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Letter to Editor

Anaesthesia Section

Delayed Recovery from Anaesthesia: Missing Information

KARTHIKEYAN KALLIDAIKURICHI SRINIVASAN

Sir,

We read the case report of delayed recovery from anesthesia by Dr More et al., [1] and wish to highlight few issues.

1. The authors observe all along that the patients muscle tone was poor (poor head lift) but there was no mention of neuromuscular monitoring at any stage. It has been clearly shown that clinical judgement of neuromuscular block or reversal correlates poorly with quantitative monitoring devices (e.g. Acceleromyograph) [2-4].
2. The incidence of residual neuromuscular blockade has shown to be as high as 60% even following reversal [5]. This remains as one of the most common but undetected occurrence in early postoperative period [6-8]. Also, it has been shown that neuromuscular blockade can persist for up to 4 hours following even a single dose of Vecuronium (0.1mg/kg) [9].
3. There has been numerous reports of neuromuscular weakness postneostigmine administration following spontaneous recovery of muscle function [10,11]. It has been suggested to use lower dose of reversal agent if the TOF is between 0.4 to 0.9 [12]. Considering the fact that full dose of reversal agent was administered in this case without TOF monitoring, it might have played a role in delayed recovery of muscle weakness.
4. The authors used suxamethonium for intubation followed by Vecuronium. Was the return of muscle function following suamethonium observed prior to administration of NDMR? If not, could this have been a case of pseudo-cholinesterase deficiency (heterozygous or atypical variant considering the duration)
5. Administration of Calcium gluconate for recovery of muscle function was not warranted without specific indication e.g. massive transfusion, hypocalcaemia, hypermagnesinemia.
6. Considering the fact that the authors treated the patient for mild hypokalaemia, the administration of loop diuretics does not make sense as it might only worsen it.
7. Was potassium administered by central line? If not, the rate of administration (20 mEq over 30 minutes) is rapid for a peripheral line.
8. The authors state clearly that the patient in spite of correction of potassium levels still showed muscle weakness. This contradicts their statement of attributing delayed recovery to hypokalaemia.

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PARTICULARS OF CONTRIBUTORS:
1. Consultant Anaesthetist, Cork University Hospital, Cork, Ireland.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Karthikeyan Kallidaikurichi Srinivasan,
32, Erris Square, Waterville, Blanchardstown, Dublin 15, Ireland.
E-mail: ksrinivasan@outlook.com

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REPLY FROM THE AUTHOR

Response to Query 1

Neuromuscular monitoring with a peripheral nerve stimulator forms an integral part to assess the recovery from muscle relaxants to judge residual paralysis after reversal with anticholinesterases. Recording of the muscle response to stimulation of the nerve is an objective method of interpretation in contrast to the subjective assessment by observing or palpating the response. The former has obvious advantage of providing more accurate and bias-free data for scientific analysis and for medicolegal considerations. Basically recording of the evoked potential can be done by either of the three available methods, Mechanomyography (MMG), Electromyography (EMG) and Acceleromyography. Current evidence has demonstrated that frequently used clinical tests of neuromuscular function (such as head lift or hand grip) cannot reliably exclude the presence of residual paralysis. When qualitative (visual or tactile) neuromuscular monitoring is used, train of four (TOF), double burst (DBS), or tetanic stimulation patterns, clinicians, often are unable to detect fade when TOF ratios are between 0.6 and 1. Furthermore, the effect of qualitative monitoring on postoperative residual paralysis remains controversial. In contrast, there is strong evidence that acceleromyography (quantitative) monitoring improves detection of small degrees (TOF ratios> 0.6) of residual blockade [1].

The most reliable test to detect residual paralysis, defined as a mechanomyographic TOF> 0.9, is acceleromyography [2]. It is widely accepted that to avoid residual neuromuscular blockade, a mechanomyographic adductor pollicis train of four (TOF) ratio of 0.9 or more is normally required [3,4].

However, our PNS monitor was not functioning, hence we had to do with clinical judgement and subjective data.

Response to Query 2

Normal neuromuscular transmission has a large margin of safety. Neuromuscular transmission is not affected even at 75% receptor occupancy, it is almost complete with 90% of receptor occupancy. The receptor occupancy is dependent on the plasma concentration of the drug. As the plasma concentration declines, spontaneous recovery occurs. Attempt to reverse the blockade, before receptor occupancy falls below 75% may result in inadequate reversal. Acidosis, hypokalaemia or hypocalcaemia, hypothermia, renal or hepatic failure may interfere with reversal of neuromuscular blockade.

