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Guest Editorial

Open wide: Blindness in cats after the use of mouth gags

The prospective study conducted by Dr. Manuel Martin-Flores and his colleagues at Cornell University published in a recent issue of *The Veterinary Journal* (Martin-Flores et al., 2014) evaluates the implications of wide mouth opening on maxillary artery blood flow in cats. Their results shed new light on what had already been suspected by the same authors and others investigating the cause of temporary and permanent blindness in cats post-anesthesia.

In one retrospective study of 20 cats with post-anesthetic blindness, spring-loaded mouth gags were used in 16 cats to enable dental or endoscopic procedures (Stiles et al., 2012). In that work, dissection of feline cadavers identified the role of the maxillary artery in supplying an extracranial arterial network (rete mirabile), which was adjacent to the skull and extended from the level of the foramen rotundum over the orbital fissure to the level of the optic foramen. The rete mirabile was situated between the (medial and lateral) pterygoid muscles ventrally and the temporal muscle dorsolaterally. It released several arteries that passed through the orbital fissure into the cavernous sinus to form an intracranial arterial network from which the cerebral arteries arose. Even though Stiles et al. (2012) could not prove an alteration of the vasculature when a spring-loaded mouth gag widely opened the mouths of the cadavers, they suggested that the use of mouth gags represents a potential risk for the development of blindness in cats.

A prospective study of six anesthetized cats examined whether maximal mouth opening would negatively affect maxillary artery blood flow (Barton-Lamb et al., 2013). Electroretinograms (ERGs), brainstem auditory evoked responses (BAERs) and magnetic resonance angiographies (MRAs) were evaluated qualitatively with the mouth closed (i.e. the natural position of the mouth when an endotracheal tube is in place) and maximally opened using a spring-loaded mouth gag. During dynamic computed tomography (CT) examinations, the detection of contrast medium in the maxillary artery was quantified by measuring Hounsfield units (HUs). While no cat developed blindness post-anesthesia, maximal mouth opening caused alterations in several indicators of maxillary artery blood flow in some individual cats (Barton-Lamb et al., 2013).

In a further prospective study of six anesthetized cats, CT was used to describe how vascular compression is possible, based on morphological differences between mouth positions, and nonselective digital subtraction angiography was used to assess whether mouth opening induced collateral circulation (Scrivani et al., 2014). It was found that the distance between the angular process of the mandible and the rostrolateral wall of the tympanic bulla became shorter when the mouth was maximally opened using a spring-loaded mouth gag, eventually altering the morphology of the maxillary artery as it courses between these two bony structures. While there was strong sequential opacification of extracranial and intracranial arteries and uniform opacification of the cerebrum and cerebellum with the mouth closed, reduced opacification of these structures was observed in several cats with the mouth opened. It was concluded that the anatomical location of the maxillary arteries predisposes them to compression when the cat's mouth is maximally opened (Scrivani et al., 2014).

Martin-Flores et al. (2014) anesthetized six healthy adult cats. The authors performed ERGs and MRAs with the mouth closed, then submaximally opened using plastic mouth gags of 20 mm, 30 mm and 42 mm, and maximally opened using a spring-loaded mouth gag. The mouth gags were placed between the maxillary and mandibular canine teeth. Maximal mouth opening with a spring-loaded gag and mouth opening with a 42 mm plastic gag (the same length as a 1-inch needle cap) produced alterations in ERG waveforms consistent with circulatory compromise and reductions in signal intensity during MRA in some cats, while no changes were observed in cats when 20 and 30 mm gags were used. The authors concluded that smaller mouth gags were associated with fewer alterations of indicators of maxillary artery blood flow (Martin-Flores et al., 2014).

