Received: 26 May 2025 | Revised: 11 November 2025 | Accepted: 4 December 2025

DOI: 10.1002/vrc2.70318

Vet Record CaseReports

CASE REPORT

Companion or pet animals

Alfaxalone–dexmedetomidine–isoflurane partial intravenous anaesthesia in combination with scalp block in a cat undergoing craniectomy for meningioma excision

Chiara Talarico | **Massimiliano Degani** | **Virginie Gronsfeld** | **Stéphanie Noël** | **Charlotte Sandersen**

Clinical Department for Companion Animals, Faculty of Veterinary Medicine, University of Liege, Liege, Belgium

Correspondence
Chiara Talarico, Clinical Department for Companion Animals, Faculty of Veterinary Medicine, University of Liege, Liege, Belgium.
Email: 5chiara.tal@gmail.com

Abstract

A 12-year-old, spayed, female domestic shorthair cat was presented for hyporexia, weakness and right circling. Magnetic resonance imaging revealed two space-occupying lesions consistent with the diagnosis of meningioma. Surgical excision of one mass was planned via craniectomy. Premedication consisted of intramuscular methadone, midazolam and dexmedetomidine, and anaesthesia was induced intravenously with alfaxalone and fentanyl. Partial intravenous anaesthesia was maintained with isoflurane and constant rate infusions of alfaxalone (8 mg/kg/h) and dexmedetomidine (0.5 μg/kg/h). Maropitant was administered for antiemetic prophylaxis. A scalp block targeting the supraorbital, zygomaticotemporal and auriculotemporal nerves was performed preoperatively with ropivacaine, and intraoperative rescue analgesia was unnecessary. Pain was assessed hourly using the short-form Glasgow Feline Composite Measure Pain Scale, and rescue methadone was required 7 hours after block completion. This case describes the implementation of a scalp block and partial intravenous anaesthesia protocol for craniectomy and cranioplasty in a cat undergoing meningioma excision.

BACKGROUND

Cerebral blood flow (CBF) autoregulation is a crucial mechanism based on variations in cerebral vascular resistance. It allows the brain to adjust local and global blood flow to meet metabolic demand, while also compensating for minor fluctuations in systemic blood pressure and cerebral perfusion pressure (CPP).[1] CPP is defined as the difference between the mean arterial pressure (MAP) and the intracranial pressure (ICP), or central venous pressure (CVP) if this is higher than the ICP.[2] However, this autoregulatory mechanism remains effective only within a defined range of MAP, while beyond these limits, CBF becomes pressure-dependent.[3] Furthermore, according to the Monro–Kellie doctrine, the skull becomes a rigid structure after the closure of the fontanels, unable to expand. As the cranium is composed of blood, cerebrospinal fluid and brain parenchyma, any increase in the volume of one or more of these components can lead to an elevation in ICP, which normally is reported to be 8–15 mmHg.[4] As fluctuations in MAP and the presence of a mass (or an elevated CVP) can compromise CBF, anaesthetic management in neurosurgical patients should aim to preserve cerebral autoregulation, minimise cardiovascular oscillations, and prevent factors that may lead to increased ICP. Several anaesthetic agents have been investigated in both human and veterinary medicine for this purpose. In human medicine, sevoflurane has shown better neuroprotective and recovery profiles compared to isoflurane,[5] while propofol demonstrated more uniform control of CBF compared to sevoflurane.[6] Propofol appears to be a better choice in cases of effective or suspected elevated ICP, due to its ability to decrease ICP.[7] Alfaxalone has been shown to exert effects on CBF similar to those of propofol in dogs.[8] To date, no studies have investigated the impact of different anaesthetic agents on CBF in cats.

Pain associated with intracranial surgery has been assessed as mild to severe in human medicine.[9] It is usually described as superficial and somatic, involving the scalp, muscles and dura mater.[10] Different strategies have been implemented to improve pain management and prevent postoperative hyperalgesia and allodynia. These include the use of systemic analgesics, such as paracetamol,[11] non-steroidal anti-inflammatory drugs,[12] intraoperative continuous rate infusion (CRI) of dexmedetomidine,[13] and either incision-site infiltration[9] or scalp block.[14] On the other side, opioids are used as rescue analgesia in case of postoperative pain.[15] Among regional techniques, the scalp block has demonstrated superior analgesic efficacy when compared to local infiltration,[16] making it a preferred option in neurosurgical procedures.

This case report aims to describe the outcomes of a partial intravenous anaesthesia (PIVA) protocol combined with a scalp block for the anaesthetic management of a cat

undergoing craniectomy and cranioplasty for meningioma removal.

CASE PRESENTATION

A 5.7 kg, 12-year-old, spayed, female domestic shorthair cat, with a 1-month history of progressive weakness and hyporexia, was presented to the Small Animals Emergency Service of the University of Liege. On admission, the cat showed right-sided circling and a mild obtundation. Heart rate (HR) was 180 beats per minute, respiratory rate (RR) was 24 breaths per minute, mucous membranes were pink and moist, capillary refill time was less than 2 seconds, and no abnormalities were detected at the cardio-respiratory auscultation. The body condition score was 5/9.

INVESTIGATIONS

A complete haematology and biochemistry panel was performed on admission, and both were unremarkable. A magnetic resonance imaging (MRI) examination was scheduled on the same day. The patient was premedicated with butorphanol (0.2 mg/kg; Torbugesic 10 mg/mL, Zoetis) and dexmedetomidine (5 μg/kg, Dexmedetomidine 0.5 mg/mL; Orion Pharma) administered intramuscularly (IM), then induced with intravenous (IV) propofol (2 mg/kg; PropoVet 10 mg/mL; Zoetis) following the left cephalic vein catheterisation. After endotracheal intubation, anaesthesia was maintained with isoflurane, and intermittent positive-pressure ventilation (IPPV) was initiated immediately upon the cat being moved to the MRI room. Volume-controlled ventilation (VCV) was set on the anaesthetic machine (Leon MRI, Löwenstein Medical) using the following parameters: tidal volume 10 mL/kg, RR: 10–16 breaths per minute, inspiratory-to-expiratory time ratio 1:2, inspiratory pause 30% of inspiratory time, and positive end expiratory pressure 5 cmH_2O. The goal was to maintain the end-tidal carbondioxide ($EtCO_2$) within a target range of 33–37 mmHg, given the clinical presentation consistent with a suspected intracranial mass. Haemodynamic parameters were monitored using a multiparameter monitor (Maglife Serenity; Schiller) displaying electrocardiogram, systolic, mean and diastolic arterial blood pressures measured by oscillometry (SAP, MAP, DAP) and pulse oximetry (SpO_2).

