Case Report

High-flow nasal oxygen for a high-risk patient undergoing sedation in the prone position

S. Sodha¹ and T. Fernandez²

1 Consultant, Department of Anaesthetics, Royal Free London NHS Foundation Trust, London, UK

2 Consultant, Department of Anaesthetics and Pain, Royal National Orthopaedic Hospital NHS Trust, London, UK

Summary

We describe the use of high-flow nasal oxygen for an obese patient with obstructive sleep apnoea presenting for revision of a spinal cord stimulator. The use of high-flow nasal oxygen allowed the delivery of a high inspired oxygen concentration with humidification and improved patient comfort compared with our usual choice of device, the Hudson mask. It also provided continuous positive airways pressure which is likely to have reduced pharyngeal collapse and atelectasis. The use of high-flow nasal oxygen enabled the delivery and careful titration of deep sedation with propofol and remifentanyl, to allow a successful revision procedure to take place without airway complications or significant oxygen desaturation in a high-risk patient in the prone position.

Correspondence to: S. Sodha

Email: serenasodha@doctors.org.uk

Accepted: 17 April 2019

Keywords: morbid obesity; hypoxaemia physiology; obesity; airway evaluation; obstructive sleep apnoea: diagnosis

Twitter: @DrSerenaS

Introduction

Sedation for spinal cord stimulator insertion represents a unique challenge to the anaesthetist. Its requirement for varying depths of sedation, the prone position and the high-risk population in which it is performed all add to its complexity.

Patients with chronic pain who present for spinal cord stimulator insertion are often tolerant to opioids and receive a variety of medications for management of their pain. This may include a combination of gabapentinoids, weak or strong opioids and benzodiazepines. The potential contribution from pre-existing medication use on respiratory drive, mechanics and response to sedation can vary considerably and needs careful evaluation pre-operatively.

High-flow nasal oxygen (HFNO) involves delivery of humidified, warmed oxygen at flow rates of up to 70 L.min⁻¹ via soft nasal cannulae. Its popularity has increased in recent years due to the ability to provide oxygenation in apnoeic patients, to deliver a high inspired oxygen concentration [1–3] and low level continuous positive airways pressure (CPAP) [4] to self-ventilating patients without the need for tracheal intubation or a bulky, tight-fitting facemask. The increase in end-expiratory pharyngeal pressure associated with HFNO has also been shown to alleviate upper airway obstruction in patients with obstructive sleep apnoea (OSA) and to reduce the incidence of apnoea [5]. In this report, we describe the novel use of HFNO for sedation in the prone position in a patient with a high body mass index (BMI) and history of OSA at high risk of airway and respiratory complications.

Report

A 57-year-old woman with a background of OSA, using a CPAP device at home, a BMI of 38 kg.m⁻² and mild asthma presented for revision of spinal cord stimulator leads. She was known to be a difficult tracheal intubation, with a Cormack and Lehane grade

3 view obtained during a previous anaesthetic, and bag-valve-mask ventilation described as manageable. Sedation for the initial spinal cord stimulator insertion was documented as uneventful, with oxygen delivery via a Hudson mask. She was noted to oxygen desaturate down to 92% in theatre and recovery.

Particular concerns for this case were an increased risk of airway obstruction and apnoea in response to sedation, the increased risk of atelectasis associated with obesity leading to reduced gas exchange and the possibility of difficulty in managing the airway with bag-valve-mask ventilation and tracheal intubation if required, all of which would be made more challenging by the requirement for prone positioning.

In view of the patient's history of OSA, raised BMI, previously difficulty with airway management and a possible complicated revision procedure, a decision was made to use high-flow nasal oxygen while the patient was sedated in the prone position. Advantages of this technique were the ability to provide CPAP, to alleviate upper airway obstruction, to provide apnoeic oxygenation if necessary and to allow delivery of a higher F_IO₂ than is possible with a Hudson mask. The application of CPAP was not a viable option in the prone position.

The nasal high-flow oxygen, humidified and warmed to 37°C system (Optiflow™, Fisher & Paykel Healthcare, Auckland, New Zealand) was initiated before the start of sedation. It was well tolerated by the patient, at a rate of 30 l.min⁻¹ initially, increasing up to 55 l.min⁻¹ when deeply sedated. The nasal cannulae were also less obtrusive compared with a Hudson mask.

Propofol was administered using the Schnider model and remifentanyl was administered using the Minto model, targeting the effect-site concentration. She required an effect-site concentration of up to 1.4 µg.ml⁻¹ propofol with a total of 505 mg given over 2 h 23 min, and up to 1.2 ng.ml⁻¹ remifentanyl with a total 355 µg given over the same period.

