Prolonged Apnoea after Succinylcholine and Atracurium Administration

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ABSTRACT

Succinylcholine and atracurium are two commonly used medicines for induction and intubation in medical procedures. Succinylcholine is a short-acting depolarising neuromuscular blocking agent that causes temporary paralysis by disrupting acetylcholine neurotransmission. Atracurium, on the other hand, is a non-depolarising neuromuscular blocking agent that competitively binds to cholinergic receptor sites. Both medications have different elimination methods: Succinylcholine is metabolised and excreted, while atracurium is excreted unchanged and its elimination is pH- and temperature-dependent. Factors such as hypothermia can affect atracurium elimination, leading to prolonged recovery time. Additionally, the duration of succinylcholine apnoea is related to the genotype of plasma cholinesterase, with homozygotes experiencing more extended paralysis compared to heterozygotes. Here, we discuss a prolonged apnoea case with succinylcholine and atracurium.

Key Words: *Prolonged apnoea, Succinylcholine apnoea, Delayed recovery, Pharmacokinetics.*

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INTRODUCTION

Succinylcholine is a short-acting depolarising neuromuscular blocking agent approved for rapid endotracheal intubation to facilitate surgical procedures and mechanical ventilation. It is an analogue of acetylcholine that attaches to the post-synaptic cholinergic receptors of the motor end-plate, disrupting acetylcholine and causing transient and rapid paralysis. In comparison, the atracurium is a non-depolarising neuromuscular blocking agent that antagonises the neurotransmitter action of acetylcholine by binding competitively with cholinergic receptor sites on the motor end-plate.[1,2]

Both agents have been extensively used for induction and intubation purposes. Succinylcholine is metabolised by acetylcholinesterase and is excreted from the body. In contrast, atracurium is excreted unchanged by the Hofmann elimination and ester hydrolysis (non-specific esterases), which are pH- and temperature-dependent processes.[3,4] Hypothermia intraoperatively may profoundly affect atracurium elimination and can potentially double the recovery time.[5,6]

Succinylcholine apnoea is related to the genotype of plasma cholinesterase, which can be homozygous and heterozygous. The duration of neuromuscular blockade depends on whether the patient is homozygous or heterozygous for the defective enzyme.[5] Heterozygotes experience a moderate duration of muscular blockade when compared to homozygotes (more than 2 hours).[5]

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CASE REPORT

A 26-year male with a traumatic saddle nose deformity underwent a septorhinoplasty manifested a prolonged recovery of spontaneous respiration, 25 minutes from succinylcholine and 270 minutes (4.5 hours) from atracurium.

The patient was a known case of migraine and was taking a combination of paracetamol 500 mg, caffeine 70 mg, and thioridazine 3 mg to control his symptoms. The patient did not have any history of previous surgery.

A pre-operative assessment was carried out including a detailed history, general physical examination, and specific examination including Mallampati scoring and neck movement. Also, an assessment of the airway, lungs, and heart by auscultation, and documentation of vital signs, such as blood pressure, pulse, temperature, and weight were carried out. He was advised an ECG, chest x-ray, complete blood count (CBC), urea creatinine and electrolytes (UCEs), and coagulation profile which were within normal limits.

He was given fitness for the surgery. The patient was identified and all patient-parameters were checked on arrival in the operating room (OR).

The patient received succinylcholine at a dose of 1 mg/kg (80 mg) to facilitate endotracheal intubation and propofol 160 mg as an induction agent. The patient was intubated successfully without any difficulty. Recovery of spontaneous breathing was expected in 4 to 6 minutes after the initial dose of succinylcholine, but spontaneous breathing was restored in 25 minutes as

observed on the capnogram. Owing to the prolonged duration of the surgery, the patient was also given the intermediate-acting muscle relaxant atracurium at a dose of 0.4 mg/kg (30 mg), from which the patient's spontaneous breathing recovered in 150 minutes contrary to its usual duration of action of 40-45 minutes. Likewise, subsequent doses of atracurium (4 mg) were given cautiously in doses of 1 mg to ensure quick recovery after the surgery. The later 4 mg added 120 minutes to the surgery. Ventilation was controlled throughout the procedure. Reversal and recovery were quick and smooth *via* the reversal agent neostigmine and glycopyrrolate.

Intraoperatively, metoclopramide 30 mg intravenously was given as antiemetic and paracetamol 1 gm intravenously as antipyretic and analgesic. Also, 5 mg of nalbuphine intravenously was given at the start of the surgery to calm the patient's nervousness. Perioperative and intraoperative monitoring included blood pressure, heart-rate, oxygen saturation, and capnogram.

DISCUSSION

Succinylcholine and atracurium are both neuromuscular blocking agents that temporarily paralyse the muscles to facilitate mechanical ventilation or surgery. Prolonged apnoea can occur as a side effect of using these medications, especially when they are given in high doses or when the patient has certain underlying conditions that increase the risk of apnoea.[7]

Several factors can contribute to prolonged apnoea after the administration of succinylcholine or atracurium including patient's underlying medical conditions, age, and the presence of other medications. The use of certain medications, such as opioids, can increase the risk of prolonged apnoea after the administration of neuromuscular blocking agents.[8]

Succinylcholine is metabolised by hydrolysis in the plasma and the neuromuscular junction, while atracurium is metabolised by plasma and liver esterases. Therefore, the metabolism of these two medications is not directly linked. However, certain factors such as the patient's age, underlying medical conditions, and the presence of other medications can affect the metabolism of both medications and may contribute to prolonged apnoea.[9]

Thioridazine is a 1st generation antipsychotic medication that is used to treat schizophrenia and other mental disorders. It acts by blocking the transmission of nerve impulses at the neuromuscular junction, resulting in muscle relaxation.[10]

It can inhibit the metabolism of neuromuscular blocking agents by inhibiting the activity of liver enzymes that are responsible for metabolising these medications. This can lead to prolonged paralysis after administering succinylcholine or atracurium.

In this case, the apnoea due to succinylcholine was for 25 minutes, indicating that either the patient was carrying a heterozygous gene for cholinesterase or the thioridazine affected the medicine's metabolism. The delay observed due to atracurium may be attributed to the thioridazine or to unrecognised accidental hypothermia.

This prolonged recovery from succinylcholine and atracurium raises the question of safer medicines with better safety profiles to avoid such a long duration of medicines' action. The history of patients' medicines should be analysed accordingly to plan the medicines used for anaesthesia. Also, maintaining an optimal temperature in the OR to prevent iatrogenic hypothermia is crucial in managing the patient, for which safety measures should always be considered.

PATIENT'S CONSENT:

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COMPETING INTEREST:

The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:

UA: Assisted the case and identified the rarity of the case, analysed and reviewed the research articles, and wrote the manuscript.

NS: Supervised the case, identified the literature, critically reviewed and made amendments in the manuscript.

Both authors approved the final version of the manuscript to be published.

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