Iatrogenic ocular trauma associated with infraorbital block performed for rhinoscopy in a cat: case report and preliminary imaging findings

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Abstract

Objectives This paper describes a case of endophthalmitis in a feline patient caused by globe penetration during an infraorbital block performed to provide analgesia during rhinoscopy, and presents additional imaging and dissection data demonstrating risk of iatrogenic ocular trauma during infraorbital blocks in cats when the infraorbital canal is entered.

Methods Case records and accompanying histopathologic reports were reviewed for the feline patient. Separately, two feline cadavers were imaged using CT following placement of 5/8" 25 G needles or 1" 22 G over the needle catheters in the infraorbital canal. Infraorbital blocks with injection of trypan blue dye followed by dissection were performed in two further feline cadavers to assess the potential for globe penetration and to provide preliminary information regarding the potential efficacy of infraorbital blocks for analgesia during rhinoscopy.

Results Clinical and histopathologic findings support inadvertent globe penetration during infraorbital block as the cause for endophthalmitis in the feline patient described. CT imaging and dye injection studies further demonstrate the risks involved with this local anesthetic technique in cats.

Conclusions and relevance Further study is needed to assess the safety and efficacy of infraorbital blocks performed for rhinoscopy in cats. Catheters may be safer anesthetic delivery devices than needles. Extreme caution should be used when entering the infraorbital canal in cats.

Keywords: Endophthalmitis; rhinoscopy; infraorbital; lidocaine; bupivacaine; anesthesia; analgesia

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Introduction

Local anesthetics are a valuable pain management tool for veterinary patients undergoing painful procedures or experiencing discomfort. Regional nerve blocks allow decreased use of systemic medications with undesirable side effects, such as anesthetic gases, opioids or non-steroidal anti-inflammatory drugs (NSAIDs).[1] Local anesthetic techniques have also become increasingly valuable in the context of recent drug shortages and restrictions on opioid availability.

Blocks in the maxillary and orbital regions are commonly performed during dental procedures in cats and dogs.[1–6] More recently, caudal maxillary and infraorbital blocks have also been suggested for use in conjunction with rhinoscopy, a procedure sometimes associated with unanticipated patient movements despite an adequate plane of anesthesia.[7,8]

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Caudal maxillary blocks used in conjunction with dental procedures have been associated with globe penetration and endophthalmitis in both cats and dogs.[9–11] Infraorbital blocks have been proposed as a simpler and potentially safer alternative.[11,12] However, infraorbital blocks performed to desensitize the nasal mucosa for rhinoscopy (hereafter denoted as 'caudal infraorbital block') require delivery of local anesthetic to the region of the pterygopalatine fossa, which necessitates introduction of the anesthetic delivery device into the infraorbital canal and potentially the orbit.[7,8] This modification of the technique increases the risk of iatrogenic ocular trauma.

Here we present the case of a cat with septic endophthalmitis attributed to globe penetration by a caudal infraorbital block performed to facilitate rhinoscopy. This is the first report of iatrogenic ocular penetration associated with an infraorbital block. We also present initial imaging and cadaver data illustrating the potential for globe penetration during caudal infraorbital blocks in cats.

Materials and methods
Case report
Clinical history and histopathologic findings were reviewed for a cat with septic suppurative endophthalmitis attributed to ocular penetrating trauma from an infraorbital block performed in association with rhinoscopy and nasal biopsy.

Imaging
Two feline cadavers were obtained through the body donation program at the Tufts University Cummings School of Veterinary Medicine, representing average-sized (5.1 kg post-mortem weight) and small (3.2 kg post-mortem weight) adult domestic shorthair cats. Both cats had no evidence of muscle wasting and no obvious ocular or craniofacial pathology. Both cadavers had been previously frozen and were thawed for imaging. Globes were hypotonous but were not reinflated or otherwise manipulated.