The MRI examination revealed the presence of two extra-axial masses. Both were associated with signs of increased ICP, though without evidence of cerebellar coning. The first mass, measuring 21.5 × 21.6 × 12.5 mm, was situated at the junction between the right parietal and occipital lobes, and it was associated with evident signs of compression; the second one, having a diameter of 3.6 mm, was located in the left temporal lobe. Anaesthesia and recovery were uneventful. Due to the suspicion of meningioma, medical treatment with prednisolone (Prednicortone 5 mg twice a day per os, orally [PO]; Dechra) was initiated at a dose of 1 mg/kg. Given the location and small size of the left temporal mass, radiotherapy was recommended; however, this option was declined by the owners. Surgical excision of the right mass was scheduled for 1 month after presentation, while, due to the anatomical position of the left mass, the possibility of a total excision was excluded.

LEARNING POINTS/TAKE-HOME MESSAGES

- The administration of a partial intravenous anaesthesia based on alfaxalone–dexmedetomidine–isoflurane can be a feasible protocol for neuroanaesthesia in cats with a meningioma, especially when sevoflurane is not available.
- The scalp block can be easily and effectively performed in cats using the same technique described for dogs, targeting the frontal, zygomaticotemporal and major occipital nerves.
- In cats undergoing intracranial surgery, the use of a regional scalp block may reduce the need for intraoperative anaesthetics and analgesics, delaying the need for rescue systemic analgesia in the postoperative period.

TREATMENT

Given the presence of the right intracranial mass, a rostrotentorial craniectomy followed by a marginal excision of the mass located in the parietal/occipital lobe and a cranioplasty was scheduled. On the day of surgery, the cat showed improved mental status and a normal cranial nerve examination; however, right-sided circling was still evident. The clinical examination was otherwise unremarkable.

The cat was subjectively deemed too stressed for IV catheterisation; therefore, premedication was administered IM and consisted of methadone (0.2 mg/kg; Comfortan 10 mg/mL, Dechra), midazolam (0.2 mg/kg; Dormazolam 5 mg/mL, Dechra) and dexmedetomidine (5 μg/kg; 0.5 mg/mL; Orion Pharma). Approximately 15 minutes later, two 22-gauge IV catheters were aseptically inserted into the right cephalic and left medial saphenous vein to separate maintenance drug infusions from fluid or bolus administrations, minimise the risk of inadvertent drug bolus delivery and ensure secure venous access throughout the neurosurgical procedure. A venous blood sample was collected for blood gas analysis, showing a partially compensated metabolic acidosis (pH 7.29; lactate 2.7 mmol/L, pCO_2 31 mmHg) and hyperglycaemia (14.8 mmol/L). Fluid therapy consisting of lactated Ringer's (RL) solution (3 mL/kg/h IV) was initiated, along with a dexmedetomidine CRI (0.5 μg/kg/h). Maropitant (1 mg/kg IV; Cerenia 10 mg/mL, Zoetis) was also administered. After 5 minutes of pre-oxygenation by mask, general anaesthesia was induced with fentanyl (3 μg/kg IV; Fentadon 50 μg/mL, Dechra) and alfaxalone (Alfaxan Multidose 10 mg/mL; Dechra) IV to effect (1 mg/kg in total). Lidocaine spray (Lidcosal, Dechra) was applied to the larynx, and the trachea was intubated with a 4-mm PVC Magill cuffed endotracheal tube (Braun). Intubation was smooth, and no coughing reflex was detected. The endotracheal tube was connected to a Mapleson D system (Intersurgical), and a 70% oxygen–medical air mixture was administered. A PIVA protocol was implemented using isoflurane (Isoflutek, Alivira Animal Health), combined with continuous IV infusions of alfaxalone and dexmedetomidine. Isoflurane was titrated to maintain an EtISO between 0.4% and 0.6%.

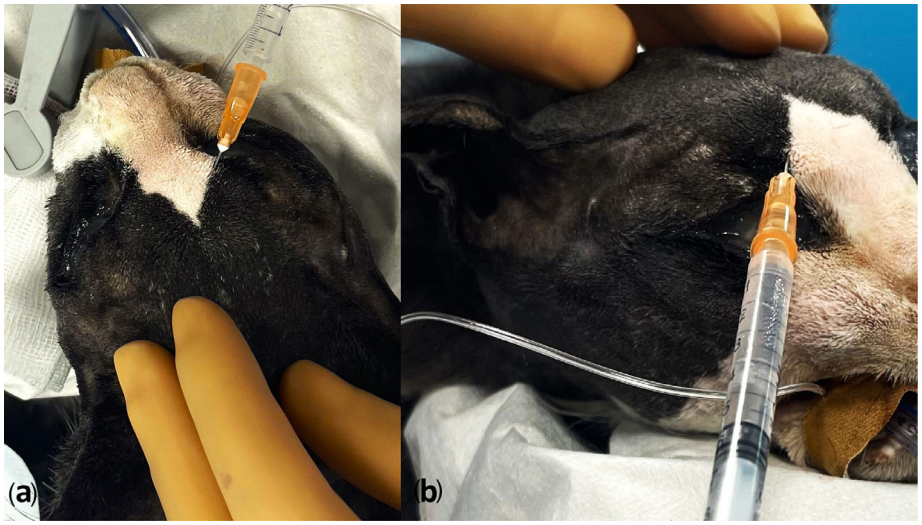

FIGURE 1 Dorsal (a) and fronto-lateral (b) view of the frontal nerve block technique. A 25-gauge, 1.6 mm hypodermic needle was advanced 5 mm between globe and the ventral rim of the orbit pointing dorsally, away from the globe.

The alfaxalone infusion was started immediately after induction at 8 mg/kg/h, and it was gradually reduced to 5 mg/kg/h if HR and MAP remained within 20% of baseline. Dexmedetomidine was administered in CRI (0.5 μg/kg/h) during the whole procedure. Prophylactic antibiotic therapy consisted of cefazoline (20 mg/kg IV; Cefazoline Sandoz 1 g, Sandoz) administered 30 minutes before the start of the surgery and repeated every 90 minutes during the intraoperative period. Throughout the procedure, the cat was maintained in sternal recumbency with the head and neck elevated at approximately 15°, ensuring that jugular compression was carefully avoided.

Intraoperative monitoring was performed using a multiparameter monitor (Mindray EPM 12 m Vet Multiparameter Vital Signs Patient Monitor for Veterinary Animal Hospital, China) continuously displaying electrocardiogram, systolic, mean and diastolic arterial blood pressures measured by oscillometry (SAP, MAP, DAP), pulse oximetry (SpO_2), $EtCO_2$, EtISO and body temperature (°C). A forced air warming device (3 M Bair Hugger Warming Unit, 505, Arizant Healthcare) was used to provide thermal support during the anaesthesia. Intermittent blood glucose monitoring (approximately every 30–45 minutes) recorded a level of 250 mg/dL at the time of induction, with an upward trend observed throughout the procedure, reaching a peak of 450 mg/dL by the end of anaesthesia.

