Our hospital runs a multi-disciplinary outpatient clinic which allows patient assessment and preparation before elective surgery. During the clinic, the patient completes a structured self-assessment questionnaire and then consults with a range of healthcare providers. A 55-year-old man presented for evaluation before undergoing bilateral inguinal herniorrhaphies. He completed the self-assessment questionnaire and was then seen and evaluated by nursing staff, a junior doctor from the surgical team, a senior anaesthetist, and a pharmacist.

He was noted to be a difficult historian by those who interacted with him on the day. He reported multiple low-grade food and drug intolerances in addition to a range of disparate and mild somatic complaints. The anaesthetist noted that there was no significant medical history. His physical examination was unremarkable apart from obesity (body mass index=32). His medical record was available at the time of his assessment.

He presented to the hospital on the operative day and was briefly re-assessed by his procedural anaesthetist. Routine monitoring was applied; his pre-induction blood pressure was recorded as 118/70 mm Hg. After pre-oxygenation, he received a standard induction and was intubated without event. Shortly after induction he experienced a 30-min episode of clinically important hypotension with systolic blood pressures of 60–80 mm Hg. He was also noted to be bradycardic with a heart rate of 35–45 beats min⁻¹. These unfavourable haemodynamics were eventually corrected with repeated boluses of fluid, metaraminol, ephedrine and glycopyrrolate. There were no other features of anaphylaxis. The case proceeded without event, his recovery was uneventful, and the patient was discharged on Day 2.

On further review of the clinical record in theatre, the anaesthetist noted that the patient had a long-standing history of severe hypothyroidism (T4 ≤ 5 pmol litre⁻¹ (ref: 10–25), TSH=100 mU litre⁻¹ (ref: 0.5–4)) but was non-compliant with his medication. Of significance, he had indicated on his preoperative self-assessment questionnaire that he had thyroid disease in response to a specific written question. If this important piece of clinical information had been identified before operation, it could have been factored into the anaesthetic plan and treatment of the subsequent intraoperative haemodynamic disturbance.

In our current system, no process exists to ensure that preoperative self-assessment questionnaire responses are followed up. Further, consultations with clinicians are loosely structured, and information gathered depends heavily on the individual clinician’s style of questioning. In this case, a structured approach may have increased the probability of this uncommon and unexpected medical issue being acknowledged before operation. Of interest, the patient was noted to be a difficult historian, possibly exacerbated by his hypothyroidism, yet had volunteered information on his thyroid condition on direct (written) questioning.

The task of preoperative assessment is both increasingly complex and vulnerable to clinical variance or error. However, advances in information technology mean that the structured, systematic collection of relevant clinical information before operation is feasible. Important issues can be automatically flagged and drawn to the attention of clinic staff. The development of checklists for application in the operating theatre has proved beneficial to patient outcome. A similar approach to the collection and processing of preoperative information is feasible and could also lead to outcome improvements.

T. Painter*
G. L. Ludbrook
Adelaide, Australia
*E-mail: thomas.painter@health.sa.gov.au

1 Ferschl MB, Tung A, Sweitzer B, Hua D, Glick DB. Preoperative clinic visits reduce operating room cancellations and delays. Anaesthesia 2005; 103: 855–9
2 Kluger MF, Bullock MF. Recovery room incidents: a review of 419 reports from the Anaesthetic Incident Monitoring Study (AIMS). Anaesthesia 2002; 57: 1060–6
do:10.1093/bja/aet148

Anaesthetic management of a patient with Charcot-Marie-Tooth disease for staged diaphragmatic plication

Editor—A 52-yr-old female with a 30 yr history of Charcot-Marie-Tooth (CMT) disease presented for a right thoracotomy and diaphragmatic plication. She suffered severe dyspnoea at rest. She was wheelchair dependent, could not lie flat, and was using home oxygen for increased periods.

Chest radiograph revealed bilaterally raised hemidiaphragms and pulmonary function tests demonstrated a severe restrictive defect (Table 1).

Induction and maintenance of anaesthesia was achieved with remifentanil and propofol infusions with incremental boluses of vecuronium. A double-lumen tube was sited, and pressure-controlled ventilation was used. After routine unilateral plication, the patient was reversed with sugammadex and extubated.

For postoperative analgesia, epipleural and wound catheters with plain 0.25% bupivacaine were used together with low-dose remifentanil infusion and regular paracetamol.

After the operation, the patient developed worsening type 2 respiratory failure treated with non-invasive ventilation during the first postoperative night, resolving the following day. The patient was discharged from hospital on the sixth postoperative day.
function revealed a dramatic improvement (Table 1).

### Table 1: Demonstrating arterial blood gas and pulmonary function.

<table>
<thead>
<tr>
<th>Pulmonary function tests</th>
<th>Preoperative</th>
<th>Following right diaphragmatic plication</th>
<th>Following left diaphragmatic plication</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEV1 (%)</td>
<td>30</td>
<td>41</td>
<td>51</td>
</tr>
<tr>
<td>FVC (%)</td>
<td>33</td>
<td>46</td>
<td>53</td>
</tr>
<tr>
<td>Arterial blood gases</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pH</td>
<td>7.41</td>
<td>7.42</td>
<td></td>
</tr>
<tr>
<td>PaCO₂</td>
<td>7.1</td>
<td>6.28</td>
<td></td>
</tr>
<tr>
<td>PaO₂</td>
<td>7.9</td>
<td>9.48</td>
<td></td>
</tr>
<tr>
<td>HCO₃⁻</td>
<td>33.9</td>
<td>30.2</td>
<td></td>
</tr>
<tr>
<td>S PO₂ (room air)</td>
<td>92%</td>
<td>96%</td>
<td></td>
</tr>
</tbody>
</table>

Six weeks later, she reported improvement in her symptoms, substantiated by a considerable improvement in pulmonary function tests (Table 1) and we proceeded to plication of the contralateral side.