Needles (5/8" 25G) and/or over the needle intravenous catheters (1" 22G) were placed by one of two board-certified veterinary anesthesiologists (LAW and RCR) using an intraoral approach for infraorbital local anesthetic blocks with the intention to provide anesthesia for the nasal cavity (ie, entering the infraorbital foramen and transiting the canal). CT was then performed to assess the relationship between needle or catheter position and the globe.

Dissection
Two additional representative adult domestic shorthair cat cadavers were obtained via the body donation program at the Tufts University Cummings School of Veterinary Medicine. Post-mortem weights were 3.6 kg and 4.6 kg. The cats had normal globes and no evident craniofacial pathology or muscle wasting. These

cadavers were obtained immediately after death and globes were of a normal shape, size and tension.

In both cats, a 5/8" 25G needle was introduced into the left infraorbital foramen by one of the authors (SAP) using an intraoral approach and was advanced up to the hub. Trypan blue dye (0.2 ml) was injected. A 1" 22G over the needle intravenous catheter was similarly introduced into the right infraorbital foramen. The catheter portion was then advanced as far as possible, maintaining the stylet tip just inside the foramen. The stylet was removed and 0.2 ml of trypan blue dye was injected. Bilateral routine transconjunctival enucleation was performed. Globes and orbits were observed for presence of dye and evidence of globe penetration, and photographs were taken.

Results
Case report
A 2-year-old, 2.5 kg spayed female domestic shorthair cat with a 1-year history of chronic sneezing and nasal discharge was presented for CT and rhinoscopy. The cat had no history of ocular disease and the eyes were superficially normal at the time of initial presentation.

CT revealed nasal mucosal thickening and turbinate destruction most consistent with chronic inflammatory disease. Both globes appeared normal in CT images (Figure 1). Rhinoscopy was performed immediately following CT. Immediately prior to rhinoscopy, bilateral caudal infraorbital blocks were performed by an experienced anesthesia resident. For this procedure, 5/8" 25G

Figure 1 Axial CT image (bone algorithm) of the cat described in this report. CT was performed owing to chronic nasal signs and prior to onset of ocular signs. Both globes are visible and of normal density in this image. The hyperdense structures within the globes are the lenses and appear asymmetrical due to uncoordinated rotation of the globes, which is a normal and expected finding in cross-sectional imaging performed under general anesthesia

needles were inserted into the infraorbital canals using an intraoral approach as previously described, with an attempt made to maintain needles parallel to the dental arcade.[13] A combination of 2% lidocaine (0.06 ml per side) and 5% bupivacaine (0.25 ml per side) was injected, with the goal of producing anesthesia of the maxillary nerves at the level of the pterygopalatine fossa. No mass lesions or foreign bodies were noted during subsequent rhinoscopy. Samples were obtained for culture and histopathology using alligator forceps passed through the instrument channel on the scope. Recovery from anesthesia was uneventful and the cat was discharged from the hospital later that day. No medications were prescribed at that time.

One day after rhinoscopy, the cat was presented to the emergency service for blepharospasm and miosis of the right eye (OD). A focal corneal opacity was noted OD, with no apparent retention of fluorescein stain. No flare was noted in either eye, and intraocular pressures (IOPs) were 16 mmHg in the left eye (OS) and 14 mmHg OD. Despite the lack of fluorescein stain uptake, a superficial post-anesthetic ulcer was suspected. Oral meloxicam (0.05 mg/kg q24h), topical oxytetracycline ointment (q8h OD) and 1% carboxymethylcellulose drops (q8h OD) were dispensed, with instructions to follow up with the primary care veterinarian in 7–10 days.

Findings from nasal biopsy samples were subsequently released and were consistent with a lymphoplasmacytic–eosinophilic rhinitis. No infectious organisms were seen. Aerobic culture yielded *Staphylococcus aureus* with no significant antibiotic resistance.

Six days after the emergency visit, the cat was presented to a veterinary ophthalmologist who documented severe intraocular inflammation, increased IOP and buphthalmos OD. The cat was then referred to our institution. Additional findings included diffuse corneal edema with peripheral neovascularization, and intracameral fibrin and hypopyon OD (Figure 2). Menace response, dazzle reflex, and direct and indirect pupillary light reflexes were absent OD. IOP OD was 43 mmHg. The globe OS was visual with no apparent abnormalities.

