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CASE REPORT

Companion or pet animals

# Continuous mandibular nerve block as sole analgesia for postoperative pain management after a hemimandibulectomy in a French Bulldog

**Adrià Aguilar-Catalan**[1] | **Laura Fresno Bermejo**[1] | **Pamela J. Murison**[2]

[1] Hospital Clínic Veterinari, Universitat Autònoma de Barcelona, Bellaterra, Barcelona, Spain

[2] University of Glasgow School of Veterinary Medicine, Glasgow, UK

**Correspondence**
Adrià Aguilar-Catalan, Hospital Clínic Veterinari, Universitat Autònoma de Barcelona, Campus Bellaterra, 08193 Bellaterra, Barcelona, Spain.
Email: adria.aguilar@uab.cat

**Abstract**

A 12-year-old French Bulldog presented for a mandibulectomy due to a large ameloblastoma in the left rostral mandibular body. Preoperative pain management consisted of methadone 0.2 mg/kg and a mandibular nerve block with ropivacaine 0.5%. Intraoperatively, an indwelling perineural catheter was placed through the mandibular canal, with the tip placed in the mandibular foramen for postoperative ropivacaine administration. Ropivacaine 0.2% was administered every 6 hours for the first 36 hours without need of any systemic analgesic administration, providing adequate analgesia and allowing for a rapid recovery. The dog was completely alert and responsive in the immediate postoperative period and started eating 12 hours after surgery without any sign of pain or discomfort. No complications were observed during the postoperative period. The perineural catheter was removed after 40 hours and the dog was administered metamizole every 8 hours for analgesia and was discharged 48 hours after surgery.

## BACKGROUND

Brachycephalic dogs are predisposed to several conditions, such as upper airway obstruction, respiratory compromise, gastrointestinal abnormalities and ocular problems, that increase the anaesthetic-related complications both during the peri-anaesthetic management and in the postoperative period, increasing hospitalisation stays.[1] In brachycephalic breeds, it is crucial to achieve a fast recovery, avoiding excessive sedation or muscle relaxation, which will allow the animal to maintain airway patency and protect against aspiration of gastric fluids.[1] At the same time, it is vital to achieve good pain control, as this can help minimise complications by promoting earlier ambulation and normal physiological functions.[1] Similarly, geriatric patients may have decreased metabolic compensatory mechanisms, decreased respiratory and cardiovascular function and altered body composition, which may predispose them to a higher anaesthetic risk and longer recovery times.[2] Special considerations such as a decreased gastrointestinal transit time, which may increase the risk of regurgitation, decreased drug metabolism and increased risk of hypothermia and hypoxia, increases the risk of intra- and postoperative complications.[2] Whenever possible, local and regional anaesthesia should be used in these patients to allow for a fast anaesthetic recovery from anaesthesia and increased hospital length stay.[2]

Postoperative analgesia is often based on the administration of opioids, non-steroidal anti-inflammatory drugs (NSAIDs) and local anaesthetics. Opioids are considered a cornerstone of pre-, intra- and postoperative analgesia because of their high analgesic efficacy.[3,4] Opioids are usually combined with NSAIDs, used to treat postoperative pain and inflammation by inhibition of the cyclooxygenase (COX) enzymes 1 and 2.[5] Peripheral nerve blocks, using local anaesthetics, have proven a vital component of a multimodal analgesia approach. Single-shot peripheral nerve blocks may then be used for intraoperative and immediate postoperative pain management in which postoperative pain may not last longer that 12–24 hours.[6,7] If longer postoperative pain is expected, the use of continuous peripheral nerve blocks (cPNB) using a perineural catheter is a highly recommended adjunct or substitute to systemic drugs to improve pain management.[7] The mandibular nerve, a branch of the trigeminal (fifth cranial nerve), provides sensory fibres to the hard and soft tissues of the mandible and motor fibres to the masticator and mylohyoid muscles.[8] Various local anaesthetic techniques involving different branches of the mandibular nerve have been described to achieve analgesia in specific locations of the mandible.[6,8] However, to achieve complete desensitisation of the mandible, a proximal mandibular nerve block, including the blockade of the mylohyoid, the lingual and the inferior alveolar nerves, is reported to be the best approach.[6,8] In human medicine, cPNB of the mandibular nerve in patients with orofacial cancer pain or mandibular fractures has been described.[9–11] In veterinary medicine, a continuous mandibular nerve block using an epidural catheter placed in the mandibular canal has been reported in an alpaca.[12] Postoperative cPNB may then be used in an effort to reduce opioid use and decrease