Her oxygen saturations were maintained at 97% or above for most of the case, with the lowest oxygen saturation recorded for a very brief period at 95%.

The only issues encountered were that, as the patient's lateral neck movement was limited, she often lay with her face partially into the pillow and as a result the soft nasal cannulae became obstructed and the set flow was not delivered. This was easily rectified by adjusting the patient's position and this is unlikely to occur in a patient without neck limitation who would lie with their head to one side.

Discussion

Sedation for spinal cord stimulator insertion poses a number of challenges for the anaesthetist. It is performed via a surgical approach involving dissection up to the spinous processes to allow needle placement in the epidural space and then requires the formation of a pocket for the internal pulse generator battery. It requires the patient to be in the prone position. It is too stimulating a procedure to be performed on an awake patient and also requires the quick offset of any hypnotics to allow evaluation of stimulation coverage to ensure accurate placement of the spinal cord stimulator leads. The fact that the patient population involved are likely to have chronic pain and be tolerant to opioids adds further complexities.

Propofol and remifentanyl provide the ability to titrate sedation to the patient's needs with a quick offset, but may also depress respiratory drive and reduce pharyngeal tone, leading to airway complications.

Obesity and OSA are well-known risk factors associated with airway complications and oxygen desaturation events during sedation [6]. The incidence of obesity and its related complications, including OSA, are increasing worldwide and, as a result, obese patients are providing ever greater challenges to the anaesthetist.

HFNO systems have been in use for decades and were first used to manage respiratory failure in the paediatric population. Since then their scope of use in the intensive care and theatre settings have increased significantly [1]. The air-oxygen blender, together with a heated humidifier, enables the delivery of warmed, humidified gases at flows of up to 70 l.min⁻¹ via specially designed nasal cannulae. HFNO is less bulky than alternative devices and provides increased patient comfort. The higher flow rates mean that less air is entrained during inspiration, leading to more reliable delivery of high fractions of inspired oxygen. HFNO also results in flushing of upper airway dead space and the generation of positive end-expiratory pressure (PEEP), which reduces work of breathing and enhances airway patency [7].

In conclusion, we report the successful use of HFNO in a patient undergoing deep sedation in the prone position, with a history of obesity, OSA and difficult airway management. HFNO provided the ability to deliver a higher fraction of inspired oxygen than the Hudson mask, which is our usual choice of device, with additional benefits of heating and humidification. It also provided CPAP, and an increase in end-expiratory pharyngeal pressure which may have reduced pharyngeal collapse and atelectasis in a patient at high risk of these complications. In the event of apnoea, HFNO would have prolonged the time to

oxygen desaturation [1], allowing repositioning and instrumentation of the airway if necessary. We believe that this is the first account of the use of high-flow nasal oxygen for sedation in the prone position.

Acknowledgements

Published with the written consent of the patient. No external funding or competing interests declared.

References

1. Patel A, Nouraei SA. Transnasal Humidified Rapid-Insufflation Ventilatory Exchange (THRIVE): a physiological method of increasing apnoea time in patients with difficult airways. *Anaesthesia* 2015; **70**: 323–9.
2. Sim MA, Dean P, Kinsella J, Black R, Carter R, Hughes M. Performance of oxygen delivery devices when the breathing pattern of respiratory failure is simulated. *Anaesthesia* 2008; **63**: 938–40.
3. Pillai A, Daga V, Lewis J, Mahmoud M, Mushambi M, Bogod D. High-flow humidified nasal oxygenation vs. standard face mask oxygenation. *Anaesthesia* 2016; **71**: 1280–3.
4. Groves N, Tobin A. High flow nasal oxygen generates positive airway pressure in adult volunteers. *Australian Critical Care* 2007; **20**: 126–31.
5. McGinley BM, Patil SP, Kirkness JP, Smith PL, Schwartz AR, Schneider H. A Nasal Cannula can be Used to Treat Obstructive Sleep Apnea. 2007; **176**: 194–200.
6. Berzin TM, Sanaka S, Barnett SR, et al. A prospective assessment of sedation-related adverse events and patient and endoscopist satisfaction in ERCP with anesthesiologist-administered sedation. *Gastrointestinal Endoscopy* 2011; **4**: 710–17.
7. Spoletini G, Alotaibi M, Blasi F, Hill NS. Heated humidified high-flow nasal oxygen in adults: mechanisms of action and clinical implications. *Chest* 2015; **148**: 253–61.