Despite apparently adequate reversal of long acting neuromuscular blocker (NMB) a 44% to 36% incidence of residual block in the recovery room defined as a TOF of < 0.7 was reported by Vibey-Mogensen et al and Bevan et al, respectively [5,6]. The frequency 8-9% of residual block was noted after the use of the intermediate acting NMB drug, with reversal of neostigmine [1,6]. The use of intermediate acting neuromuscular drugs, can reduce, but do not eliminate the risk of residual paralysis, when compared to long acting neuromuscular drugs [1,7]. Postoperative residual curarisation was defined as a TOF<0.7 [7].

Response to Query 3

Anticholinesterase agents such as neostigmine, posses neuromuscular blocking properties in the absence of previously administered muscle relaxants [8,9]. Neostigmine, in a small number of patients, has been shown to increase tetanic fade hence a considerable degree of spontaneous recovery from a muscle relaxant has occurred. However it is difficult to comment on the likely effect of this in terms of adequacy of muscle power and respiratory function. The degree of fade during a train of four (TOF) stimulation has been correlated with indices of clinical recovery of muscle function, and changes in the TOF may therefore give a better guide to the clinically relevant changes in muscle power. Recovery of the train of four (TOF) ratio to a value of > 0.7 is synonymous with the adequate return of neuromuscular function, but there is little information available concerning the subjective experience that accompanies residual neuromuscular block wherein the TOF ratio is in the range of 0.7 to 0.9 [10].

Again, as our PNS monitor was not functioning we had to do without TOF monitoring.

Response to Query 4

The return of spontaneous respiratory efforts following the intubating dose of suxamethonium was seen clinically. The endtidal carbon dioxide ETCO2 waveform monitor, resistance to ventilation in reservoir bag, hemodynamic changes were observed and vecuronium was administered, hence pseudo-cholinesterase deficiency was ruled out.

Response to Query 5

Metabolic causes like hypoglycaemia, severe hyperglycaemia, hypothyroidism, hepatic and renal diseases, acid –base and electrolyte imbalances and hypothermia can be related to delayed recovery. Hypothyroidism can be responsible for impaired ventilatory responses to arterial hypoxaemia or hypercarbia. Our patient was optimised hypothyroidism, hence for benefit of doubt we gave calcium gluconate.

Response to Query 6

We gave only small dose of loop diuretic (10 mg) and considering that preoperative potassium levels were normal though patient was taking ACE inhibitors, we did not expect significant hypokalaemia of 2.98 mmol/L. (Treatment for hyperkalaemia is furosemide 20-40 mg IV, time of onset being 5-15 minutes and duration of action 4-6 hours) [11].

Response to Query 7

Rate of infusion of K = 10- 20 mEq/h, maximum infusion rate is 40 mEq/h. Continuous cardiac monitoring and infusion via a central venous catheter are recommended for infusion rates > 10 mEq/h. Maximum K = 80 mEq/L via a peripheral vein, upto 120 mEq/L via a central vein (admixed in 0.9% or 0.45% sodium chloride injection) [11].

- Concentrations of potassium chloride greater than 30 mmol in 1000mL in non-isotonic solutions (e.g. sodium chloride 0.9%) may cause pain and phlebitis on administration.
- Potassium chloride 10 mmol in 100 mL is an isotonic solution as it is prepared with a lower concentration of sodium chloride (0.29%) and hence can be administered peripherally.

  We administered 20 mEq via peripheral line over 30 minutes with ECG monitoring, however it should have been given over an hour.

Response to Query 8

After KCL infusion, we repeated K levels and it was 3.9 mmols/L and patient showed adequate muscle tone and power, hence we extubated her, which was almost two and a half hours after giving reversal. We, agree that neuromuscular monitoring with a PNS monitor would have allowed us to assess with accuracy the adequacy of recovery from general anaesthesia, but because of non functioning of our monitor, we had to do with clinical judgement. Hence, we concluded that the probable cause of delayed recovery in an elderly patient with optimised hypothyroidism and bronchial asthama, was incidental hypokalaemia.

Thanks,

Dr. Preeti More

E-mail: preetipreety@hotmail.com

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