Ocular and orbital ultrasound suggested that pathology was confined to the globe (Figure 3). Initial treatment with oral amoxicillin–clavulanic acid (28 mg/kg q12h) and topical dorzolamide (q12h OD), flurbiprofen (q12h OD), prednisolone acetate (q6h OD), oxytetracycline (q8h OD) and carboxymethylcellulose (q6h OD) yielded no improvement in IOP or inflammation OD.

Owing to the severity and timing of the cat's ocular disease, additional sections from nasal biopsy samples were obtained and were stained with Gomori methenamine silver; no fungal organisms were seen. Serum *Cryptococcus* antigen testing was also performed and was inconsistent with infection. Enucleation was then elected for palliative and diagnostic purposes.

Figure 2 Clinical photograph showing diffuse corneal edema with peripheral neovascularization and marked intraocular inflammation characterized by hypopyon and fibrin in the anterior chamber (star)
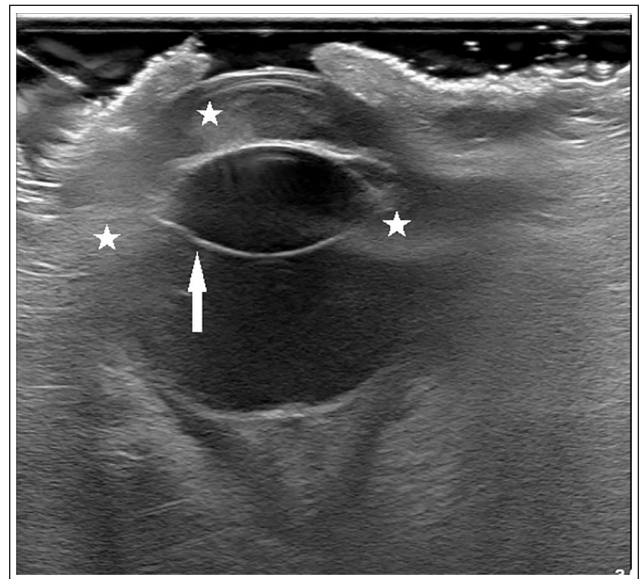

Figure 3 Ultrasound image of globe and orbit OD. Orbital structures are considered normal. Hypoechoic material is seen in the anterior chamber and at the level of the ciliary body (stars); a focal discontinuity in the posterior lens capsule is suspected (arrow)