After clipping and aseptic preparation of the skin of the head, a scalp block was performed with ropivacaine 0.5% (0.5 mL/kg; Ropivacaine hydrochloride, Fresnius Kabi), using a technique described for dogs.[17] The block was performed unilaterally, on the right side. A 25-gauge, 1.6 mm hypodermic needle was used to perform the injections. The indentation on the most dorsal point of the dorsal orbital margin was palpated for the frontal nerve (FN) block (Figure 1). The needle was advanced 5 mm between the globe and the ventral rim of the orbit, pointing dorsally, away from the globe. The caudal orbital ligament and the zygomatic process of the frontal bone, just ventral to the orbital ligament, were localised to perform the zygomaticotemporal nerve (ZTN) block (Figure 2). In this case, the needle was advanced 5 mm while pointing ventrally, rostrally and medially to the nasal planum. Finally, the neck was ventroflexed to perform the major occipital nerve (MON) block (Figure 3), consisting of two injections. The occlusion of the jugular veins was carefully avoided. For the rostral injection, the needle was introduced medially to the caudomedial edge of the scutiform cartilage and advanced towards the cranial aspect of the spinous process of the axis. For the caudal injection, the needle was inserted laterally to the caudal edge of the spinous process of the atlas. It was advanced into the muscle using a 20° angle first, and then cranially, in parallel fashion to the dorsal spinous process, up to the cranial edge of the atlas. An aspiration test was performed before each injection, and ropivacaine was injected gradually while retracting the syringe. A volume of 0.1 mL/kg/site was used for the FN block and the ZTN block, splitting the remaining volume into the two injections of the MON block.

The cat was transferred to the operating theatre and connected to a paediatric rebreathing system (Universal F, Kingsystem). VCV (Prima 320, Penlon) was started aiming for an $EtCO_2$ of 33–37 mmHg. IPPV was set as previously described for the MRI examination, but no PEEP was applied intraoperatively. A 25% increase in HR and/or MAP, sustained for more than 1 minute, compared with their respective values immediately before the abrupt rise, was considered a sign of nociception.[18]

Surgery began approximately 25 minutes after the execution of the scalp block. The cat remained haemodynamically stable throughout the procedure. HR remained generally low, ranging from 90 to 110 beats per minute. Despite this bradycardia, MAP remained within acceptable limits, ranging between 75 and 95 mmHg. No rescue analgesia was required during surgery. As MAP approached 60 mmHg during mass removal, a 5 mL/kg RL bolus was administered over 15 minutes to prevent hypotension, resulting in the maintenance of normotension.

Slight cerebral swelling was macroscopically observed immediately after the mass excision, and prednisolone (0.5 mg/kg IV; Prednisolone 2.5%, 50 mL, Inovet) was injected. MAP progressively decreased over the following 10 minutes (from 80 to 60 mmHg), and an IV bolus of

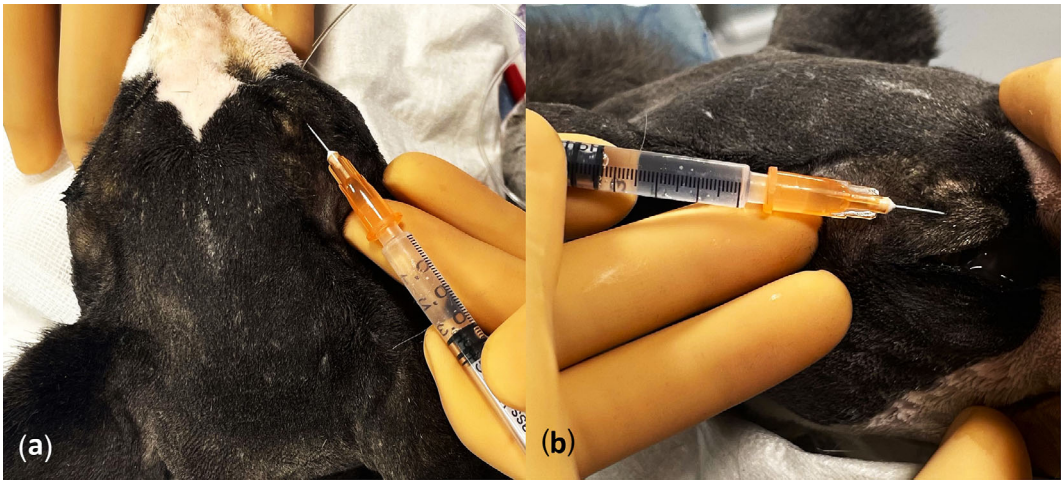

FIGURE 2 Dorsal (a) and fronto-lateral (b) view of the zygomaticotemporal nerve block technique. A 25-gauge, 1.6 mm hypodermic needle was advanced 5 mm while pointing ventrally, rostrally and medially to the nasal planum.

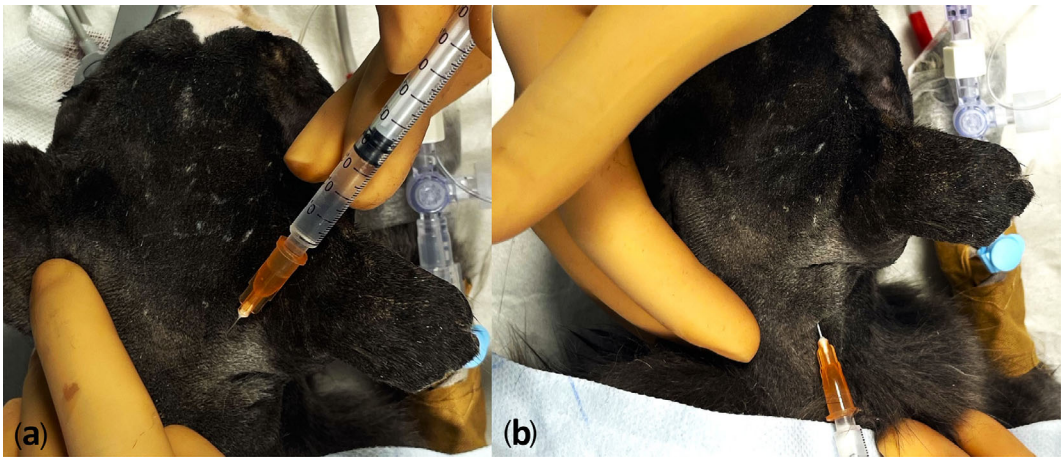

FIGURE 3 Dorsal view of the rostral (a) and caudal (b) approach of the major occipital nerve block technique. The neck was slightly ventroflexed. A 25-gauge, 1.6 mm hypodermic needle was introduced medially to the caudomedial edge of the scutiform cartilage and advanced towards the cranial aspect of the spinous process of the axis (a); then, the needle was inserted laterally to the caudal edge of the spinous process of the atlas and advanced into the muscle using a 20° angle first, cranially, in parallel fashion to the dorsal spinous process, up to the cranial edge of the atlas (b).

hypertonic saline solution (3 mL/kg; 7.5 g/100 mL; Braun) (HTS) was administered over 15 minutes. This intervention resulted in the restoration of normotension, and the cerebral oedema was subjectively assessed to have decreased.

