

Isoflurane and Sevoflurane recovery in rhesus macaque (*Macaca mulatta*): Preliminary results of a prospective study

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Introduction

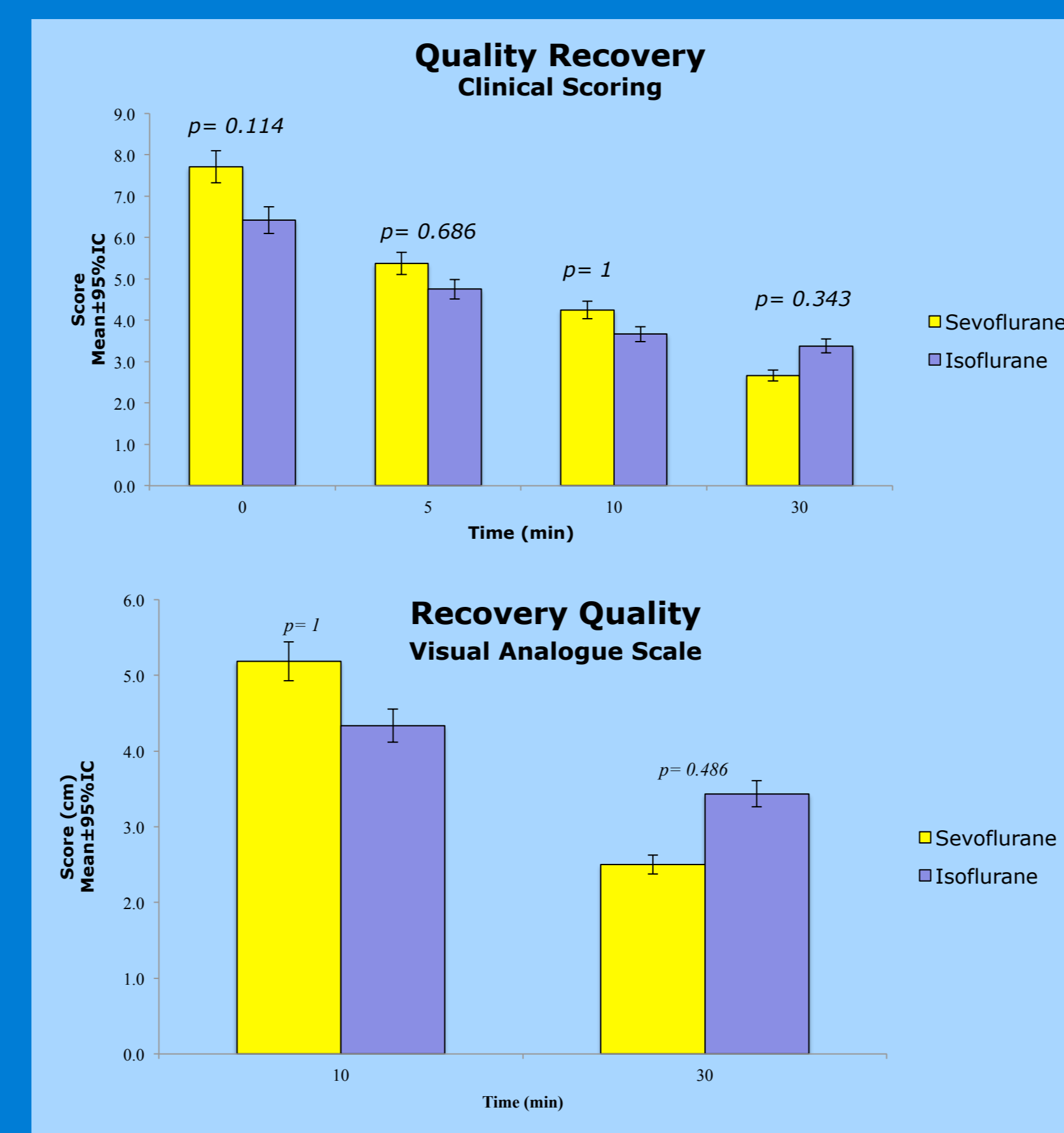
Recovery is a critical period of anaesthesia where excitation and delirium can occur and this can represent a risk both for the animal and the staff. The characteristics of recovery from anaesthesia are dependent on the agents used during the procedure. Isoflurane (ISO) and sevoflurane (SEV), both volatile anaesthetic agents, are widely used in human and veterinary anaesthesia. The aim of this study was to compare the duration and quality of recovery from these agents in rhesus macaques to assist in selection of anaesthetic regimens in this species.