or exclude opioid-associated adverse effects,[12,13] especially in patients that may benefit from a rapid recovery.

The present case report describes the postoperative pain management using a perineural indwelling catheter in the mandibular canal as the only method for analgesia administration in a rostral hemimandibulectomy in a geriatric French Bulldog.

## CASE PRESENTATION

A 12 year-old, 14-kg, neutered, male French Bulldog presented to the surgery department in the Hospital Clínic Veterinari, Universitat Autònoma de Barcelona, with a large mass in the left cranial mandibular body with occasional bleeding. The mass had been diagnosed previously by biopsy as an odontogenic ameloblastoma. The dog presented with inappetence and weight loss. Previous medical history includes a hemilaminectomy due to intervertebral disc disease at the age of 6 years. At the age of 9 years, the dog underwent an orchidectomy due to a seminoma. Additionally, when the animal was 11 years old, a urethrostomy was performed due to urinary obstruction.

## TREATMENT

The dog was accepted for general anaesthesia, imaging investigation and surgery.

On the day of anaesthesia, the physical examination showed a poor body condition (body condition score of 3 out of 9) and referred upper airway stertor auscultated in all lung fields. The dog was aggressive, and did not allow any manipulation without sedation. Haematology revealed a mild decrease in haematocrit (33%), a decrease in erythrocytes count (5.3 M/$\mu$l) and a decrease in haemoglobin concentration (12.1 g/dl) with an increase in the platelet count (576,000/$\mu$l). The biochemistry was normal.

The dog received omeprazole (1 mg/kg) and maropitant (1 mg/kg) the day before surgery.

Preanaesthetic medication consisted of acepromazine (0.025 mg/kg) and methadone (0.3 mg/kg) intramuscularly (IM). Twenty minutes after preanaesthetic medication, the sedation was considered sufficient, and a 20 G over-the-needle catheter was placed in the left cephalic vein. As a difficult intubation was suspected, the dog was preoxygenated for 5 minutes before induction, which was accomplished with 2 mg/kg intravenous (IV) propofol. Intubation was successfully performed with a 6-mm internal diameter cuffed endotracheal tube and the dog was connected to a circle rebreathing system. Anaesthesia was maintained with isoflurane in 100% oxygen (0.7–1 L/min). Monitoring consisted of electrocardiography, capnography, oscillometric noninvasive blood pressure, pulse oximetry and oesophageal temperature.

On the computed tomography (CT), a large mass was observed occupying the mid to rostral part of the left mandibular body with severe osteolysis and bone destruction (Figure 1). However, the caudal part of the mandible body appeared intact with no signs of mass infiltration or osteolysis. As the tumour had defined margins and was not invading nearby structures, a left rostral hemimandibulectomy was considered rather than a more palliative approach. After owner's consent, the animal was prepared for surgery.

**LEARNING POINTS/TAKE-HOME MESSAGES**

- The use of a continuous peripheral nerve block allowed for a rapid recovery after anaesthesia with a rapid functional recuperation.
- Local anaesthetic administration through perineural catheters may be used as a sole postoperative means of pain management in certain patients.
- Pain scoring is mandatory if a continuous peripheral nerve block is used to avoid inadequate pain control.
- No complications were observed due to the perineural catheter or ropivacaine administration.