Once the cranioplasty was started, alfaxalone infusion was interrupted, and the EtISO was increased up to 0.8%. Weaning from mechanical ventilation was completed during this phase. Isoflurane and dexmedetomidine administration were interrupted at the end of the surgery.

The durations of surgery and anaesthesia were 150 and 210 minutes, respectively. Cardiovascular and respiratory variables remained within physiological limits during recovery. Extubation was performed 20 minutes after discontinuation of isoflurane.

OUTCOME AND FOLLOW-UP

Recovery from anaesthesia was uneventful, and the cat was transferred to the Intensive Care Unit, where it received oxygen supplementation via face mask. Body temperature was 36.6°C upon arrival, and active warming continued until normothermia was achieved. A slight delay in the return of the palpebral reflex on the right side was noted during the early recovery phase, but it resolved spontaneously without further intervention. Intermittent blood glucose monitoring was continued during hospitalisation, with a value of 422 mg/dL recorded 30 minutes after the end of anaesthesia, and 350 mg/dL approximately 4 hours later. The following therapy, consisting of prednisolone (0.5 mg/kg PO twice per day), cefazoline (20 mg/kg IV three times per day) and maropitant (1 mg/kg IV once per day), was continued during hospitalisation. Postoperative pain was assessed every hour, starting 1 hour after extubation, using the short-form Glasgow Feline Composite Measure Pain Scale (GCMPS-Feline).[19] Methadone (0.2 mg/kg IV) was administered in the presence of a GCMPS-Feline score ≥5 out of 20. The first postoperative rescue methadone administration was performed approximately 7 hours after the scalp block execution, when a pain score of 7 out of 20 was recorded. From this point on, methadone (0.2 mg/kg IV) was administered every 4 hours and continued for 12 hours, before decreasing the dosage to 0.1 mg/kg IV every 4 hours during the following 24 hours. The cat exhibited improved appetite and activity levels, so it was

discharged to the owners after an uneventful postoperative period of 48 hours.

The cat was re-evaluated 3 days later. A follow-up 1 month later confirmed complete healing of the surgical wound and a stable, healthy physical and neurological state.

DISCUSSION

To our knowledge, this is the first case report describing the use of an alfaxalone–dexmedetomidine–isoflurane PIVA in combination with a scalp block for the anaesthetic management of a cat undergoing intracranial meningioma excision. The multimodal anaesthetic and analgesic protocol used in this case appeared to produce satisfactory outcomes in terms of anaesthetic depth, perioperative pain management, and patient recovery.

The anaesthetic management used in this case was calibrated, attempting to maintain the CBF and avoid any increase in ICP during the perioperative period. As previously mentioned, autoregulation of CBF is a complex, multifactorial process that remains effective only within defined physiological limits. Among these, the maintenance of MAP within the range of approximately 60–150 mmHg is essential to ensure stable CPP and adequate oxygen delivery to neural tissue. When MAP falls below this lower threshold, CBF becomes pressure-dependent, predisposing to cerebral ischaemia. Conversely, when MAP exceeds the upper limit, there is a risk of blood–brain barrier disruption and cerebral oedema secondary to hyperperfusion.[3]

Dexmedetomidine was included in the premedication protocol, although it may increase the risk of vomiting and transient elevations in ICP, particularly in patients with intracranial pathology. When feasible, subcutaneous administration of maropitant before premedication may help reduce this risk.[20] However, given the patient's high stress level and the potential discomfort associated with subcutaneous injection, maropitant was administered IV immediately after catheter placement instead.

The head was always kept in an elevated position, and any compression of the neck or abdomen was avoided while manipulating the cat. In addition, fentanyl was used in co-induction with propofol to reduce the cough response and prevent ICP increase during intubation.[21] Mechanical ventilation was applied to ensure tight control of $EtCO_2$, thereby reducing the risk of cerebral vasodilation associated with hypercapnia. The use of PEEP can reduce venous return, thereby increasing CVP and potentially impairing the autoregulatory mechanisms controlling ICP.[2]

Anaesthetic maintenance can be achieved through inhalant anaesthetics delivered via vaporiser, or by total intravenous anaesthesia (TIVA) protocols, which involve the exclusive use of IV agents. Alternatively, PIVA incorporates IV agents in conjunction with inhalant anaesthetics. To the authors' best knowledge, only one case report describes the anaesthetic management of a cat undergoing intracranial surgery, in which isoflurane was used in combination with a dexmedetomidine infusion.[21] A recent case series described seven cats undergoing craniotomy in which a scalp block was combined with perioperative alfaxalone–dexmedetomidine infusions; maintenance anaesthesia was achieved without volatile agents in all but one cat.[22]

Studies conducted in dogs report the use of either TIVA with propofol and alfentanil,[23] or alfaxalone and remifentanil.[24] Other reports in dogs describe the implementation of a PIVA protocol either with sevoflurane and dexmedetomidine,[25] or with isoflurane, alfentanil and dexmedetomidine infusions in combination with scalp block.[26] In a retrospective study conducted in dogs submitted to intracranial surgery and anaesthetised with sevoflurane, the effects of a dexmedetomidine infusion were compared to short-acting opioids. In that study, the use of dexmedetomidine resulted in significantly higher MAP during anaesthesia, without showing any beneficial effect on the quality of recovery, as the occurrence of postoperative hypertension and agitation was equally reported in both groups.[27]

Better control of CBF and CO_2 reactivity has been reported with sevoflurane or TIVA in both human and veterinary literature.[24] Volatile anaesthetics allow rapid adjustment of anaesthetic depth during changes in surgical stimulation; however, sevoflurane is generally preferred for its superior cerebrovascular profile.[5] This case, therefore, illustrates the potential value of a PIVA protocol in situations where sevoflurane is unavailable. The combination of alfaxalone and dexmedetomidine provided MAC-sparing, sedative and analgesic effects, reducing isoflurane requirements and stabilising anaesthetic depth. Such multimodal balance may help limit volatile-induced cerebral vasodilation, preserve CO_2 reactivity, and facilitate controlled ventilation, while also allowing lower infusion rates and smoother recovery. Nonetheless, the advantages of PIVA depend on the clinician's experience, monitoring quality and patient physiology.

Systemic (and cerebral) vasodilatation induced by inhalant anaesthetic agents is largely dependent on anaesthetic depth, but cerebral autoregulation is generally preserved at 1 MAC. Hypercapnia lowers the MAC at which autoregulation fails, while hypocapnia increases it.[28] In dogs, both alfaxalone and propofol have shown superior preservation of cerebrovascular CO_2 reactivity compared to isoflurane, and the reduction in CBF appears to be less pronounced with these injectable agents.[8]

In the present case, alfaxalone was preferred over propofol, considering the risk of Heinz bodies formation, the reported longer recovery time with propofol,[29] and alfaxalone's milder negative chronotropic effect.[30] According to the authors' knowledge, the use of alfaxalone in TIVA protocols, either alone or with other drugs, has been described in dogs and less in cats,[22,31] while a PIVA is not reported. According to the literature, recommended alfaxalone infusion rates are around 10 mg/kg/h.[31] In this case, considering the concurrent use of isoflurane and dexmedetomidine and the clinical status of the patient, alfaxalone was titrated to effect, then gradually reduced and discontinued after the mass was completely removed to minimise potential side effects due to accumulation, such as delayed recovery, vocalisations and myoclonus.[32] The alfaxalone infusion was discontinued as the surgery was nearing completion, when the risk of affecting CBF was minimal.