Histopathologic evaluation of the globe revealed a severe suppurative endophthalmitis with penetrating posterior lens trauma, intralenticular neutrophils and retinal detachment (Figure 4). Gram staining showed numerous Gram-positive cocci within degenerate neutrophils. No scleral penetration site was specifically identified on microscopic evaluation of available sections and no gross examination of the sclera was performed prior to paraffin embedding and sectioning of
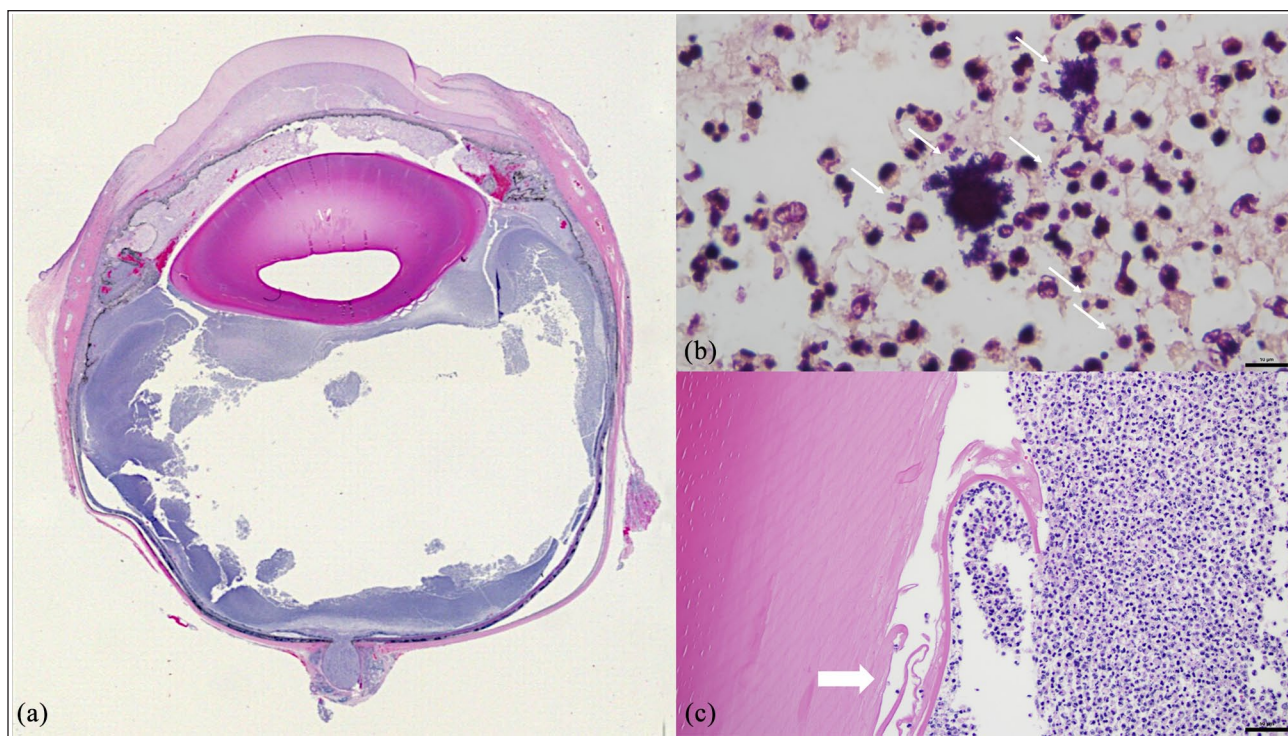
Figure 4 (a) Subgross image of globe (hematoxylin and eosin stain). Basophilic material (consisting primarily of degenerate neutrophils with intracellular bacteria) is visible in the anterior chamber, surrounding the lens and lining the posterior segment. (b) Material surrounding the lens (Gram stain). Numerous degenerate neutrophils with intracellular Gram-positive bacteria are visible (examples indicated by arrows; × 100 magnification, bar = 10 µm). (c) Ruptured posterior lens capsule and intralenticular neutrophils (hematoxylin and eosin stain). The scrolled capsule and intralenticular neutrophils (arrow) are consistent with penetrating trauma to the posterior aspect of the lens prior to enucleation (× 20 magnification, bar = 50 µm)

the eye. However, the globe was not sectioned in its entirety, and failure to identify a specific site of entry is not uncommon in penetrating injuries with septic implantation.[11,14,15] Based on histopathologic findings involving the lens and a lack of signs (fever, leukocytosis, malaise) consistent with bacteremia, endogenous endophthalmitis was rejected as an etiology and iatrogenic penetrating trauma associated with the infraorbital local anesthetic block was considered the most likely cause of endophthalmitis in this cat.[11,14,15]

Imaging

Performance of a caudal infraorbital block with either a 25G needle or a 22G intravenous catheter brought the tip of the delivery device into close proximity with the eye (Figures 5 and 6). In the larger cat, the eye was not penetrated with either technique, although the globes did not possess their pre-mortem shape, size or turgidity, and thus may have been less vulnerable to penetration. In the smaller cat, the 25G needle was noted to penetrate the globe (Figure 7).

Dissection

Caudal infraorbital block with a 25G needle penetrated the left eye of the 3.6 kg cat but not the larger cat, although

in the latter globe movement was noted during placement of the needle. In the smaller cat, trypan blue dye was seen in the anterior chamber following injection and a scleral wound was noted at dissection (Figure 8).

