Poster #: 320

Electroacupuncture analgesia, stress responses, and variations in sensitivity in rats anesthetized with different sub-MAC anesthetics

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Background

- The use of anesthetics to stabilize animals for the purpose of electroacupuncture (EA) analgesic studies can be problematic because of the interference of differential physiological responses to EA and pain.
- In this study, EA-induced physiological profiles were surveyed under a sub-minimal alveolar concentration (sub-MAC) of halothane and isoflurane anesthetics in a our proposed minimal-stress model.

Methods

- First, to select an adequate concentration, compliance with EA and tail-flick stimulation was evaluated under various concentrations of halothane and isoflurane.
- Second, under selected concentrations, electrical stimulation of 0.5 ms, 3-4 mA pulse waves for 30 min was delivered at the right hind limb (Zusanli, ST36). Two groups of low- and high-frequency EA (4Hz, 100-Hz) were compared.
- Finally, EA effects were compared by tail-flick latency (TFL), hemodynamic variables, and individual variations in analgesic sensitivity.

Table 1
Behavioral indexes observed during 90 min halothane and isoflurane anesthesia

	Halothane concentration					Isoflurane concentration				
	0.1%	0.3%	0.5%	0.7%	1.1%	0.5%	0.75%	1.0%	1.25%	1.5%
Induction period (0-30 min)										
Agitation	5/6	3/5	0/9	0/8	0/8	4/6	0/9	0/8	0/8	0/5
Nervous posture[a]	4/6	2/5	0/9	0/8	0/8	3/6	2/9	0/8	0/8	0/5
Leg withdrawal	6/6	3/5	1/9	0/8	0/8	5/6	1/9	0/8	0/8	0/5
Difficult needling	6/6	3/5	1/9	0/8	0/8	6/6	1/9	0/8	0/8	0/5
Maintenance period (30-90 min)										
Eye open	6/6	5/5	6/9	5/8	2/8	6/6	5/9	4/8	2/8	0/5
Cornea reflex	6/6	5/5	6/9	6/8	1/8	6/6	7/9	3/8	2/8	1/5
Ear pinna reflex	6/6	5/5	9/9	8/8	2/8	6/6	9/9	8/8	3/8	2/5
Recovery (min)	< 1	< 3	3-5	3-5	3-10	< 0.5	<1	1-3	2-5	3-8
Over-sedation	0/6	0/5	0/9	4/8	8/8	0/6	0/9	0/8	6/8	5/5
Death	0	0	0	0	1[b]	0	0	0	0	0

The data are express as " (+) rat number/group rat number " . The definition of each behavior sign is described in text.
[a] Defined as "body or back curling"
[b] The rat showed dyspnea after induction period.

Table 1 Behavioral indexes observed during 90 min halothane and isoflurane anesthesia.

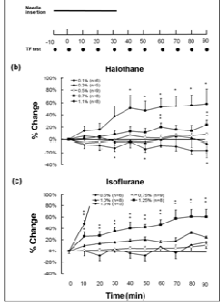

Fig 1. **Effects of different concentrations of halothane & isoflurane on tail-flick latency (TFL).** (a) A study for concentration survey. "●" are time points for the TF test. (b) & (c): TFL under halothane (b) & isoflurane (c) showed a concentration- dependent effect. The percent change (%change) indicates TFL vs. "basal latency" at time 0. RM-ANOVA for the time effect, Tukey's test for post-hoc comparisons. ∗ p < 0.05, ∗∗ p < 0.01 for gps vs. the basal latency.

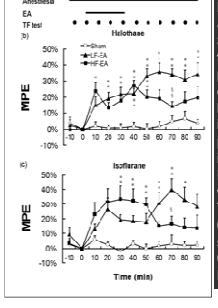

Fig 2 **Effects of high- & low-frequency EA (HF-EA & LF-EA) applied to the ST36 point (Zusanli) under two anesthetics.** (a) Design protocols. (b) and (c) Time course of EA under 0.5% halothane & 0.75% isoflurane. The maximal possible effect (MPE) indicates analgesic effects. Data were analyzed by one-way ANOVA, followed by Tukey's post-hoc test. ∗ p < 0.05, ∗∗ p < 0.01, vs. the sham control group; §p < 0.05, §§p < 0.01, HF-EA vs. LF-EA.

Results

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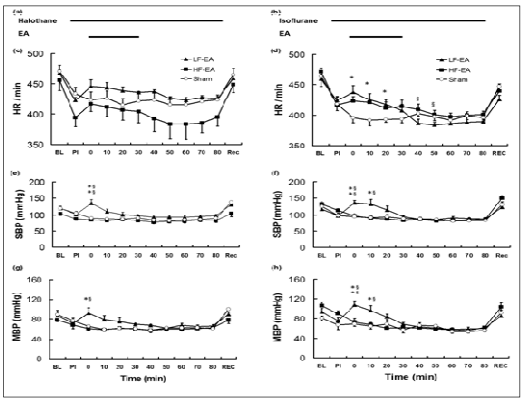
- The optimal concentrations for halothane and isoflurane were 0.5% and 0.75%, respectively, and TFLs were stable under these anesthetic levels (Table 1). However, rats under 0.75% isoflurane had better compliance than those under 0.5% halothane.
- EA showed distinct analgesic patterns between 100 and 4Hz EA, but there was no difference between the two gases (Fig 1 & 2)
- Temporal and distinct changes in the HR and BP were shown after different frequent EAs; however, there was no hemodynamic difference between groups treated with the two anesthetics (Fig 3).
- Ratios of EA non-responders were 38% and 33% for the isoflurane and halothane groups, respectively, showing no difference in EA sensitivity between the two gases (Fig. 4).

Fig 3. **Effects of high- (HF-EA) and low-frequency EA (LF-EA) on the heart rate (HR), and systolic (SBP) and mean blood pressures (MBP) under various anesthetics. (a) and (b) Study design for EA hemodynamic assessment. (b–h) The individual EA on the HR, SBP, and MBP under 0.5% halothane and 0.75% isoflurane for 90 min.** BL, baseline; PI, post-induction phase; REC, recovery phase. Data were analyzed by one-way ANOVA, followed by Tukey's post-hoc test. ∗ p < 0.05, ∗∗ p < 0.01, vs. the sham control group; §p < 0.05, §§p < 0.01, HF-EA group vs. LF-EA group.



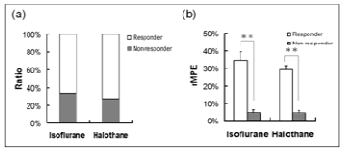


Fig 4. **Comparison of EA "responders" & "non-responders". (a) No significant difference was shown in responder/non-responder ratios between 0.75% isoflurane and 0.5% halothane. (b) Graph illustrates EA's effects produced by responders and non-responders under various anesthetics. Significantly higher responsive maximal possible effects (rMPEs) were shown in responder rats compared to non-responder rats.** ∗ p < 0.01, responders vs. non-responders by un-paired t-test.

Conclusion

- **We concluded that sub-MAC halothane and isoflurane provide optimal conditions for the study of EA-induced analgesia in rats.**
- **In this model, 0.75% isoflurane appears to be a better choice than 0.5% halothane in terms of EA compliance.**