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Case report

Use of sugammadex in a 'can't intubate, can't ventilate' situation

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Editor's key points

- Sugammadex reversal of rocuronium has been suggested for management of a difficult airway.
- In a patient with upper airway pathology, attempts at tracheal intubation resulted in a 'can't intubate, can't ventilate' situation.
- Sugammadex reversed the rocuronium but did not restore airway patency.
- Alternative strategies for airway management must be immediately available.

A 78-yr-old woman presented for a panendoscopy to investigate dysphonia and dysphagia. Intubation was anticipated to be difficult but possible, and mask ventilation was anticipated to be possible. After induction of anaesthesia and after three attempts at intubation, a 'can't intubate, can ventilate' situation deteriorated to a 'can't intubate, can't ventilate' (CICV) situation. Rocuronium-induced neuromuscular block was successfully reversed with sugammadex, as evidenced by the restoration of diaphragmatic movement, the ability of the patient to move her limbs, and the presence of a train-of-four nerve stimulation with no fade; however, ventilation was still not possible. A cricothyroid puncture using a Ravussin needle was performed successfully to provide emergency oxygenation. A tracheostomy was performed to allow the panendoscopy. CICV situations are rare anaesthetic emergencies. While sugammadex can be relied upon to reverse rocuronium-induced neuromuscular block, it should not be relied upon to rescue all CICV events, especially where airway instrumentation has led to airway swelling. The availability of sugammadex does not obviate the need for emergency tracheal access in the event of failed oxygenation. The presence of head and neck pathology should lead to the consideration of securing the airway awake.

Keywords: airway obstruction; γ-cyclodextrins; intubation, intratracheal

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Sugammadex is a modified γ-cyclodextrin that rapidly and completely reverses the neuromuscular block associated with rocuronium.[1] Even at high doses of rocuronium (1.2 mg kg^{-1}), reversal by high-dose sugammadex (16 mg kg^{-1}) is faster than the spontaneous recovery from 1 mg kg^{-1} of succinylcholine.[2] This rapid reversal of neuromuscular block has led to sugammadex being suggested as a rescue drug in a 'can't intubate, can't ventilate' (CICV) scenario[3 4] after administration of rocuronium. We report what we believe to be the first case of the use of sugammadex in a CICV scenario, which highlights that rapid reversal of neuromuscular block with sugammadex will not relieve necessarily airway obstruction caused by the instrumentation of a compromised airway and that it is not a substitute for emergency tracheal access.

Case report

A 78-yr-old woman (65 kg) with a 4 month history of dysphonia and dysphagia presented for an elective panendoscopy and left-sided tonsillectomy. She denied any symptoms of orthopnoea or stridor, and otherwise her medical history was unremarkable. Airway assessment revealed a Mallampati score of 3, with a 4 cm mouth opening, thyromental distance of 7 cm, and full dentition. Nasendoscopy performed by a consultant head and neck surgeon 2 weeks previously had revealed a swelling in the left tonsil with oedematous uvula which partially obscured the view of the pharynx, but the vocal cords and larynx appeared normal. A CT scan performed the day before surgery reported a large enhancing mass lesion in the region of the left palatine tonsil with significant bilateral cervical lymph nodes and narrowed airway at the level of the hyoid.

The discrepancy between the findings of the nasendoscopy and CT scan was discussed between two experienced consultant anaesthetists and a consultant head and neck surgeon in order to formulate plans for securing tracheal intubation. An awake fibreoptic intubation was considered. Intubation was anticipated to be difficult, although mask ventilation was anticipated to be possible. A stepwise plan for intubation was agreed. The initial plan was, therefore, induction of general anaesthesia with direct laryngoscopy, with a secondary plan of the use of an alternative blade,

videolaryngoscope (Glidescope™; Verathon Inc., WA, USA), or a fibreoptic bronchoscope, depending on the difficulty encountered. The tertiary plan was to wake the patient up, reversing the rocuronium-induced neuromuscular block with sugammadex. The sugammadex was brought into the anaesthetic room and a 16 mg kg^{-1} dose was calculated but not drawn up. In the event of failed oxygenation, a cricothyroid puncture was planned and a Ravussin needle (VBM Medizintechnik, Sulz, Germany) and Manujet (VBM Medizintechnik) were immediately available. The placement of a Ravussin needle pre-induction was not deemed necessary, given that ventilation was anticipated to be possible. All of the equipment required for each of the plans was prepared in the anaesthetic room. As is usual, the theatre nursing team were also alerted to the anticipated difficulty with intubation, management plans discussed, and they prepared a tracheostomy kit as a precaution.

The patient was pre-oxygenated for 4 min and then anaesthesia induced with fentanyl 75 μg administered i.v. followed by propofol 160 mg. This was followed immediately with rocuronium bromide 40 mg (0.61 mg kg^{-1}) to achieve muscle relaxation. Bag-mask ventilation was easily achieved and the lungs were ventilated with oxygen at an F_{IO_2} of 1.0 and sevoflurane at an end-tidal concentration of 1.9%. After 2 min, gentle direct laryngoscopy was performed with a Macintosh size 3 blade. On laryngoscopy, the anatomy was unidentifiable because of a large, rigid, fungating mass in the oropharynx and obliterating any view of the larynx or epiglottis. Direct laryngoscopy was abandoned and bag-mask ventilation successfully recommenced. Indirect laryngoscopy with the Glidescope was attempted to try and bypass the mass. This did not improve laryngoscopy and contact bleeding had commenced, so bag-mask ventilation was successfully re-instigated. A second consultant anaesthetist performed direct laryngoscopy with a size 4 Macintosh blade which was also unsuccessful. Bag-mask ventilation had now become increasingly difficult, despite the use of a Guedel airway and two-person mask ventilation. A size 3 laryngeal mask airway (LMA Unique™, Intavent Orthofix, Berks, UK) was inserted; however, ventilation was not possible and so it was removed.