Caudal infraorbital block with a 22G catheter did not lead to globe penetration in either cat. Injection of trypan blue through the catheter led to deposition of dye in the medial anterior portion of the orbit (Figure 9).

Discussion

Local and regional anesthetic techniques involve perineural instillation of anesthetic drugs via a needle, intravenous catheter or other delivery device to provide analgesia or akinesia. These techniques have become popular with veterinarians for pain management and as a means of decreasing anesthetic gas, opioid and NSAID use, particularly during dental procedures, and their use is now advocated as part of the standard of care for dentistry in small animals.[2–6] Despite their clear benefits, however, local anesthetic injections are not without risk. In dogs and cats, the oral cavity is in close proximity to the orbit. Inadvertent ocular penetration with needles used to administer local anesthetic has been documented or suspected in a number of cats and dogs.[9–11] All previously reported cases have been linked with dentistry-associated
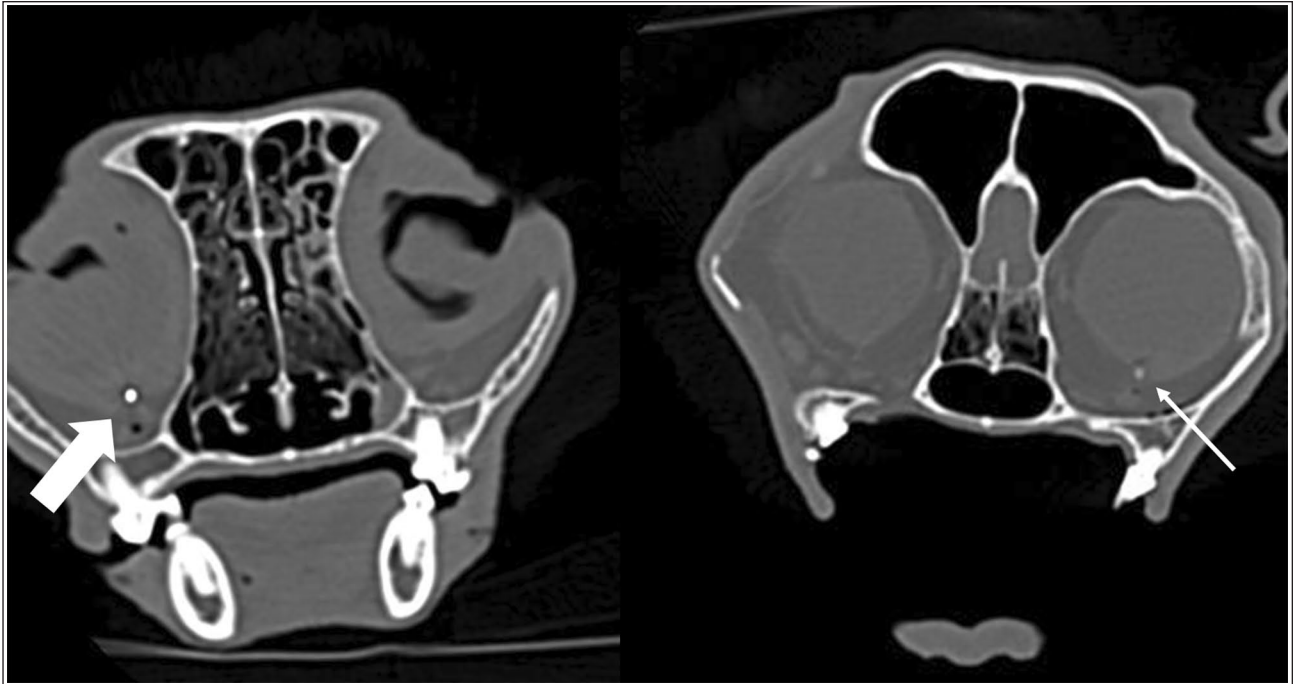
Figure 5 Axial CT images (bone algorithm) of an average-sized domestic shorthair cat. The image on the left shows a 25 G needle placed in the infraorbital foramen (wide arrow); the image on the right shows a 22 G catheter placed in the infraorbital foramen (thin arrow)
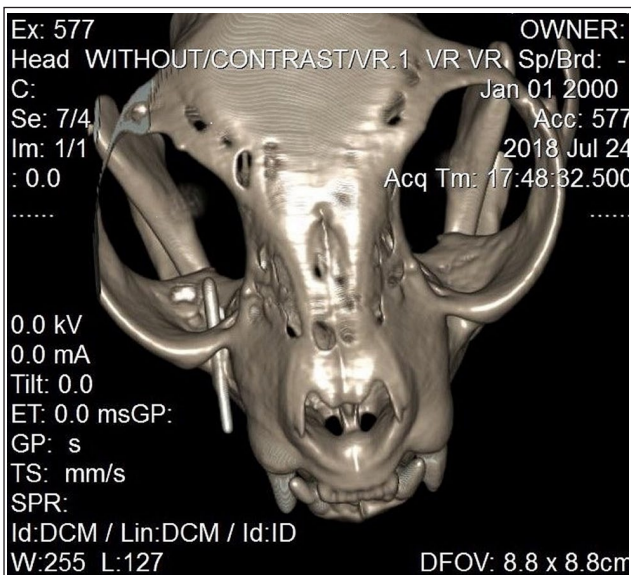