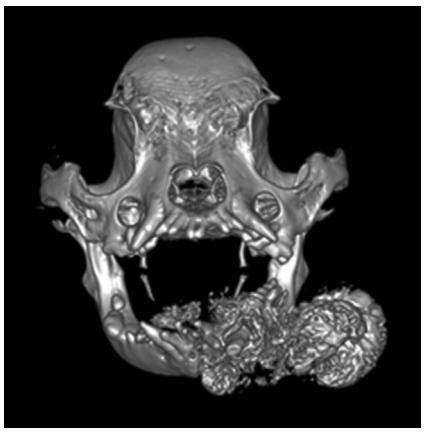

**FIGURE 1** Computed tomography image of the odontogenic ameloblastoma

Before surgery, a 22 G arterial catheter was placed in the right dorsal pedal artery for invasive arterial blood pressure monitoring.

Once clipped and aseptically prepared, a proximal mandibular nerve block using a nerve locator was performed.[6] Anatomic landmarks for the nerve location were the caudoventral aspect of the zygomatic arch and the temporomandibular joint. A 21-gauge, 40 mm stimulating needle was inserted rostral to the temporomandibular joint in a caudo-rostral direction. The stimulating current was set at 1 mA. The needle was advanced until the contraction of the digastricus, pterygoideus and the masseter muscles, as well as movement of the jaw were elicited. The stimulating current was then reduced, and the local anaesthetic was delivered when no stimulation was elicited at 0.3 mA. The mandibular nerve block was accomplished with 0.5 mg/kg ropivacaine 1% (0.7 ml) diluted with water for injection to a final concentration of ropivacaine 0.5% and a total volume of 1.4 ml. Cefazoline (25 mg/kg IV) was administered before surgery. Fluid therapy was started with lactated Ringer's solution at 5 ml/kg/h. Surgery lasted for 120 minutes. Anaesthesia started uneventfully, heart rate was between 130 and 140 beats per minute, respiratory rate was from 15 to 25 breaths per minute and mean arterial blood pressure (MAP) was maintained between 65 and 75 mmHg. Fifty minutes after the start of surgery, blood pressure gradually decreased over 10 minutes

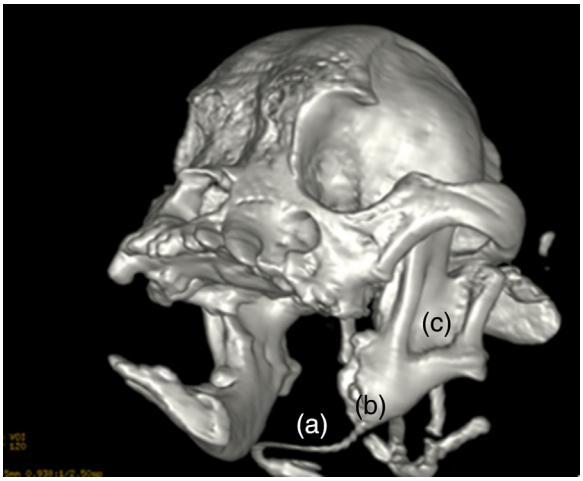


**FIGURE 2** Computed tomography image of the catheter placed after the rostral hemimandibulectomy. (a) Diffusion catheter entering the mandibular canal. (b) Entrance of the mandibular canal in the mandibular remnant. (c) Mandibular ramus

from a MAP of 68 to 54 mmHg, and heart rate increased to 146 beats per minute. As haemorrhage was deemed significant, blood loss was estimated to be 340 ml at that time and a crystalloid bolus (20 ml/kg administered over 20 minutes) together with hypertonic saline (2 ml/kg bolus in 15 minutes) were administered. This resolved hypotension, increasing MAP to pretreatment values and decreasing heart rate to 115 beats per minute. From that point, anaesthesia was uneventful. During surgery, the dog received methylprednisolone (1 mg/kg IV), and a second dose of cefazoline (25 mg/kg).