The transition to inhalant anaesthesia, along with dexmedetomidine co-administration, may have contributed to the absence of these complications during recovery. As suggested in previous studies, delayed recovery cannot be exclusively attributed to alfaxalone, as other drugs, perioperative hypothermia, and the impact of dexmedetomidine

on CYP450 metabolism[33] may all contribute.[34] Additionally, alfaxalone in cats seems to better preserve the respiratory pattern when compared to propofol.[31] This was irrelevant in the intraoperative period, as mechanical ventilation was adopted. However, it could have a positive impact on the recovery in reducing the risk of hypercapnia.

Dexmedetomidine CRI was included in the anaesthetic protocol for several reasons. In cats, where glucuronidation is limited, short-acting or reversible agents are generally preferred to avoid prolonged recovery. Dexmedetomidine is well-documented in veterinary literature for its sedative,[35] analgesic[35] and MAC-sparing effects.[36] It has also been shown to improve recovery quality,[36] enhance cardiovascular stability,[37] attenuate sympathetic responses,[38] and reduce ICP by inhibiting hypercapnia- and inhalant anaesthetics-induced cerebral vasodilation.[39] Similar findings have been reported in human medicine, where intraoperative dexmedetomidine CRI enhances haemodynamic stability, reduces ICP, and improves overall outcomes[39]. Moreover, dexmedetomidine has been suggested to attenuate cognitive impairment associated with ischaemic cerebrovascular events.[40]

In this case, the bradycardia observed intraoperatively was most likely attributable to the dexmedetomidine CRI. However, as MAP remained within physiological limits, no parasympatholytic drug was administered in order to avoid abrupt increases in HR and MAP, which could have secondarily raised ICP and cause myocardial stress. Dexmedetomidine was discontinued at the end of surgery, and atipamezole was not administered to allow a smooth, gradual recovery and to avoid potential adverse effects such as vasodilation, hypotension, vomiting or increased ICP, which could elevate the risk of cerebral haemorrhage or haematoma.[41–43]

The hyperglycaemia observed was partially attributed to the administration of α_2-agonists,[44] surgical manipulation and corticosteroid treatment. Glucose metabolism dysregulation has been reported in human patients with intracranial meningiomas, with hyperglycaemia being a common finding.[45] This association remains poorly investigated in veterinary medicine, and further studies are needed to explore the potential link between meningiomas and hyperglycaemia in cats. Hyperglycaemia may also worsen cerebral acidosis, ischaemia and oedema, and it has been associated with high mortality rates and poor neurological impact in veterinary species.[46] Dexmedetomidine has been demonstrated to decrease insulin concentration via αA2-adrenoceptor inhibition on pancreatic β-cells in veterinary species.[44] In the present case, a decreasing trend in blood glucose was observed following dexmedetomidine discontinuation, although hyperglycaemia persisted during follow-up. Despite its neuroprotective properties, the effect of dexmedetomidine on blood glucose levels should be carefully considered in neurological patients, as it may exacerbate intracranial hypertension.

As mentioned above, intracranial surgery is associated with severe perioperative pain if inadequate analgesia is provided. Poor perioperative management can impair normal respiratory and cardiovascular function, prolong hospitalisation times and increase the risk of developing chronic postoperative pain.[47]

The scalp block is a blind locoregional anaesthetic technique that involves the combined blockade of the frontal, zygomaticotemporal and major occipital nerves. This technique has been described in veterinary medicine for dogs,[17] where it has been incorporated into multimodal analgesic protocols to provide perioperative analgesia in patients undergoing craniotomy or craniectomy. More recently, its clinical application has also been reported in cats undergoing intracranial surgery, supporting its feasibility and potential effectiveness in this species.[22]

In this case, the block was performed with the aim of reducing intraoperative requirements for maintenance anaesthetics and opioids, limiting the need for postoperative rescue analgesia, minimising postoperative nausea and vomiting, and encouraging the return of spontaneous feeding. The duration of action for ropivacaine 0.5% has been reported to be approximately 6 hours in dogs following ovariohysterectomy,[48] and between 60 and 360 minutes in rats.[49] Although bupivacaine 0.5% may provide a slightly longer duration in dogs,[48] ropivacaine was preferred in this case, given the reported cardiotoxic potential of bupivacaine.[50] Although the ropivacaine dose used (2.5 mg/kg) exceeded the commonly recommended maximum for cats,[51] higher doses up to 3 mg/kg have been safely reported in recent feline clinical studies.[52,53] In the absence of cadaveric investigations describing the dye spread after scalp block in cats, a larger volume, consistent with that described for dogs, was selected to ensure adequate diffusion of the local anaesthetic, rather than the smaller volumes used by Cabral Naranjo et al. (2025).[22] As the innervation of the feline skull is less clearly defined than in dogs, the author assumed the information found in literature about canine species could have been extended to cats as well.[54] The blocks were performed using landmarks similar to those described in dogs, with adjustments made for feline-specific anatomical differences. Notable variations in cats include a larger and shallower orbit, elongated zygomatic and frontal processes joined by a shorter orbital ligament, and a less prominent sagittal crest.[22]

Although no detailed anatomical descriptions of the FN, ZTN and MON are currently available in cats, potential complications related to their blockade have been described in both human and veterinary medicine. For the FN block, the proximity to ocular structures may pose a risk of globe trauma or inadvertent intravascular injection. However, aspirating before injection and directing the needle dorsally are common safety precautions. Being the ZN (zigomatic nerve) part of the FN complex, the motor fibres of the FN could be potentially affected. The ZNcontributes to the formation of the rostral auricular plexus together with the FN, lacrimal nerve and the auricular rami of the auriculopalpebral nerve, a branch of the FN.[54] In people, the ZTN block has been associated with transient FN paralysis, mydriasis and ocular akinesia due to unintended spread of local anaesthetic to nearby motor fibres.[55] Similar risks are described in dogs, where aberrant diffusion of local anaesthetic may affect branches of the facial or oculomotor nerves, especially when high volumes or concentrations are used.[55,56] In a canine cadaveric study, none of the cited nerves was stained apart from the ZTN; however, this aspect was not specifically evaluated during the dissection.[17] For the MON block, complications such as transient facial nerve dysfunction have been reported in people, potentially due to anatomical interconnections between the occipital and posterior auricular branches of the FN, forming the caudal auricular plexus.[54] In the present case, despite the

use of a moderate volume and concentration of ropivacaine and the execution of all three nerve blocks on the same side, no clinical complications were observed. A mild asymmetry in the return of palpebral and auricular reflexes was noted during recovery, but this resolved spontaneously and was not associated with any long-term neurological deficit.

