The effects of sevoflurane and desflurane anesthetics on regional cerebral oxygen saturation during the operation of lower extremities with pneumatic tourniquet

Airi KUMASAKA, Ryo AKIMOTO, Asumi SUGIURA, Shinya ODA, Kaneyuki KAWAMAE

Department of Anesthesiology, School of Medicine, Yamagata University, Yamagata, Japan

Introduction

- Hemodynamic status changes by deflating the pneumatic tourniquet during lower extremity surgery, and it sometimes triggers severe complications for elderly patients¹⁾.
- As we reported previously, we investigated the effects of sevoflurane and propofol on regional cerebral oxygen saturation (rSO₂) during the operation of lower extremities with pneumatic tourniquet.
- Sevoflurane group indicated significantly higher levels of rSO₂ than propofol group. (Fig.1)

- It is not certain whether the results are applicable to other inhalator anesthetic agents.
- The goal of this study was to determine whether rSO₂ values differ between sevoflurane and desflurane anesthesia during lower extremity surgeries that require pneumatic tourniquet.

Fig.1 ΔrSO₂ Sevoflurane vs. Propofol

Materials and Methods

- 44** patients undergoing operation of lower legs were included, and randomly divided into **sevoflurane (sevo)** and **desflurane (des)** groups.
- Inclusion criteria: The American Society of Anesthesiologists physiological status 1 or 2 patients.
- Exclusion criteria: Under 18 years old patients and/or with past history of cerebral disease.
- Around 1.0 MAC of anesthetic gas was adjusted to control the BIS values within 40 – 60, and mechanically ventilated with FiO₂ 0.4 and maintained normocapnia.
- Physiological parameters, arterial blood gas analysis and **rSO₂** values were recorded **5 min before, 5, 10 and 15 min after** deflation of the tourniquet.
- Patients were followed for a week after the operation to record complications.
- All data were expressed as the mean ± SD and statistical comparisons were evaluated by Willcoxon rank sum test. P-values less than 0.05 were considered as statistically significant.
- ΔrSO₂=rSO₂ values at each time points – baseline rSO₂** (5min before the deflation)

Results

Table.1 Patient demographic and Clinical characteristics

	sevo	des
n	22	22
Sex (M/F)	7/15	9/12
Age (Yr)	68.0±14.9	76.2±7.9
Body weight (kg)	60.1± 1 4.8	61±12.1
Height (cm)	154.1±9.5	151.5±8.4
BMI (kg/cm2)	25.5±4.5	26.4±4.6
Duration of surgery (min)	132.3±34.5	120.1±36.8
Duration of anesthesia (min)	204.5±39.2	185.9±41.6
Duration of tourniquet time (min)	89.9±24.8	88.4±27.3
Estimated blood loss (ml)	16.0±50.4	17.6±74.9
Urine output (ml)	218.0±196.4	171.4±139.0
Intake (ml)	1204.5±380.0	1077.3±359.2
MAP (ml)	0.0	20.5±93.7
Total dose of Remifentanil (mg)	2.0±0.7	1.8±0.7
use of ephedrine (mg)	2.6±4.2	2.7±3.9

*Statistically different among the groups

Table.2 Blood gas analysis and hemodynamics

	sevo	des	sevo	des	sevo	des	sevo	des	sevo	des
	5min before deflation		5min after deflation		10min after deflation		15min after deflation			
MAP (mmHg)	70.1±10.1	73.2±12.6	56.8±8.5	57.5±9.2	56.2±7.8	58.2±6.6	58.7±9.0	56.6±6		
HR (bpm/m)	60.6±6.9	60.5±8.9	60.0±8.0	61.7±8.8	61.0±7.7	63.9±9.3	61.1±7.5	65.0±7.9		
BIS	45.4±6.5	43.2±8	47.0±8.2	44.6±6.7	47.2±7.6	46.1±7.1	47.4±7.1	46.5±7.8		
Hb (g/dl)	11.4±1.5	11.6±1.7	11.5±1.5	11.5±1.9	11.2±1.5	11.4±1.7	11.1±1.6	11.3±1.7		
EtCO ₂ (mmHg)	36.6±2.8	37.4±2.6	40.0±4.4	41.7±3.6	39.0±4.2	41.3±3.1	38.3±4	40.7±3.2		
PaCO ₂ (mmHg)	38.4±4.4	37.6±3.3	43.1±3.9	42.3±3.3	41.8±4.7	41.5±3.4	40.7±3.7	41.2±3.2		
PaO ₂ (mmHg)	155.3±39.6	131.1±28.5	169.5±31.5	135.7±26.5	171.9±35.0	141.6±28.5	169.0±35.3	139.5±31.0		
P/F ratio	365.2±93.4	337.9±70.1	339.2±77.7	352.4±65.1	404.9±85.7	365.4±71.1	317.9±86.2	359.6±76.6		
Et anes gas con CI (L/min/m ²)	1.3±0.2	3.8±0.5	1.2±0.2	3.6±0.5	1.2±0.2	3.5±0.5	1.1±0.2	3.4±0.6		
rSO ₂ (%)	64±10.1	66.8±6.7	64.4±9.4	66.0±5.6	65.5±8.6	67.8±5.6	65.7±8.5	68.1±5.9		

*Statistically different among the groups

- There was significant differences between the groups in the age of patients. But we confirmed the age of patients was not significantly affected to the rSO₂ values by regression analysis.
- Sevo group had significantly higher rSO₂ values than desflurane group 5minutes after deflation. (p=0.03)
- Sevo group indicated continuous increase in rSO₂ values after deflation.
- However, des group showed decline in rSO₂ values after deflation.
- There were no significant differences between the groups in terms of post-operative complications.

Discussion and Conclusion

- 5 minutes after deflation of tourniquet, there was significant difference between two inhalational anesthetic agents on rSO₂.
- It is known inhalational anesthetics impair cerebral autoregulation, but only the sevoflurane can preserve the cerebral autoregulation at the concentration of clinical use²⁾.
- And some chemical mediators might to this results. For instance, sevoflurane is known to induce the Hypoxia Inducible Factor, and it has cytoprotective effects on ischemic period³⁾.

References

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Fig.2 ΔrSO₂ Sevoflurane vs. Desflurane