.
The prevalence of POTS is difficult to establish and there are no accurate epidemiological studies. Current estimates suggest at least 500,000 patients are affected by the disorder in the United States alone. Symptoms commonly present between the ages of 15 to 50 years with a female preponderance of five to one.

The onset of POTS is often abrupt and approximately 50% of patients can recall a viral prodrome. The condition may often be mistaken for depression or anxiety; indeed these conditions may also coexist and aggravate the syndrome. The clinical presentation of POTS often overlaps with the chronic fatigue syndrome, and 25-50% of patients with chronic fatigue syndrome also have POTS. An association may also exist between POTS and joint hypermobility which has been described in some patients with Ehlers-Danlos syndrome.

POTS is often difficult to diagnose, and other confounding illnesses must be excluded. A detailed history is required to establish the severity of orthostatic intolerance. Twenty-four-hour blood pressure monitoring coupled with a diary recording daily activity is useful in documenting the severity of symptoms. A full autonomic system review should be undertaken to assess the autonomic systems involved and look for an autonomic neuropathy. Routine investigations such as full blood count and electrolytes are usually normal. A 24-hour urinary sodium is a simple test to clarify that the patient has an adequate fluid and sodium intake. Plasma catecholamines should be sampled supine and after standing for 15 minutes; in approximately half of patients standing, the noradrenaline exceeds 600 picogram/mL, which is considered a hyperadrenergic response.
Cardiovascular investigations should include a 12-lead electrocardiograph, cardiac rhythm monitoring to exclude primary cardiac causes of syncope and tilt table testing. In specialised centres, this can be invasive with placement of an arterial line, plasma sampling for noradrenaline, and microneurography of the peroneal nerve.\(^2\)

Pharmacological and non-pharmacological interventions are useful in managing POTS, however the evidence base for these interventions is poor. Table 2 summarises the various interventions that have been used.

<Take in Table 2 here>

Patients suffering with POTS have been shown to experience clear limitations in their quality of life and the condition can affect employment prospects and other important domains.\(^17\) There is limited information available regarding the prognosis of POTS. Generally, the younger the patient, the better the prognosis.\(^3, \! 18\) Approximately 90% of patients will respond to a combination of non-pharmacological and pharmacological interventions. After onset of post-viral POTS, 50% of patients recover in two to five years.\(^3, \! 18\) Patients with hyperadrenergic POTS usually require therapy indefinitely.\(^3, \! 18\)

Information on the anaesthetic implications of POTS is not well elucidated. There are several case reports detailing the management of the parturient patient,\(^19, \! 20\) however to our knowledge there are no case reports describing the anaesthetic management of the patient with POTS presenting for emergency general surgery.

The anaesthetic management in this case focused particularly upon ensuring stable haemodynamics. Despite the previous episode of post-operative left heart failure, it was felt
that ensuring normovolaemia was of paramount importance, considering the patient’s poor oral intake in the two days prior to surgery, third space losses, and the impaired absorption of dihydroergotamine and fludrocortisone. The patient was fluid resuscitated in the emergency department with 2 L of normal saline. A further 1.5 L of compound sodium lactate was given in theatre. With agreement from the surgical team, a planned laparoscopic approach was abandoned due to the desire to avoid unnecessary tilting of the operating table, the haemodynamic effects of a pneumoperitoneum, and to expedite the rapid completion of the surgery. We relied upon invasive arterial blood pressure to closely monitor arterial pressure. The central venous access provided important information regarding volume status and allowed administration of vasoactive drugs (phenylephrine and noradrenaline) if required.

For the intraoperative treatment of hypotension, alpha-1 adrenoceptor agonists such as phenylephrine\(^{21}\) and noradrenaline\(^{22}\) may be used to augment vascular tone in patients with POTS. However, they must be cautiously titrated because in some patients, lower extremity sympathetic denervation may cause upregulation of peripheral alpha-1 adrenoceptors and contribute to receptor hypersensitivity. Ephedrine should probably be avoided as it causes an indirect noradrenaline release and has a weak beta-1 agonist effect, both of which may aggravate symptoms.\(^{19}\)

At all times, the patient was positioned carefully with gradual and controlled movements to avoid provoking symptoms and signs of orthostatic intolerance. Automated pneumatic calf compression stockings were used to promote venous return and ensure adequate preload,
and post-operative intensive care permitted close monitoring of the patient’s haemodynamic status.
References


Tables

Table 1: Symptoms in patients with POTS

<table>
<thead>
<tr>
<th>Light-headedness and dizziness</th>
</tr>
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<tbody>
<tr>
<td>Weakness</td>
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<tr>
<td>Syncope</td>
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<tr>
<td>Palpitations</td>
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<tr>
<td>Headache</td>
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<tr>
<td>Fatigue</td>
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<td>Sleep disturbance</td>
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<td>Migraine</td>
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<td>Exercise intolerance</td>
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<tr>
<td>Dyspnoea</td>
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<tr>
<td>Tremulousness</td>
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<tr>
<td>Nausea and abdominal pain</td>
</tr>
<tr>
<td>Sweating</td>
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<tr>
<td>Anxiety</td>
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<tr>
<td>Exacerbation of symptoms by heat</td>
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<tr>
<td>Exacerbation of symptoms by exercise</td>
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</tbody>
</table>
**Table 2: Interventions which may be useful in POTS**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower extremity compression stockings</td>
<td>Used to increase venous return and decrease venous pooling, but often poorly tolerated by patients.</td>
</tr>
<tr>
<td>Water and salt supplementation</td>
<td>Used to expand plasma volume.</td>
</tr>
<tr>
<td>Exercise</td>
<td>Aerobic activity and resistance training to augment skeletal muscle pump.²³</td>
</tr>
<tr>
<td>Fludrocortisone</td>
<td>A potent mineralocorticoid that promotes sodium and fluid retention to expand plasma volume, and sensitizes peripheral alpha adrenergic receptors. Hypokalaemia and peripheral oedema can be problematic.²</td>
</tr>
<tr>
<td>Midodrine</td>
<td>An alpha-1 adrenergic agonist (tablet), which acts as a peripheral vasoconstrictor and increases blood pressure.⁹</td>
</tr>
<tr>
<td>Propanolol</td>
<td>Sympatholytic beta-blocker which reduces resting heart rate and heart rate increment during standing. Dose-limiting adverse effects include fatigue and hypotension.⁸</td>
</tr>
<tr>
<td>Pyridostigmine</td>
<td>An acetylcholinesterase inhibitor, which enhances both sympathetic and parasympathetic ganglionic transmission, resulting in enhanced vascular adrenergic tone and exerting a vagotonic effect.⁹</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>Selective serotonin reuptake inhibitors tend to be more useful in neurocardiogenic syncope and noradrenergic reuptake inhibitors are somewhat more useful in POTS.³,²³</td>
</tr>
<tr>
<td>Clonidine, methyldopa</td>
<td>Central sympatholytic agents used to treat patients with refractory hyperadrenergic POTS.⁹</td>
</tr>
<tr>
<td>Dihydroergotamine</td>
<td>An ergot alkaloid, used to cause arteriolar vasoconstriction to attenuate the response to upright posture.</td>
</tr>
<tr>
<td>Octreotide</td>
<td>A somatostatin analogue, which acts as a potent vasoconstrictor and is used to treat patients with refractory POTS.³,⁹</td>
</tr>
<tr>
<td>Erythropoietin</td>
<td>Used for blood volume expansion and vasoconstriction.⁹,²³</td>
</tr>
</tbody>
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