Induction and maintenance of anesthesia was achieved with remifentanil and propofol infusions. We avoided neuromuscular blocking agents after induction of general anaesthesia, as residual curarization despite reversal with sugammadex perhaps contributed to the deterioration in respiratory function after the initial procedure. Xylocaine spray was applied to the vocal cords to facilitate intubation. Intra-thecal preservative free morphine was used in addition to epinephrine catheters. Recovery was uneventful and the patient was discharged 5 days later.

Five weeks later, she reported a dramatic improvement in her symptoms and a chest radiograph demonstrated a near-normal appearance of the diaphragms. Repeat pulmonary function revealed a dramatic improvement (Table 1).

CMT is an inherited sensory and motor polyneuropathy, with an incidence of 1 in 2500 and is associated with phrenic nerve palsy, disorders in diaphragmatic function and abnormalities of the thorax, leading to a restricted pulmonary function. The efficacy of diaphragmatic plication has been described in the literature. As far as we are aware, this is the first reported case of staged diaphragmatic plication in a patient with CMT disease.

Concerns have been raised about the use of neuromuscular blocking agents in patients with CMT disease. Evidence base is limited, and controversy exists as both prolonged and attenuated responses to neuromuscular blocking agents have been described. Neuromuscular blocking agents such as atracurium and mivacurium do not have a prolonged duration of action in this cohort of patients and succinylcholine may also be safely used. Some suggest avoiding succinylcholine as hyperkalaemia has been reported in other conditions associated with polyneuropathies and denervation injuries. The risk of malignant hyperthermia appears to be unfound as this is a peripheral neuropathy not myopathy. A study performed by Antognini reported no problems with the use of succinylcholine in 41 patients and halothane in 77 patients.

No cases of neurotoxicity have been reported with nitrous oxide use, nitrous oxide theoretically could cause neurotoxicity especially during prolonged cases through inhibition of methionine synthase.

There are concerns with the use of regional anaesthesia in patients with pre-existing neurological disease. This fear is compounded by the lack of controlled studies evaluating the potential risks of regional anaesthesia in this cohort of patients. Despite this, there are anecdotal case reports where epidural and spinal anaesthesia has been used for obstetric and orthopaedic procedures without exacerbating the underlying disease process. However, it is crucial that a full neurological examination is conducted and deficits are documented before proceeding with a regional technique. Other anaesthetic considerations include cautious positioning and protection of pressure points as nerve compression may exacerbate the underlying neuropathy.

### Declaration of interest

None declared.

### Acknowledgements

Mr J. Zacharias, Consultant Cardiothoracic Surgeon. Mr V. Sri- vastava, Cardiothoracic Surgical Clinical Fellow.

T. M. Pasha*  
A. Knowles  
Blackpool, UK  
E-mail: tmpasha1@gmail.com

Utilizing sampled gas to decrease fresh gas flow

Editor—Among the adoption of numerous technologies to improve patient safety during anaesthesia, respiratory gas monitoring is a key component. The monitoring of respiratory gas not only alerts the clinician about the adverse events such as anaesthetic overdose, wrong agent, or unsuitable oxygen content, they also help in maintaining an adequate depth of anaesthesia, thereby preventing awareness. Virtually every anaesthesia workstation has these essential monitors and they have undergone continuous improvements over the years in terms of cost, size, and functioning. They are increasingly relied upon to know the uptake of anaesthetic gases, especially when low-flow anaesthesia is administered. The majority of these monitors utilize side-stream sampling, and the sampling rate varies from as low as 50 ml min⁻¹ with the newer models of gas-monitoring devices (PHASEIN AB, Danderyd, Sweden) to as high as 250 ml min⁻¹ (Artema AION anesthesia gas analyzer; Artema Medical AB; Sundbyberg, Sweden).¹ Hence a fair amount of anaesthetic agent is sampled by the gas monitor every minute which ends up in the scavenging system. Anaesthesiologists commonly account for this sampling rate while determining the total gas flow during low-flow anaesthesia. Utilizing the sampled gas from the gas monitor may lessen the wastage of vapours to the scavenging system and allow further lowering of fresh gas flows safely even when older gas monitoring devices with higher sampling rates are used.

We describe a simple modification of the gas sampling monitor connections to further decrease the fresh gas flow than that which is conventionally used. We attached microbore extension tubing to a simple filter or a heat–moisture exchanger placed at the expiratory limb of the circle system (Fig. 1a) to the sample gas out port of the gas monitoring device (D-Fend) (Fig. 1b). This enables the sampled gas to be utilized again in the circuit instead of diverting it to the scavenging system. In a leak-free circuit, we have used fresh gas flows as low as 250–350 ml min⁻¹ safely while monitoring the anaesthetic agent and oxygen concentrations. That would be about half the fresh gas flow and hence half the utilization of vapours when compared with using the conventional scavenging system along with the gas monitor. We have also noted a better matching of dialled and delivered concentration of the anaesthetic agent with this new modification. We have to utilize higher oxygen concentrations and monitor for trace gases vigilantly when used for a longer period of time. As the majority of the gas analyzers are based on non-dispersing infrared (NDIR) spectroscopy unlike mass spectrometry, there should be little concern about the formation of trace gases because of the gas monitor itself. The cost-effectiveness of this modification probably holds good for longer duration of anaesthetic gas usage to cover for the additional equipment.

Fig 1 Connection of microbore extension tubing to the expiratory post of anaesthesia gas monitor (a) and to a filter/HME in the expiratory limb of anaesthesia circuit (b).

¹ doi:10.1093/bja/aet142