

Case Report

Open Access

“I Can’t breathe”: Two Case Reports of Inadequate Reversal of Residual Muscle Paralysis

J V Kapofi¹ and K U Tob^{2*}¹Medical officer, Department of Anaesthesia, Windhoek Central Hospital, Ministry of Health and Social Services, Windhoek, Namibia²Senior lecturer, Department of Anaesthesiology, University of Namibia, Hage Geingob Campus, Windhoek, Namibia**ABSTRACT**

Reversal of residual muscle paralysis is usually done at the end of a General Anaesthesia with Relaxant Technique (GART) before extubation. However, some patients may have inadequate reversal of their residual muscle paralysis. This may lead to persistent muscle paralysis despite the patient being awake from anaesthesia. A scenario of “I can’t breathe” therefore comes to play which is scary and discomforting to the affected patients.

We hereby present two cases of inadequate reversal of residual muscle paralysis in our patients who underwent different procedures under general anaesthesia. The aim of this presentation is to highlight the need for adequate reversal of residual muscle paralysis, the need to routinely monitor neuromuscular function during general anaesthesia and to review the existing literature.

***Corresponding author**

Dr. K U Tob, MBBS, PGDA, FMCA, FWACS Senior Lecturer/Senior Specialist Anaesthesiologists, Cert in Critical care, University of Namibia, Hage Geingob Campus, Windhoek, Namibia. E-mail: tobikingsley265@gmail.com

Received: June 14, 2021; **Accepted:** June 25, 2021; **Published:** July 03, 2021

Case Reports

First case is 17-year-old male patient scheduled for removal of right clavicle plate and screws under general anaesthesia. He had plating of his right clavicle done about a year ago following a right clavicular fracture sustained while participating in a contact sport. Anaesthesia and surgery was uneventful and he was planned for plate removal.

He had no known co-morbidities and did not smoke nor drink alcohol. He weighed 63kg with a body mass index of 22kg/M². The Pre-anaesthetic review revealed no significant clinical or laboratory findings. He was fasted according to the American Society of Anaesthesiologists fasting guidelines. On the morning of surgery, he was transferred to the operating room in a stable condition.

On arrival at the operating theatre, The World Health Organisation check list and pre-anaesthetic anaesthetic machine check was done and appropriate medications were drawn and labelled. An intravenous access was secured with an 18G cannula on the left arm and 1liter 0.9% saline was put up to run at about 100ml/hr. Induction of anaesthesia was achieved with appropriate doses of propofol and endotracheal intubation was facilitated with appropriate dose of rocuronium. Correct placement of the endotracheal tube was confirmed with bilateral chest auscultation and end-tidal carbon dioxide tracing. Anaesthesia was maintained with sevoflurane in oxygen.

At the end of surgery which lasted about one hour, residual muscle

paralysis was reversed with appropriate doses of neostigmine (2.5mg) and glycopyrrolate (0.4mg). The inhalational agent was turned off and oropharyngeal suctioning was done under direct vision and the patient was extubated. However, few minutes after extubation, patient complained that he could not breathe which necessitated oxygen administration and a diagnosis of possible inadequate reversal of residual muscle paralysis was made. Another doses of neostigmine and glycopyrrolate was administered and patient became comfortable afterwards with good tidal breath and oxygen saturation in room air.

The second case is of a 59-year-old male, diagnosed with recurrent bladder cancer with symptoms of gross haematuria, frequency and urgency who presented for a proposed operation of Cystoscopy +/- Transurethral resection of bladder cancer under general anaesthesia. The patient had previous general anaesthesia in 2011 for an initial TURBT which was uneventful. He had a 30-pack year smoking history with no other comorbidities and no known allergies.

Pre-operative examination revealed a frail elderly looking male, weighing 45kg with no pallor. The airway examination was normal apart from a finding of a few missing teeth. Respiratory and cardiovascular examinations were unremarkable. Investigations revealed abnormal findings of a low haemoglobin of 9.3 g/dl and a chest X-ray which showed hyper-inflated lungs. The patient was group and screened in the event of significant intraoperative blood loss, fasted accordingly and anxiolytics were prescribed.