After the mandibulectomy, a perineural diffusion catheter was introduced through the mandibular canal. A 16 G, 30 cm long polyurethane catheter was used, with a 10 cm dispersion area with micropores. The mandibular canal was identified by the surgeon at the rostral end of the mandibular remnant and the catheter was introduced through it in a rostro-caudal direction. The catheter was advanced until the tip was sensed by palpation exiting through the mandibular foramen in the mandibular ramus. The 10 cm dispersion area was observed to be all within the mandibular canal. Once in place, the rostral end of the catheter was tunnelled subcutaneously to the ventral and rostral remaining part of the mandible. The external part of the diffusion catheter was then turned caudally, and its distal end was sutured to the skin of the neck with a Roman sandal tie, allowing for local anaesthesia to be administered safely during the postoperative period. After the perineural catheter placement, the surgical incision was closed. A postoperative CT was performed to confirm the catheter position passing through the mandibular canal, emerging from the mandibular foramen (Figure 2). An Elizabethan collar was used as the animal was aggressive, and to avoid dislodging or accidentally distracting the perineural catheter.

Anaesthetic recovery was uneventful. Postoperative treatment consisted of methylprednisolone (1 mg/kg IV every 24 hours), amoxicillin-clavulanic acid (22 mg/kg IV every 8 hours), maropitant (1 mg/kg SC every 24 hours) and omeprazole (1 mg/kg IV every 12 hours). Analgesia was accomplished with 0.3 mg/kg of ropivacaine 0.2% (0.15 ml/kg and a total volume of 2.1 ml) through the catheter every 6 hours. Once recovered, the dog was pain scored using the Glasgow Composite Pain Scale - Short Form (GCPS-SF). Pain scoring was then performed by the first author (AdriàAguilar-Catalan) 2 hours postoperatively, and again every 4 hours after for the first 12 hours. All scores were between 1 and 2 out of 24 with no requirement for rescue analgesia during the first hours after surgery. All physical examinations were normal, and the dog remained comfortable with no signs of pain or discomfort during the night. Moreover, the dog's behaviour improved, allowing surgical site palpation and wound cleaning with no signs of aggression.

## OUTCOME AND FOLLOW-UP

Twelve hours after the end of surgery, the dog started eating. Pain scoring was continued every 12 hours, with no increase in the pain scoring at any evaluation time. The cephalic IV catheter was removed 16 hours after surgery as the dog was eating and drinking, with no signs of discomfort. Metamizole (25 mg/kg PO every 8 hours) was started 24 hours after surgery. All physical examinations remained normal during the first day.

Ropivacaine instillation was stopped 32 hours after surgery. Pain scoring was performed at 8:00 AM (40 hours after surgery) with a score of 1/24. Omeprazole and maropitant were stopped and metamizole (25 mg/kg PO) was continued every 8 hours. As pain scores were low, the perineural catheter was removed and the dog was discharged in the afternoon, 48 hours after surgery. Ambulatory treatment consisted of prednisone 1 mg/kg PO every 24 hours for 2 days, followed by a decreasing dose protocol, metamizole (25 mg/kg PO every 12 hours) was continued for 2 days and amoxicillin-clavulanic acid (22 mg/kg PO every 12 hours) was continued up to 10 days postoperatively.

## DISCUSSION

The present case report describes the use of a perineural diffusion catheter placed in the mandibular canal during surgery for postoperative pain control. To the authors' knowledge, this is the first report of a perineural catheter as the sole postoperative analgesia after a mandibulectomy in a dog.

