The recovery time of muscle relaxation from rocuronium using sugammadex was significantly prolonged in the most severe CKD group of hypoalbuminemia under sevoflurane anaesthesia

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Background of goal of study

It is well known that renal dysfunction, estimated by plasma creatinine concentrations, increased the risk of residual neuromuscular block (RNMB) induced by rocuronium and that there are possibly no relationships between the dose of Sugammadex (SGDX) and recovery from neuromuscular block under renal dysfunctions under various degrees. However, there are no reports, based on the renal function estimated by Glomerular Filtrating Ratio (eGFR), on the relationship between RNMB, serum albumin, renal dysfunction and during of sevoflurane (SEV) anaesthesia. Therefore, based on the chronic kidney disease (CKD) severity classification by eGFR, we examined the effect of the SGDX towards the rocuronium in patients under SEV anaesthesia. We evaluated the recovery time from Post Tetanic Count (PTC) 1 to Train of Four (TOF) ratio 100%, using TOF monitoring.

Material and methods

We selected twenty-four adult severe CKD patients ($\text{eGFR} \leq 15$) for present study in our hospital, underwent surgery under general anaesthesia. We divided the patients into 2 groups.

L group : albumin (pre-operation) $\leq 3.0\text{g/dl}$
All patients currently undergoing dialysis. (n=13)

N group : albumin (pre-operation) $> 3.0\text{g/dl}$
All patients currently undergoing dialysis. (n=11)

Anaesthesia was induced in both groups with 2mg/kg propofol and 0.8mg/kg rocuronium for tracheal intubation and maintained with SEV anaesthesia. The PTC1 state was sustained by administration of an appropriate rocuronium dosage. After confirming the PTC1 value at the end of the surgery, pure oxygen was administered, and then 4mg/kg SGDX was slowly intravenously injected over 5s. The time interval between PTC1 and TOF ratio 100% was measured. We use the TOF-watch(T.X.)SX [Organon(Ireland)Ltd.].

Patient characteristics

	N group (n=11)	L group (n=13)	P value
Age(year)	59.5 ± 13.9	72.9 ± 10.5	0.01
Sex	M(8):F(3)	M(8):F(5)	0.5
Height(cm)	156.0 ± 20.9	151.6 ± 22.7	0.63
Weight(kg)	61.2 ± 18.1	55.2 ± 8.4	0.3
ASA physical status I/II/III/IV/V	0/0/11/0/0	0/0/13/0/0	
Anesthesia time(min)	126.9 ± 49.6	236.6 ± 156.5	0.039
Operation time(min)	70.3 ± 35.4	170.2 ± 144.6	0.036
Rocuronium(mg)	65.0 ± 16.9	77.7 ± 32.1	0.25
Sugammadex(mg)	240.9 ± 68.8	208.5 ± 23.4	0.12
Albumin(pre op.)(g/dl)	3.5 ± 0.5	2.3 ± 0.4	0.0001
Volume of infusion(ml)	579.1 ± 139.1	872.7 ± 557.5	0.13
Amount of bleeding (ml)	139.7 ± 334.5	195.9 ± 202.7	0.65

Results

No significant differences were observed between both groups with regard to the patient's , height, and weight. A statistically significant difference (on-way ANOVA. P value < 0.05 significant) was observed between the time taken by the muscles to recover from relaxation induced by SGDX in the N group vs that in the L group : [$390 \pm 250\text{s}$; vs 795 ± 448 (mean $\pm$ SD)s. P = 0.012]

Figure : Box plot of the control group and the CKD group muscle relaxation recovery time by sugammadex from rocuronium . Displayed is a box-and-whisker plot (the 25th, 50th, 75th percentiles) along with 10th, 90th percentiles whiskers. The whiskers are lines extending above and below each box.

Discussion

Albumin is related to the microcirculation.

We thought that low albumin reduces colloid osmotic pressure and microcirculation decreased. Hypoalbuminemia causes microcirculatory failure. By the stagnation of microcirculation, we thought that the arrival of the intravenously administered drug to the effect site would be delayed. Therefore, it was possible that the arrival of SGDX was delayed to the effect site and recovery from muscle relaxation was delayed.

We need to search the cause in detail.

Conclusion

In the severe CKD patients, the muscle relaxation recovery time from PTC1 to TOF ratio 100% was prolonged in hypoalbuminemia $\leq 3.0\text{g/dl}$ group compared to albumin $> 3.0\text{g/dl}$ group during the recovery from rocuronium following SEV anaesthesia when using SGDX. Thus, we recommend that it is necessary to manage muscle relaxation monitoring more carefully for CKD patients with hypoalbuminemia.