A CICV scenario was now recognized and the decision made to awaken the patient. Oxygen saturation levels remained at 98%. The volatile agent was turned off, and sugammadex 1 g (15.4 mg kg^{-1}) administered given i.v. within 30 s of the decision to awaken the patient being made. This was ~6 min after the administration of rocuronium. A nerve stimulator was attached to the patient. Further attempts at ventilation continued unsuccessfully. After 60 s, spontaneous chest wall movement was observed with the patient beginning to make respiratory effort and moving her upper limbs. Train-of-four nerve stimulation showed no evidence of fade. An obstructed pattern of breathing was witnessed with no capnography trace or movement of the reservoir bag. Oxygen saturations had now decreased to 92%, so an adult Ravussin cannula was inserted through the cricothyroid membrane to achieve rescue oxygenation. Placement was confirmed with aspiration of air and evidence of carbon dioxide on capnography, followed by oxygenation with the Manujet™ set to an initial pressure of 0.5 bar and a rate of 5 bpm. Adequate inhalation and exhalation was confirmed by the rise and fall of the anterior chest wall, with upper airway manoeuvres being used to maintain a route for exhalation. The driving pressure was subsequently increased to 1 bar to achieve adequate tidal volumes and oxygen saturation levels increased to 98%.

An emergency tracheostomy was performed between the first and second tracheal rings by the surgical team with anaesthesia maintained using i.v. propofol. A 7.0 mm cuffed tracheostomy tube was inserted and conventional ventilation achieved followed by a panendoscopy and tonsillar biopsy. After the procedure, anaesthesia was discontinued and the patient woken up. She was nursed on the high dependency unit overnight, before returning to the ward. There was no neurological deficit. Histology showed a squamous cell carcinoma and a tracheostomy remained *in situ* while the patient underwent treatment for the tongue base tumour.

Discussion

CICV situations are an anaesthetic emergency requiring rapid and decisive management. Given the rarity of CICV events, the incidence is difficult to estimate; however, recent work has suggested an incidence during all anaesthetics of one in 50 000.[5] It is likely that the incidence is higher in patients with head and neck pathology. Both the ASA[6] and the Difficult Airway Society (DAS)[7] have published guidelines on the management of CICV situations. The introduction of sugammadex, with its rapid reversal of even profound neuromuscular block, has led to the suggestion that it is a potential rescue strategy in CICV situations.[3 4 8 9]

A CICV scenario may be induced through multiple airway manipulations occurring during either the unanticipated or anticipated difficult intubation, which may cause swelling or soiling of the airway, as occurred in our case. Indeed, the recently published Fourth National Audit Project of the Royal College of Anaesthetists and Difficult Airway Society (NAP4) report found that in head and neck pathology, repeated attempts at laryngoscopy were a common cause of airway deterioration and morbidity.[10] The use of sugammadex in these situations will reverse rocuronium neuromuscular block, as occurred in our case as shown by the presence of a train-of-four with no fade leading to the return of respiratory efforts, although this may not be associated with a restoration of a patent upper airway. The end-result of CICV (failure to oxygenate) would still be present. In these circumstances, then rescue oxygenation strategies, such as the placement of a cricothyroid puncture device, must be used while an emergency definitive airway is secured.

CICV scenarios may be apparent immediately after the onset of anaesthesia, for example, failed ventilation in the morbidly obese when associated with difficult laryngoscopy. In situations such as this, where the CICV scenario occurs before there have been multiple airway manipulations, the

reversal of rocuronium-induced neuromuscular block with sugammadex and the return of upper airway tone is likely to restore a patent airway. However, this is reliant on the correct dose of sugammadex being immediately available and easily accessible. A recent manikin study stated that in a CICV scenario, the time to calculate the correct dose of the drug and draw it up is 6.7 min.[11]

Our case illustrates that sugammadex, while completely reversing rocuronium-induced neuromuscular block, did not rescue a CICV situation, and that it is not a panacea for all anticipated and unanticipated difficult airway management. Sugammadex may have a role in the management of CICV situations of different aetiology; however, rescue oxygenation techniques should be used in a timely fashion if required. If sugammadex is part of a rescue management plan, then it should be used early in the management of the difficult airway situation, before repeated airway manipulations. It also highlights that an airway management plan needs to be reassessed in the light of new investigations and supports the NAP4 recommendations of the avoidance of multiple attempts at laryngoscopy.[10] A repeat nasendoscopy would have been appropriate to investigate the discrepancy between the previous nasendoscopy and the CT scan and would have likely led to the further consideration of some form of awake airway management, such as fibreoptic intubation or a prophylactic cricothyroid cannula. Given the situation encountered at laryngoscopy, it is possible that an awake fibreoptic intubation may have failed. Finally, it is important that all members of the operative team are briefed in advance of any potential difficulties and are aware of a stepwise plan in order to allow adequate preparation and effective management of such emergencies.

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Consent for publication was granted by the patient.

Declaration of interest

None declared.

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