Mandibulectomies are considered severely painful surgical procedures, which often need high doses of systemic analgesics, such as pure μ agonist opioids, increasing the risk of side effects associated with these drugs. The use of local and regional anaesthesia produces numerous benefits, such as reduced opioid use, fewer opioid-related side effects, reduced length of hospital stay, faster rehabilitation and patient satisfaction in human beings.[7,14] Local anaesthetics reversibly block voltage-gated sodium channels in the neurons to reduce excitability. The transmission of noxious stimuli to the spinal cord and brain is prevented, thus providing analgesia.[15] Mandibular nerve block can be used to improve pain management and increase quality of life in patients with mandibular fractures or tumours.[6,9–12]

The animal described in this case report was a brachycephalic geriatric dog with inappetence and weight loss. Due to the dog's condition, our main objective was to enhance the recovery and promote a fast return to normal function by providing adequate pain management and avoiding excessive postoperative sedation. cPNBs using indwelling perineural catheters for pain management in mandibular fractures

and cancer pain have been described in human medicine with good results.[9–11] In veterinary medicine, Stathopoulou et al. reported the management of a mandibular body fracture in an alpaca with cPNB.[12] In that case report, an alpaca presented with a mandibular body fracture due to a dental root abscess. Pain was not controlled with the use of buprenorphine and meloxicam according to the alpaca's clinical appearance. To improve pain management, an epidural catheter was placed under CT guidance for an inferior alveolar nerve block. The epidural catheter was introduced through the mandibular foramen in a caudo-rostral direction until the tip of the catheter lay in the mandibular canal. One millilitre of ropivacaine 0.75% was administered every 6 hours and systemic analgesics were discontinued. After catheter placement and ropivacaine administration, the alpaca seemed brighter and more responsive, and started eating. The catheter was left in place for 10 days and no complications due to the catheter placement were observed. However, after sedation for wound debridement, the alpaca became distressed and dysphagic, and an aspiration pneumonia was suspected. Euthanasia was performed due to the guarded prognosis of the case.[12] Therefore, although euthanasia was performed due to the poor prognosis and continuing disease processes, the placement of a perineural indwelling catheter in the mandibular canal for the intermittent administration of local anaesthetic was considered an excellent way to provide analgesia, avoiding systemic analgesia administration.

Benefits of cPNB include a direct analgesic effect by blocking the transmission of pain from the affected area, allowing for a dramatic decrease in supplemental opioid therapy and a decrease in opioid-related side effects as well as enhanced postoperative recovery.[12,14] Opioids have been associated with multiple adverse effects, such as sedation, nausea, vomiting, respiratory depression and urinary retention as well as opioid-induced hyperalgesia, in both human and veterinary medicine,[16,17] and may prolong recovery and return to normal function in patients with previous physiological decline in organ functions or in their mechanisms of compensation.[2,18] Therefore, in this brachycephalic geriatric dog, it was considered best to avoid potential opioid adverse effects by using local anaesthetic perineural administration and to reserve opioid analgesics as rescue analgesia if needed. Due to this dog's temperament, it was considered that avoiding opioids would help in encouraging activity and avoiding ileus/decreased gut activity to allow a rapid return to normal function (in order to be able to discharge the dog to the owner's care). NSAIDs also provide good analgesia for postoperative inflammatory pain without sedation or delayed recovery, but they may increase the risk of gastrointestinal, renal or liver complications.[5] Moreover, NSAIDs could not be used in the present case as corticosteroids were being administered concurrently.[5,19] Therefore, it was decided to administer 0.3 mg/kg ropivacaine 0.2% every 6 hours and to pain score the animal using GCPS-SF intermittently. No additional systemic analgesics were required during the first 24 hours after surgery. Administration of metamizole, a COX 3 inhibitor and endogenous opioid and endocannabinoid system activator,[20] was started before discharge to provide ambulatory analgesia. The timing ensured adequate onset before perineural catheter removal.[20,21]

cPNB catheters are not without complications. The complications reported in the literature include obstruction, dislodgement, leakage, disconnection, irritation or allergic reactions, as well as inaccurate tip placement, infections, cardiovascular and central nervous system local anaesthetic toxicity and neurological complications such as nerve injury.[14] Specific mandibular block complications include diplopia, temporary loss of vision, ophthalmoplegia, ptosis, mydriasis and periorbital blanching.[12] However, in the present case, no complications were observed neither during placement nor during the postoperative management of the perineural catheter.