Methods

- 10 adult male rhesus macaques (*Macaca mulatta*) were randomly assigned to receive either isoflurane (Iso) or sevoflurane (Sevo), to undergo an unrelated procedure. They received ketamine (10mg/kg) or medetomidine-midazolam-fentanyl (20µg/Kg-0.5mg/Kg-10µg/Kg) followed by propofol to effect (0-7mg/Kg). Anaesthesia was maintained with Sevoflurane (1.1±0.1 MAC) or Isoflurane (1.0±0.2 MAC) for 496±28 minutes, together with alfentanil (0.2µg/kg/min). Animals were mechanically ventilated. Meloxicam (0.3mg/kg s/c) and methylprednisolone infusion (5.4mg/kg/hr) were administered.
- Time to extubation and return of the righting reflex were recorded for the 10 primates. Eight primates (4 in each group) were videotaped during the immediate recovery period. Samples of 3 minutes duration at 0, 5, 10 and 30 minutes post extubation were extracted and scored by 6 treatment – blinded observers.
- A new clinical scoring scheme (CSS) based on a 15 point scale was used to assess quality of recovery at each time point. A visual analogue scale (VAS) of 10 cm was also used to score the 10 minute and 30 minute periods post extubation. For both methods, a high score indicates a poor recovery.
- Overall differences in treatment effect over time were compared using a Friedman's test and differences at each time point compared using a Mann-Whitney U test. SPSS software (version 22, IBM) was used to perform the statistic tests.

Results

Extubation time did not differ significantly between treatments (ISO = 610 ± 321 seconds; SEV = 230 ± 89 seconds; $p = 0.0556$), but the return of the righting reflex was significantly shorter in the SEV group (ISO = 1488 ± 757 seconds; SEV = 466 ± 79 seconds; $p = 0.0159$). There was a significant difference with the CSS over the time in the both treatment group ($p_{ISO} = 0.024$; $p_{SEV} = 0.008$). However only the SEV group had a significant difference over time with the VAS scoring ($p_{ISO} = 0.317$; $p_{SEV} = 0.046$). No significant difference was found between treatment groups at each time point either with the CSS or the VAS.



Recovery Clinical Scoring

• Eye					
Score	2	1	0	+1	+1
	Close	Semi-close	Open	Nystagmus	Rubbing its eyes
• Mouth					
Score	3	2	1	0	
	Vomiting	Lips smacking/ Nausea sign	Hypersalivation	Nothing	
• Body Position					
Score	3	2	1	0	
	Lateral/ventral decubency	Unsuccessful attempt to sit	Successful attempt to sit/ Sit but wobbly	Sit and stable	
• Ataxia					
Score	3	2	1	0	
	Strong	Mild	Slight	Absence	
• Environment awareness					
Score	2	1	0		
	No	Partially	Yes		
TOTAL : /15					



Discussion

The results observed in this prospective study were consistent with the majority of previous studies in people and other animal species. Sevoflurane is associated with a faster recovery than isoflurane, but no significant difference in the quality of recovery was found between the two agents. There was a non-significant trend for isoflurane recovery to be better in the first 10 minutes of the recovery, then due to the faster elimination of sevoflurane, the recovery quality was better than isoflurane at 30 minutes. Expanding the number of animals in each treatment group would increase study power and enable this trend to be examined more robustly. Further work is also needed to test the reliability and reproducibility of CSS and VAS scoring of quality of recovery.

Conclusion

- Recovery in rhesus macaques is faster with sevoflurane than Isoflurane but no significant difference in quality recovery was observed in the present study.

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