Intra-operatively the WHO checklist was done. Intravenous access

was secured with two cannulas, 18G and 16G respectively and the allowable blood loss was calculated. Ringer's lactate was commenced at a rate of 80ml/hour. Induction was then commenced with fentanyl 100mcg, propofol 120mg and atracurium 25mg, the patient was intubated with ETT size 7.5 at a depth pf 21cm. Anaesthesia was maintained with Sevoflurane, oxygen and air. The patient was ventilated with volume control ventilated at a tidal volume of 350ml, a respiratory rate of 13 and a PEEP of 5.

Drugs given intraoperatively include Tranexamic Acid 1g, 50mcg fentanyl, Paracetamol IVI 1g as well as a maintenance dose of atracurium. The blood loss was estimated at 500ml. At the end of the surgery which lasted approximately 90min, the NDMR was reversed with 2.5mg neostigmine and 0.4mg glycopyrrolate and the inhalational agent switched off. The airway was suctioned fully and the patient was successfully extubated after the protective airway reflexes returned. The patient was transferred to the post anaesthesia care unit (PACU) in the recovery position breathing spontaneously on room air.

After 5min in PACU the patient was fully awake but restless and complaining of inability to breath well with oxygen saturation of 90-91%. A diagnosis of residual muscle relaxant was made after which supplemental oxygen was given at 2L/min and the reversal agent was repeated at the same dose. The patient then became calm and the oxygen saturation improved to 93% to 94% on room air.

Literature Review

Reversal of neuromuscular blockade is usually done at the end of a General Anaesthesia with Relaxant Technique (GART) before extubation. However, some patients may have inadequate reversal of their muscle paralysis. This may lead to persistent muscle paralysis despite the patient being awake from anaesthesia. A scenario of "I can't breathe" therefore comes to play which is scary and discomforting to the affected patients.

Debaene and coworkers reported persistent residual muscle paralysis in about 10% of their patients who had Non-Depolarizing muscle blocker with either atracurium, vecuronium or rocuronium despite being the administration of anticholinesterase [1]. The authors noted that the incidence was higher in patients who had shorter duration surgery and those who had repeat muscle relaxant. In this case report, the average duration of surgery was two hours and none of our patient had a repeat dose of muscle relaxant intraoperatively.

In another study, McGaul and colleagues demonstrated that despite the use of neostigmine for the reversal of residual muscle paralysis, the incidence of incomplete or inadequate reversal was as high as 65%. Interestingly, 50% of their patients had neuromuscular monitoring with peripheral nerve stimulator while the other half had clinical criteria for assessment of neuromuscular function [2]. In addition to shorter duration of surgery, they observed that larger doses of muscle relaxants and shorter time interval between last incremental dose of NDMB and extubation accounted for their observation.

Inadequate reversal of residual muscle paralysis has many complications which include postoperative respiratory failure. As far as back as 1981, postoperative respiratory complication was found to account for about 34% of anaesthesia-related deaths in the UK [3]. Six of these deaths were directly linked to residual muscle paralysis despite the use of reversal agent. More recently, Naguib et al. conducted a meta-analysis which suggested that the incidence of postoperative pulmonary complication (POPC)

was lower with the use of intermediate acting muscle relaxant as compared to the longer-acting ones [4]. In the two patients reported in our case report, an intermediate acting neuromuscular blocker, rocuronium was used.

Although the use of use of neostigmine for the reversal of residual muscle paralysis has been accepted to reduce the incidence of POPC, a recent study in the USA has questioned the veracity of this long-held belief. In this study, the use of neostigmine was observed to actually increase the incidence of POPC [5]. The authors opined that, the association between the use of intermediate-acting NMBs and POPC was rather dose-dependent. In the same vein, another study suggested that the same dose-dependent relation existed between neostigmine and an increase in POPC [6]. The appropriate use of neostigmine and a subjective assessment with train-of-four has been postulated to eliminate the dose-dependent association between NDMB and POPC.