Hypertonic saline was administered to increase blood pressure and reduce cerebral oedema observed following mass removal. Its osmotic effect promotes intravascular volume expansion by shifting fluids from the interstitial and intracellular compartments. This contributes to improved cerebral perfusion by reducing haematocrit and blood viscosity, and by enhancing red blood cell deformability.[57] In human medicine, hypertonic saline has been reported to be more effective than mannitol in decreasing ICP, although some studies have found no significant difference between the two agents.[58] Hypertonic saline is also described to have a faster onset of action and more sustained effects compared to mannitol.[59] Additionally, it reduces leukocyte adhesion, thereby exerting an anti-inflammatory effect.[57]

Based on this case, the use of a PIVA protocol combining alfaxalone, dexmedetomidine and isoflurane may represent a valuable component of a multimodal anaesthetic strategy in cats undergoing intracranial surgery, especially when sevoflurane is not available. However, further studies are required to better understand the pharmacokinetics, pharmacodynamics, optimal dosing ranges and potential complications associated with PIVA in feline patients. Additionally, the scalp block appeared to provide effective perioperative analgesia in this cat undergoing craniectomy involving the parietal and occipital regions. This technique may also have potential for use in procedures involving the frontal region. Further cadaveric studies and randomised clinical trials are needed to clarify the anatomical landmarks and innervation patterns in cats, in order to refine this locoregional technique and explore additional clinical applications.

AUTHOR CONTRIBUTIONS

Chiara Talarico, Massimiliano Degani, Virginie Gronsfeld and Stéphanie Noël were involved in the clinical management of the case. Chiara Talarico, Massimiliano Degani, Virginie Gronsfeld, Stéphanie Noël and Charlotte Sandersen were involved in data treatment, interpretation and preparation of the manuscript.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

ETHICS STATEMENT

By signing the admission form, owners gave written informed consent for the collection of data from their cat and its publication in an anonymised format. Ethical review and approval were not required for the animal study, because this case report has been written using data collected in a clinical setting. No research has been performed on the patient.

ORCID

Chiara Talarico https://orcid.org/0009-0006-0298-3890
Massimiliano Degani https://orcid.org/0000-0002-4375-8407
Virginie Gronsfeld https://orcid.org/0000-0002-1250-6207

REFERENCES

1. Jordan JD, Powers WJ. Cerebral autoregulation and acute ischemic stroke. Am J Hypertens. 2012;25(9):946–50. https://doi.org/10.1038/ajh.2012.53
2. Jain V, Pandit R, Choudhary J. Blood pressure target in acute brain injury. Indian J Crit Care Med. 2019;23(S2):136–39. https://doi.org/10.5005/jp-journals-10071-23191
3. Messick JM Jr, Newberg LA, Nugent M, Faust RJ. Principles of neuroanesthesia for the nonneurosurgical patient with CNS pathophysiology. Anesth Analg. 1985;64(2):143–74. https://doi.org/10.1213/00000539-198502000-00008
4. Mascarenhas S, Vilela GH, Carlotti C, Damiano LE, Seluque W, Colli B, et al. The new ICP minimally invasive method shows that the Monro–Kellie doctrine is not valid. Acta Neurochir Suppl. 2012;114:117–20. https://doi.org/10.1007/978-3-7091-0956-4_21
5. Shan J, Sun L, Wang D, Li X. Comparison of the neuroprotective effects and recovery profiles of isoflurane, sevoflurane and desflurane as neurosurgical pre-conditioning on ischemia/reperfusion cerebral injury. Int J Clin Exp Pathol. 2015;8(2):2001–9.
6. Kaisti KK, Metsähonkala L, Teräs M, Oikonen V, Aalto S, Jääskeläinen S, et al. Effects of surgical levels of propofol and sevoflurane anesthesia on cerebral blood flow in healthy subjects studied with positron emission tomography. Anesthesiology. 2002;96(6):1358–70. https://doi.org/10.1097/00000542-200206000-00015
7. Cole CD, Gottfried ON, Gupta DK, Couldwell WT. Total intravenous anesthesia: advantages for intracranial surgery. Oper Neurosurg. 2007;61(5):369–78. https://doi.org/10.1227/01.neu.0000303996.74526.30
8. Bini G, Bailey KM, Voyvodic JT, Chiavaccini L, Munana KR, Keenihan EK. Effects of alfaxalone, propofol and isoflurane on cerebral blood flow and cerebrovascular reactivity to carbon dioxide in dogs: a pilot study. Vet J. 2023;291(105939):105939. https://doi.org/10.1016/j.tvjl.2022.10593
9. Galvin IM, Levy R, Day AG, Gilron I. Pharmacological interventions for the prevention of acute postoperative pain in adults following brain surgery. Cochrane Database Syst Rev. 2019;2019(11):CD011931. https://doi.org/10.1002/14651858.cd011931.pub2
10. De Benedittis S, Lorenzetti A, Migliore M, Spagnoli D, Tiberio F, Villani RM. Postoperative pain in neurosurgery: a pilot study in brain surgery. Neurosurgery. 1996;38(3):466–70. https://doi.org/10.1097/00006123-199603000-00008
11. Ghaffarpasand F, Dadgostar E, Ilami G, Shoaee F, Niakan A, Aghabaklou S, et al. Intravenous acetaminophen (paracetamol) for postcraniotomy pain: systematic review and meta-analysis of randomized controlled trials. World Neurosurg. 2020;134:569–76. https://doi.org/10.1016/j.wneu.2019.11.066
12. Carpenter RE, Byron CR. Equine local anesthetic and analgesic techniques. In: Grimm KA, Lamont LA, Tranquilli WJ, editors. Lumb & Jones' veterinary anesthesia and analgesia. 5th ed. Hoboken, USA: Wiley & Sons; 2015. p. 886e911.
13. Song J, Ji Q, Sun Q, Gao T, Liu K, Li L. The opioid-sparing effect of intraoperative dexmedetomidine infusion after craniotomy. J Neurosurg Anesthesiol. 2016;28(1):14–20. https://doi.org/10.1097/ana.0000000000000190
14. Wardhana A, Sudadi S. Scalp block for analgesia after craniotomy: a meta-analysis. Indian J Anaesth. 2019;63(11):886. https://doi.org/10.4103/ija.ija_315_19
15. Mestdagh FP, Lavand'homme PM, Pirard G, Joshi GP, Sauter AR, Van de Velde M. Pain management after elective craniotomy: a systematic review with procedure-specific postoperative pain management (PROSPECT) recommendations. Eur J Anaesthesiol. 2023;40(10):747–57. https://doi.org/10.1097/eja.0000000000001877
16. Akcil EF, Dilmen OK, Vehid H, Ibısoglu LS, Tunali Y. Which one is more effective for analgesia in infratentorial craniotomy? The scalp block or local anesthetic infiltration. Clin Neurol Neurosurg. 2017;154:98–103. https://doi.org/10.1016/j.clineuro.2017.01.018
17. Kushnir Y, Marwitz GS, Shilo-Benjamini Y, Milgram J. Description of a regional anaesthesia technique for the dorsal cranium in the dog: a cadaveric study. Vet Anaesth Analg. 2018;45(5):684–94. https://doi.org/10.1016/j.vaa.2018.05.006
18. Otero PE, Guerrero JA, Tarragona L, Micieli F, Sanchez MF, Donati PA, et al. Ultrasound-guided greater ischiatic notch plane block combined with the caudal quadratus lumborum block (GIN-TONIC block) in dogs undergoing pelvic limb surgery: preliminary results. Animals. 2024;14(12):1764. https://doi.org/10.3390/ani14121764