Figure 6 Three-dimensional CT reconstruction showing a 25 G needle in the infraorbital foramen of an average-sized domestic shorthair cat. Note the extent of penetration of the needle into the orbit

Figure 7 Axial CT image (bone algorithm) showing a 25 G needle placed in the infraorbital foramen and penetrating the globe of a small domestic shorthair cat

The feline patient described above represents the first reported case of inadvertent ocular penetration associated with a local anesthetic block during rhinoscopy and the first case associated with an infraorbital block. The lack of previous reports of iatrogenic ocular trauma associated with infraorbital blocks is likely an indicator of their favorable safety profile in most situations. However, as this technique is adapted for use in conjunction with rhinoscopy, that safety profile may change, particularly in feline patients.

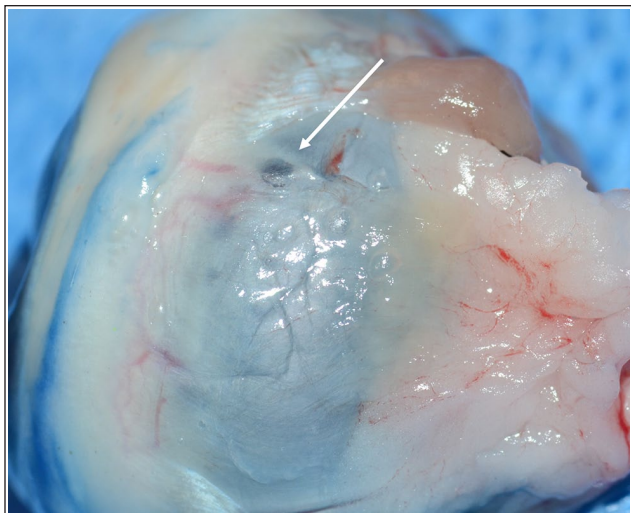Rhinoscopy can present an anesthetic challenge, as head movement, sneezing and gagging frequently

caudal maxillary blocks, in which the anesthetic delivery device is inserted percutaneously or intraorally at the junction of the maxilla and zygomatic arch, caudal to the last maxillary molar.