As early as in the 1970s, Gray and colleagues, had recommended the use of train-of-four (TOF) twitch technique anytime a NDMB is used intraoperatively [7]. They had suggested that a reversal agent should only be administered after all the four twitches have been detected. This has been found to equate with good recovery of muscle tone as exhibited by sustained head lift for five seconds, adequate tongue protrusion and cough [8]. However, neuromuscular monitoring with the use of TOF is not routinely practiced in most centers especially in the developing countries such as ours. Clinical criteria of sustained head lift, firm had grip, tongue protrusion, eye opening to commands etc remain the mainstay of monitoring adequate reversal of residual muscle paralysis in our center.

The use of sugammadex, a gamma-cyclodextrin introduced to clinical practice in 2008 has been found to significantly reduce the incidence of incomplete reversal muscle paralysis compared to when neostigmine was used [9]. The affinity of sugammadex for rocuronium is said to be comparable to the affinity of acetylcholine for postsynaptic nicotinic receptors. At a dose of 2mg/kg, sugammadex completely reverses moderate neuromuscular blockage with rocuronium within 2minutes which is quicker than the action of neostigmine [10]. In a study on 624 patients, Cammu and coworkers observed that only one patient among those who received sugammadex developed residual muscular block postoperatively [11]. However, it is paramount that neuromuscular monitoring be done whenever sugammadex or neostigmine is used to reverse residual muscle paralysis. This is because residual block remains a risk [12].

Conclusion

Inadequate or incomplete reversal of residual muscle paralysis after general anaesthesia with relaxant technique exposes surgical patients to unpleasant and sometimes life-threatening complications. Appropriate use of neostigmine and neuromuscular monitoring should be routinely employed in addition to the commonly use clinical criteria to forestall untoward complications following the use of NDMB.

References

1. Debaene B, Plaud B, Dilly M-P, Donati F (2003) Residual paralysis in the PACU after a single intubating dose of nondepolarizing muscle relaxant with an intermediate duration of action. *Anesthesiology* 98: 1042-1048.
2. McCaul C, Tobin E, Boylan JF, McShane AJ (2002) Atracurium is associated with postoperative residual curarization. *Br J Anaesth* 89: 766-769.

3. Lunn JN, Hunter AR, Scott DB (1983) Anaesthesia-related surgical mortality. *Anaesthesia* 38: 1090-1096.
4. Naguib M, Kopman AF, Ensor JE (2007) Neuromuscular monitoring and postoperative residual curarization: a meta-analysis. *Br J Anaesth* 98: 302-316.
5. Grosse-Sundrup M, Henneman JP, Sandberg WS, et al. (2021) Intermediate acting non-depolarizing neuromuscular blocking agents and risk of postoperative respiratory complications: prospective propensity score matched cohort study. *Br Med J* 345: e632.
6. McLean DJ, Diaz-Gil D, Farhan HN, Ladha KS, Kurth T, ET AL. (2015) Dose-dependent association between intermediate-acting neuromuscular-blocking agents and postoperative respiratory complications. *Anesthesiology* 122: 1201-1213.
7. Ali HH, Utting JE, Gray TC (1970) Stimulus frequency in the detection of neuromuscular block. *Br J Anaesth* 42: 967-978.
8. Donati F (2013) Residual paralysis: a real problem or did we invent a new disease? *Can J Anesth* 60: 714-729.
9. Brueckmann B, Sasaki N, Grobara P, M K Li, T Woo, et al. (2015) Effects of sugammadex on incidence of postoperative residual neuromuscular blockade: a randomized, controlled study. *Br J Anaesth* 115: 743-751.
10. Flockton EA, Mastronardi P, Hunter JM, C Gomar, R K Mirakhur, et al. (2008) Reversal of rocuronium-induced neuromuscular block with sugammadex is faster than reversal of cisatracurium-induced block with neostigmine. *Br J Anaesth* 100: 622-630.
11. Cammu GV, Smet V, De Jongh K, Vandeput D (2012) A prospective, observational study comparing postoperative residual curarisation and early adverse respiratory events in patients reversed with neostigmine or sugammadex or after apparent spontaneous recovery. *Anaesth Intensive care* 40: 99-1006.
12. Kotake Y, Ochiai R, Suzuki T, Setsuro Ogawa, Shunichi Takagi, et al. (2013) Reversal with sugammadex in the absence of monitoring did not preclude residual neuromuscular block. *Anesth Analg* 117: 345-351.