19. Reid J, Scott EM, Calvo G, Nolan AM. Definitive Glasgow acute pain scale for cats: validation and intervention level. Vet Rec. 2017;180(18):449. https://doi.org/10.1136/vr.104208
20. Martin-Flores M, Sakai DM, Learn MM, Mastrocco A, Campoy L, Boesch JM, et al. Effects of maropitant in cats receiving dexmedetomidine and morphine. J Am Vet Med Assoc. 2016;248(11):1257–61. https://doi.org/10.2460/javma.248.11.1257
21. Martín Bellido V, Martínez i, Ferré B, McDonald H, Vettorato E. Effect of intravenous fentanyl on cough reflex and quality of endotracheal intubation in cats. Vet Anaesth Analg. 2023;50(3):230–37. https://doi.org/10.1016/j.vaa.2023.01.002
22. Cabral Naranjo A, McMillan MW, Lehnus KS. Peripheral nerve blocks of the dorsal cranium in cats undergoing craniotomy: seven cases (2022–2023). J Small Anim Pract. 2025;66:484–94. https://doi.org/10.1111/jsap.13846
23. Raisis AL, Leece EA, Platt SR, Adams VJ, Corletto F, Brearley J. Evaluation of an anaesthetic technique used in dogs undergoing craniectomy for tumour resection. Vet Anaesth Analg. 2007;34(3):171–80. https://doi.org/10.1111/j.1467-2995.2006.00318.x
24. Warne LN, Beths T, Fogal S, Bauquier SH. The use of alfaxalone and remifentanil total intravenous anesthesia in a dog undergoing a craniectomy for tumor resection. Can Vet J. 2014;55(11):1083–88.
25. Tayari H, Bell A. Dexmedetomidine infusion as perioperative adjuvant in a dog undergoing craniotomy. Vet Rec Case Rep. 2019;7(1):e000727. https://doi.org/10.1136/vetreccr-2018-000727
26. Schaldemose M, Lehnus K. Peripheral nerve block of the dorsal cranium in two dogs undergoing craniotomy. Vet Rec Case Rep. 2022;10(2):e337. https://doi.org/10.1002/vrc2.337
27. Marquez-Grados F, Vettorato E, Corletto F. Sevoflurane with opioid or dexmedetomidine infusions in dogs undergoing intracranial surgery: a retrospective observational study. J Vet Sci. 2020;21(1):e8. https://doi.org/10.4142/jvs.2020.21.e8
28. McPherson RW, Traystman RJ. Effects of isoflurane on cerebral auto regulation in dogs. Anesthesiology. 1988;69(4):493–99. https://doi.org/10.1097/00000542-198810000-00008
29. Pascoe PJ, Ilkiw JE, Frischmeyer KJ. The effect of the duration of propofol administration on recovery from anesthesia in cats. Vet Anaesth Analg. 2006;33(1):2–7. https://doi.org/10.1111/j.1467-2995.2005.00216.x
30. Muir W, Lerche P, Wiese A, Nelson L, Pasloske K, Whittem T. The cardiorespiratory and anesthetic effects of clinical and supraclinical doses of alfaxalone in cats. Vet Anaesth Analg. 2009;36(1):42–54. https://doi.org/10.1111/j.1467-2995.2008.00428.x
31. Campagna I, Schwarz A, Keller S, Bettschart-Wolfensberger R, Mosing M. Comparison of the effects of propofol or alfaxalone for anaesthesia induction and maintenance on respiration in cats. Vet Anaesth Analg. 2015;42(5):484–92. https://doi.org/10.1111/vaa.12231
32. Zaki S, Ticehurst KE, Miyaki Y. Clinical evaluation of Alfaxan-CD as an intravenous anaesthetic in young cats. Aust Vet J. 2009;87(3):82–87. https://doi.org/10.1111/j.1751-0813.2009.00390.x
33. Sandbaumhüter FA, Theurillat R, Thormann W. Effects of medetomidine and its active enantiomer dexmedetomidine on *N*-demethylation of ketamine in canines determined in vitro using enantioselective capillary electrophoresis. Electrophoresis. 2015;36(21–22):2703–12. https://doi.org/10.1002/elps.201500147
34. Beths T, Touzot-Jourde G, Musk G, Pasloske K. Clinical evaluation of alfaxalone to induce and maintain anaesthesia in cats undergoing neutering procedures. J Feline Med Surg. 2014;16(8):609–15. http://doi.org/10.1177/1098612X13514420
35. Cardoso CG, Marques DRC, da Silva THM, de Mattos-Junior E. Cardiorespiratory, sedative and antinociceptive effects of dexmedetomidine alone or in combination with methadone, morphine or tramadol in dogs. Vet Anaesth Analg. 2014;41(6):636–43. https://doi.org/10.1111/vaa.12172
36. Souza SS, Intelisano TR, De Biaggi CP, Moura CA, Selmi AL, Dias RA, et al. Cardiopulmonary and isoflurane-sparing effects of epidural or intravenous infusion of dexmedetomidine in cats undergoing surgery with epidural lidocaine. Vet Anaesth Analg. 2010;37(2):106–15. https://doi.org/10.1111/j.1467-2995.2009.00512.x
37. Ohata H, Iida H, Dohi S, Watanabe Y. Intravenous dexmedetomidine inhibits cerebrovascular dilation induced by isoflurane and sevoflurane in dogs. Anesth Analg. 1999;89(2):370–77. https://doi.org/10.1213/00000539-199908000-00023
38. Sinclair MD. A review of the physiological effects of alpha2-agonists related to the clinical use of medetomidine in small animal practice. Can Vet J. 2003;44(11):885–97.
39. Soliman RN, Hassan AR, Rashwan AM, Omar AM. Prospective, randomized study to assess the role of dexmedetomidine in patients with supratentorial tumors undergoing craniotomy under general anaesthesia. Middle East J Anesthesiol. 2011;21(3):325–34.
40. Zhang J, Wang G, Zhang F, Zhao Q. Improvement of postoperative cognitive dysfunction and attention network function of patients with ischemic cerebrovascular disease via dexmedetomidine. Exp Ther Med. 2018;15(3):2968–72. https://doi.org/10.3892/etm.2018.5806
41. Siegenthaler J, Pleyers T, Raillard M, Spadavecchia C, Levionnois OL. Effect of medetomidine, dexmedetomidine, and their reversal with atipamezole on the nociceptive withdrawal reflex in beagles. Animals. 2020;10(7):1240. https://doi.org/10.3390/ani10071240
42. Zatroch KK, Sakai DM, Parry S, Campoy L, Martin-Flores M. Evaluation of atipamezole as a treatment for dexmedetomidine-induced cardiovascular depression in anesthetized cats. Am J Vet Res. 2019;80(5):455–60. https://avmajournals.avma.org/view/journals/ajvr/80/5/ajvr.80.5.455.xml
43. Budde JA, McCluskey DM. Plumb's veterinary drug handbook. 10th ed. Hoboken, NJ: Wiley-Blackwell; 2023.
44. Bouillon J, Duke T, Focken AP, Snead EC, Cosford KL. Effects of dexmedetomidine on glucose homeostasis in healthy cats. J Feline Med Surg. 2020;22(4):344–49. http://doi.org/10.1177/1098612X19847282
45. Orešković D, Madero Pohlen A, Cvitković I, Alen JF, Raguž M, Álvarez-Sala de la Cuadra A, et al. Chronic hyperglycemia and intracranial meningiomas. BMC Cancer. 2024;24(1):448. https://doi.org/10.1186/s12885-024-12243-4
46. Syring RS, Otto CM, Drobatz KJ. Hyperglycemia in dogs and cats with head trauma: 122 cases (1997–1999). J Am Vet Med Assoc 2001;218:1124–29. https://doi.org/10.2460/javma.2001.218.1124
47. El-Boghdadly K, Levy NA, Fawcett WJ, Knaggs RD, Laycock H, Baird E, et al. Peri-operative pain management in adults: a multidisciplinary consensus statement from the Association of Anaesthetists and the British Pain Society. Anaesthesia. 2024;79(11):1220–36. https://doi.org/10.1111/anae.16391
48. Lambertini C, Kluge K, Lanza-Perea M, Bruhl-Day R, Kalchofner Guerrero KS. Comparison of intraperitoneal ropivacaine and bupivacaine for postoperative analgesia in dogs undergoing ovariohysterectomy. Vet Anaesth Analg. 2018;45(6):865–70. https://doi.org/10.1016/j.vaa.2018.06.012
49. Dony P, Dewinde V, Vanderick B, Cuignet O, Gautier P, Legrand E, et al. The comparative toxicity of ropivacaine and bupivacaine at equipotent doses in rats. Anesth Analg. 2000;91(6):1489–92. http://doi.org/10.1097/00000539-200012000-00036
50. Aprea F, Vettorato E, Corletto F. Severe cardiovascular depression in a cat following a mandibular nerve block with bupivacaine. Vet Anaesth Analg. 2011;38(6):614–18. https://doi.org/10.1111/j.1467-2995.2011.00654.x
51. Grubb T, Lobprise H. Local and regional anaesthesia in dogs and cats: overview of concepts and drugs (part 1). Vet Med Sci. 2020;6(2):209–17. https://doi.org/10.1002/vms3.219
52. Paolini A, Bianchi A, Buci R, Parrillo S, Di Giosia A, Ristori C, et al. Use of a quadratus lumborum block in queens undergoing ovariectomy: a randomised controlled trial. J Feline Med Surg. 2024;26(9):1098612×241275277. https://doi.org/10.1177/1098612X241275277
53. Di Franco C, Cozzani C, Vannozzi I, Briganti A. Low-volume (0.3 mL/kg) ropivacaine 0.5% for a quadratus lumborum block in cats undergoing ovariectomy: a randomized study. Vet Sci. 2025;12(6):524. https://doi.org/10.3390/vetsci12060524
54. Nickel R, Schummer A, Seiferle E. In: Gobetto A, editor. Trattato di anatomia veterinaria degli animali domestici (4): Sistema nervoso, ghiandole endocrine, organi di senso. Vol. 4. Milano: CEA; 1988.
55. Giuliano EA, Walsh K. The eye. In:Campoy L, Read MR, editors. Small animal regional anesthesia and analgesia. USA: Blackwell Publishing; 2013. p. 103e118.
56. Mahajan R, Jain K, Kalsotra P, Bloria S. Transient facial nerve paralysis in two patients following zygomaticotemporal nerve block—case studies. Indian J Anaesth. 2023;67(7):664–66. https://doi.org/10.4103/ija.ija_985_22
57. Gwak D-S, Ko S-B. Hyperosmolar therapy for regulation of cerebral edema and intracranial pressure. J Korean Med Assoc. 2023;66(5):297–302. https://doi.org/10.5124/jkma.2023.66.5.297