Ropivacaine was chosen as the local anaesthetic agent in this case. Several reasons were considered when choosing ropivacaine as the analgesic agent. Ropivacaine has a long duration of action, longer than lidocaine and similar to bupivacaine, ranging from 180 to 480 minutes in the dog. However, ropivacaine analgesia has been reported to last up to 10 hours in a mandibular block in a dog, so a longer interval between administrations may be possible.[7] Ropivacaine also shows increased cardiovascular and nervous system safety profile with less accumulation.[22,23] This feature is especially important in cPNB as repeated doses of the drug are administered over time so increased plasma concentrations of the drug may reach toxic concentrations. Finally, ropivacaine shows a greater degree of differential block than other local anaesthetics due to its decreased lipophilicity when compared to other local anaesthetics. Ropivacaine is less likely to penetrate, and therefore to block, large, myelinated fibres such as motor A$\beta$ fibres. This may be beneficial in the case of nerves with sensory and motor fibres such as the mandibular nerve,[22,23] which is important in masticatory muscle movement.

Local anaesthetic administration may cause nerve injury, via mechanical, ischaemic or chemical factors. Nerve injury may lead to neurological deficits that tend to be transient. Mechanical or ischemic damage could occur with pressure on nerves or on the blood vessels supplying those nerves. Direct neurotoxicity is thought to be related to the physicochemical properties of local anaesthetics, composition, the concentration of local anaesthetic administered and the duration of the administration; however, the cellular mechanisms leading to the nerve damage are still not clear.[15,24] A low concentration of ropivacaine was used in the present case report, as it is the usual ropivacaine concentration used by the first author in postoperative nerve blocks. Low concentration of local anaesthetics is thought to reduce local anaesthetic nerve damage.[12] This low concentration was effective to provide analgesia, probably due to the proximity of the catheter to the mandibular nerve. In Stathopoulou et al., 1 ml of ropivacaine 0.75% was administered every day for 10 days in an alpaca, with no abnormal postmortem mandibular nerve histopathological findings observed.[12] Thus, the lower ropivacaine concentrations and shorter duration of use in the present case report are not expected to have caused any nerve damage. Using a low concentration of drug enabled a larger volume of ropivacaine to be used, which may have been beneficial to ensure adequate spread along the mandibular nerve.

During surgery, hypotension developed, associated with active haemorrhage due to the mass resection. Bleeding was assessed by looking at the surgery drapes and swabs, as well as the amount of blood in the suction container.[25] The total amount was considered to be 340 ml approximately, which accounted for nearly 30% of the dog's estimated circulatory volume. Blood products were not available immediately, so an initial bolus of crystalloids and hypertonic saline 7.5%

were administered. Hypertonic saline produces a greater volume expansion than the volume administered and has been recommended in animals for initial management of haemorrhage.[26] In the present case, fluid therapy improved cardiovascular variables and transfusion was withheld in case of further intraoperative blood loss or postoperative decreased blood volume were observed.

In conclusion, the administration of 0.3 mg/kg ropivacaine 0.2% (total volume 2.1 ml) every 6 hours through a perineural indwelling catheter placed in the mandibular canal to block the mandibular nerve was found to be an effective means of providing analgesia after a mandibulectomy in a dog. The animal recovered uneventfully, with no complications associated with catheter placement, which allowed for a rapid return to normal function after surgery.

## CONFLICT OF INTEREST

The authors declare they have no conflicts of interest.

## ETHICS STATEMENT

All legal and ethical requirements were met in the present study in regards to the humane treatment of the animal described in this paper.

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## ORCID

*Adrià Aguilar-Catalan* https://orcid.org/0000-0003-2403-9383

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