Figure 8 Enucleated globe following caudal infraorbital block performed with 25 G needle, with injection of trypan blue dye. Scleral wound denoted by arrow

Figure 9 Orbit of domestic shorthair cat showing dye distribution following caudal infraorbital block performed with a 22 G catheter

accompany the procedure, limiting visualization and sample collection, and potentially compromising patient safety.[7,8,16] Interest has thus arisen in regional anesthetic techniques to facilitate rhinoscopy and improve patient comfort and safety.[7,8,17] Sensory innervation to nasal structures is provided by the ophthalmic and maxillary divisions of the trigeminal nerve. The ophthalmic division of the nerve cannot be accessed readily in companion animals, but the maxillary nerve may be approached as it courses along the orbital floor.[7] Because the branches that innervate nasal structures leave the maxillary nerve in the region of the

pterygopalatine fossa proximal to the infraorbital canal, two techniques have been investigated for regional nasal anesthesia – the caudal maxillary block and the caudal infraorbital block. The caudal maxillary block may produce better antinociception but has previously been associated with globe penetration and may be more difficult to perform correctly.[7,8,12] The caudal infraorbital block demonstrates some efficacy, however, and is perceived to be simpler to perform and 'safer', and thus has been recommended for use during rhinoscopy.[8,12,16]

Little attention has been paid to anatomic considerations for infraorbital blocks in general, with many authors failing to consider species, breed or patient size, and most recommending routine entry into the canal with the anesthetic delivery device.[4–6,18–20] Some suggest entering the canal with the delivery device but urge caution.[21–24] Few state a specific concern regarding entry into the infraorbital canal in cats.[3,13,23,24] Illustrations accompanying most references show a needle as the delivery device, and even those references that describe use of an intravenous catheter generally do not emphasize that the two may not be interchangeable in terms of risk of ocular injury.[8]

In the cat, the infraorbital canal is approximately 3–4 mm in length, and the globe fills the majority of the orbit.[23,25] A standard 25 G needle is approximately 15.9 mm (5/8") in length, thus inadvertent globe penetration is a genuine possibility based on canal length alone. The dimensions of the canal and the lack of working space may also limit the ability to direct the anesthetic delivery device away from the globe. Smaller cats may be more at risk: the case reported herein describes an unusually small adult cat, and the cadavers in which globe penetration occurred were also smaller cats. Brachycephalic and small-breed dogs, whose infraorbital canals are similarly truncated, may also be at risk of globe penetration during caudal infraorbital blocks, although the larger orbital space in relation to globe size in dogs may provide some protection.[25]

Use of an intravenous catheter to deliver local anesthetic may create a larger margin of safety, as the semi-rigid catheter material is less likely to penetrate the sclera than a needle. Following dissection in the cadaver portion of this study, one of the authors (SAP) attempted to penetrate the equatorial sclera of the enucleated globes with both 20 and 22 G catheters with the stylet withdrawn. Although the equatorial sclera is quite thin (0.1–0.2 mm in the cat),[26] the catheters deformed rather than penetrated the tissue.

Conclusions

Preliminary imaging and dissection data presented here along with a clinical case of globe penetration and subsequent septic endophthalmitis indicate that caudal

infraorbital blocks for rhinoscopy carry a risk of severe iatrogenic ocular trauma in cats, even when performed by experienced clinicians. Additional studies using larger numbers of cats with greater variation in size and facial morphology are needed for further characterization. Similar investigations may also be merited in brachycephalic and small-breed dogs.

Local anesthetic techniques are a valuable means of improving patient comfort and minimizing use of inhalant and injectable anesthetics and other drugs with potential side effects. Refinement of local blocks used in conjunction with rhinoscopy is therefore an important goal. Use of an intravenous catheter rather than a needle as an anesthetic delivery device may improve the safety profile of caudal infraorbital blocks and allow their use in many veterinary patients. Alternate approaches to analgesia may still need to be considered in extremely small patients, however.

Distribution of dye in the dissections performed also suggests that caudal infraorbital blocks might fail to deliver adequate local anesthetic to the pterygopalatine fossa to produce nasal analgesia. Post-mortem evaluation is limited by lack of normal tissue perfusion and dissolution of local anesthetic into neighboring tissues and may not fully reflect the clinical effectiveness of this technique. Further studies are therefore warranted to evaluate both safety and efficacy of regional anesthetic techniques for rhinoscopy in cats.

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