58. Kamel H, Navi BB, Nakagawa K, Hemphill JC III, Ko NU. Hypertonic saline versus mannitol for the treatment of elevated intracranial pressure: a meta-analysis of randomized clinical trials. Crit Care Med. 2011;39(3):554–59. https://doi.org/10.1097/ccm.0b013e318206b9be
59. Oh S, Delic JJ. Hyperosmolar therapy in the management of intracranial hypertension. AACN Adv Crit Care. 2022;33(1):5–10. https://doi.org/10.4037/aacnacc2022743

How to cite this article: Talarico C, Degani M, Gronsfeld V, Noël S, Sandersen C. Alfaxalone–dexmedetomidine–isoflurane partial intravenous anaesthesia in combination with scalp block in a cat undergoing craniectomy for meningioma excision. Vet Rec Case Rep. 2026;14:e70318. https://doi.org/10.1002/vrc2.70318

MULTIPLE-CHOICE QUESTION

In this case, a partial intravenous anaesthesia (PIVA) protocol combining alfaxalone, dexmedetomidine and isoflurane was used in a cat undergoing craniectomy for meningioma removal. What is the main advantage of this PIVA approach compared with total intravenous anaesthesia or isoflurane alone?

POSSIBLE ANSWERS TO MULTIPLE-CHOICE QUESTION

A. It eliminates the need for mechanical ventilation.
B. It minimises cerebral vasodilation and haemodynamic fluctuations associated with high concentrations of inhalant anaesthetics.
C. It reduces the risk of bradycardia caused by dexmedetomidine.
D. It provides faster recovery than sevoflurane.
E. It prevents the accumulation of injectable agents and allows easier adjustment of anaesthetic depth.
F. Both B and E.

CORRECT ANSWER

PIVA offers a balanced approach combining injectable and inhalant anaesthesia. Low-dose isoflurane with alfaxalone and dexmedetomidine infusions provides stable anaesthetic depth while reducing volatile requirements (MAC-sparing effect). This minimises cerebral vasodilation and intracranial pressure increases associated with high isoflurane concentrations and, compared with TIVA, allows easier titration of depth and smoother recovery—particularly advantageous when sevoflurane is unavailable.