The series of articles on the potential causes of post-anesthetic blindness in cats, mostly published in *The Veterinary Journal* (Stiles et al., 2012; Barton-Lamb et al., 2013; Martin-Flores et al., 2014), should be a wake-up call for those working in feline dentistry and oral surgery. Mouth gags and wedge props certainly aid in keeping the mouth open to allow access to the oral cavity and oropharynx (Reiter, 2013). Gags are spring-loaded or screw activated and are often placed between the maxillary and mandibular canine teeth. Various sizes and shapes are available, and plastic inserts at the ends of the metal gags help to prevent damage to the crowns of the teeth. Props are designed to be wedged between the maxillary and mandibular premolars and molars. Custom-made devices (such as needle caps and syringe cases that are cut to the desired length) can also be used and are placed between any teeth of the upper and lower jaws. Similar to wedge props, they are radiolucent and so do not interfere with diagnostic imaging (Reiter, 2013).

However, caution should be exercised where wide mouth opening is necessary, and the duration should be minimized to reduce the risk of masticatory muscle strain and injury to the temporomandibular joints. Wide mouth opening might also reduce maxillary artery blood flow, potentially resulting in temporary or permanent blindness post-anesthesia. Even though it seems safer than a spring-loaded mouth gag, using a 42 mm needle cap (Fig. 1) between the maxillary and mandibular canines to keep the mouth open is not necessary to access important areas of the feline oral cavity. The wider the mouth is opened, the tighter the lip and cheek become and the more difficult it will be to deflect these tissues to accomplish procedures such as dental cleaning or tooth extraction. Placing 30 mm or 20 mm plastic gags (Figs. 2 and 3) between maxillary and

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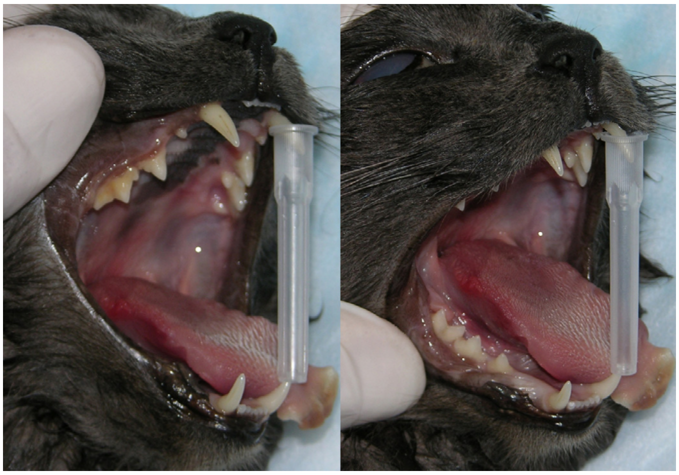

Fig. 1. A 42 mm needle cap is placed between the left maxillary and mandibular canines of a feline cadaver head. While there is some restriction when raising the upper lip, deflecting the lower lip to access the caudal mandibular cheek teeth is nearly impossible. The image on the left is with the upper lip raised and the image to the right is with the lower lip deflected. © Alexander Reiter.

Fig. 2. A needle cap cut to a length of 30 mm is placed between the left maxillary and mandibular canines of a feline cadaver head. Both upper and lower lips can be deflected sufficiently to access maxillary and mandibular cheek teeth. The image on the left is with the upper lip raised and the image to the right is with the lower lip deflected. © Alexander Reiter.

Fig. 3. A needle cap cut to a length of 20 mm is placed between the left maxillary and mandibular canines of a feline cadaver head. Both upper and lower lips can readily be deflected to access maxillary and mandibular cheek teeth. The image on the left is with the upper lip raised and the image to the right is with the lower lip deflected. © Alexander Reiter.

mandibular canines enables adequate mouth opening for these procedures.

Martin-Flores et al. (2014) not only provide further evidence of reduced maxillary artery blood flow when cats' mouths are opened wide, they also offer a simple strategy to reduce the risk of post-anesthetic blindness by using custom-made plastic gags shorter than the common needle cap. This is a fine example of applied research that can readily be tailored to everyday veterinary practice.

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