An innovative assembly to maintain isoflurane anaesthesia for dental procedure in rats

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SUMMARY
An innovative assembly to maintain isoflurane anaesthesia in rats is described. This assembly was used successfully in laboratory rats for dental procedures that may last as long as sixty minutes. Repeated exposures to isoflurane anaesthesia, of up to eight times within a 30-day study period in healthy laboratory rats did not result in any observable adverse-effects.

Keywords: Isoflurane anaesthesia, anaesthetic circuit, nose cone, rat

INTRODUCTION
Small mammals such as hamsters, gerbils, guinea pigs, fancy mice and fancy rats are gaining popularity as pets. They may be presented to veterinarians for examination and procedures that may require anaesthesia. The main three methods to anaesthetise these little mammals include the use of injectable anaesthetics alone, inhalant anaesthetic alone, or the combination of injectable and inhalant anaesthetics (Heard, 2004).

The most common anaesthetic agents used for induction and maintenance of anaesthesia in rodents are the combination of ketamine and xylazine. Ketamine is a dissociative anaesthetic with analgesic properties. Used on its own, ketamine typically results in anaesthesia that is characterised by muscle rigidity and presence of reflexes. Therefore, ketamine is usually combined with another agent that has better muscle relaxation properties. Xylazine is a sedative with good analgesic and muscle relaxation properties; but it may cause significant cardiorespiratory depressions (Albrecht et al., 2014).

Therefore, it may be safer and more convenient to maintain the anaesthesia with inhalant anaesthetic rather than re-dosing the rodents using injectable agents (Gargiulo et al., 2012).

Delivery of an inhalant anaesthetic with high vapour pressure such as isoflurane requires the use of a vapouriser to precisely control the split ratios, and deliver safe concentration. In addition, a rodent anaesthetic circuit and nose cone is required. Commercially available rodent anaesthetic circuit is essentially a smaller than standard non-rebreathing circuit, and a small nose cone with replaceable rubber diaphragm. Where these are not immediately available, a simple modification to the commonly used modified Jackson-Rees (MJR) anaesthetic circuit could be a useful alternative. This paper reports the use an innovative adaptation of commonly available items in most veterinary practice to maintain isoflurane anaesthesia safely in laboratory rats for dental procedures.

MATERIAL AND METHODS
In a study to induce periodontal disease in laboratory rats, high doses of ketamine-xylazine, even at 100 mg/kg ketamine and 5 mg/kg xylazine could not abolish chewing reflex satisfactorily to allow dental procedures. Several failed attempts prompted the trial use of MJR-circuit to deliver isoflurane. The patient-end of the MJR circuit has a 22 mm diameter X 20 mm small space; and could fit the rat’s snout. It may be suitable to be adapted as a rodent nose cone. Initially, a cut-fingertip of a rubber glove was tried as the diaphragm. Deep anaesthesia could be maintained, however, the rubber glove was too soft, and the rat’s snout often got displaced during dental manipulation. In place of the rubber glove, strips of elastic bandage (3M Coban™, Natural rubber, 15 82 DH-9999-78 Germany) were tried and found to be more suitable. Finally, a plastic frame was used to secure a 15 mm / 22 mm elbow connector. The 15 mm end was connected to the MJR circuit, while the 22 mm end was covered with the elastic bandage to act as the rat’s nose cone (Figure 1).

RESULTS AND DISCUSSION
Using this modification, rats can be maintained for dental procedures that may last as long as 60 minutes. This innovative assembly has been used to maintain isoflurane anaesthesia successfully in the study. Anaesthesia was induced by placing the rats into a 10-litre plastic container. A 15 mm / 22 mm connector was fitted onto the top lid of this container to facilitate connection to the MJR circuit. Anaesthesia was typically delivered at 2 L/min oxygen, with 5% isoflurane setting; and rats became anaesthetised within 2 to 3 minutes. Subsequent sessions ranged 10 to 15 minutes. Following isoflurane anaesthesia, all rats recovered well and resumed their usual activities in the afternoon. The potential toxic effect of repeated anaesthesia was evaluated at the end of the 30-day study period. Under isoflurane anaesthesia, blood was collected via cardiac...
Figure 1. Assembly to deliver inhalant anaesthesia to rat
N, 22 mm end of an elbow connector wrapped with Coban™ to fit the rat’s snout; part of Coban™ is anchored to the rat’s incisors. H, the elbow connector is fit through a hole in a plastic frame; C, 15 mm end of the connector is connected the MJR circuit; P, plastic frame to secure the connector and accommodate the rat in dorsal position.

puncture, followed by euthanasia. Serum were harvested the same day and stored at -20ºC until analysis. After euthanasia, the viscera organs were examined grossly.

In this report, the serum creatinine and alanine aminotransferase (ALT) levels for two groups of rats (n=6 per group) are presented (Table 1). Group LP were rats that had 4/0 nylon ligatures placed on both second upper molars and intragingival injection of Porphyromonas gingivalis lipopolysaccharide to induce periodontal disease. Group C were rats with no intervention, except for the 8 times of anaesthesia for teeth and oral examination. Both the serum creatinine and ALT levels were not different between groups, and the values were within the published normal limits (Table 1). The normal limits for creatinine and ALT has been reported as 44.2 – 53.0 µmol/L and 28.0 - 40.0 U/L, respectively (Giknis and Clifford, 2006).

<table>
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<th>Group</th>
<th>CREAT (µmol/L)</th>
<th>ALT (U/L)</th>
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<tr>
<td>LP</td>
<td>41.16±2.92</td>
<td>35.16±3.97</td>
</tr>
<tr>
<td>C</td>
<td>41.5±2.42</td>
<td>35±6.75</td>
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Data expressed as mean ± SD. Group LP, induced periodontal disease. Group C, control. n=6 per group. There were no difference between groups (T-test, α=0.05).

Gross examination of the liver, kidney and spleen in both groups revealed no significant findings. One rat in Group LP showed four pin points of petechiation at the fundus. The finding of gastric ulcer in this rat may be due to stress following induction of periodontal disease.

CONCLUSIONS

In conclusion, a simple assembly, modified from readily available items can be used to deliver inhalation anaesthesia in rats. Practitioners whom possess a small animal anaesthetic machine and MJR circuit may consider this adaptation for the rodent patients. Moreover, results from this study showed that repeated exposures to isoflurane anaesthesia did not cause any observable adverse-effects in the rats.

CONFLICT OF INTEREST

No conflict of interest between the authors.

REFERENCES


