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PERIANAESTHETIC MANAGEMENT OF CANINE PATIENTS THAT UNDERWENT HEMILAMINECTOMY FOR MEDULLAR COMPRESSION

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Abstract

This study presents the perianaesthetic management for eight dogs, aged between 3 and 9 years old that underwent a hemilaminectomy surgical procedure for medullar decompression. The patients were presented at the Faculty of Veterinary Medicine in Bucharest for acute onset of posterior unilateral paresis. Following the examination through magnetic resonance imaging, medullar compression was diagnosed at different thoraco-lumbar levels and surgery was recommended (hemilaminectomy). Four of the patients were premedicated with Fentanyl 3 μg/kg and Midazolam 0.2 mg/kg administered intravenously (IV) and the other four received Dexmedetomidine 2 μg/kg, Butorphanol 0.2 mg/kg and Ketamine 2 mg/kg intramuscularly (IM). For induction Propofol was administered IV at a dose of 3 mg/kg and patients were intubated. All patients had an epidural anaesthesia with Lidocaine (2 mg/kg). Maintenance consists in the administration of a constant rate infusion (CRI) of Fentanyl (3 μg/kg per hour) and Ketamine (1 mg/kg per hour) for the first four patients and a CRI of Lidocaine (3 mg/kg per hour) and Ketamine (1 mg/kg per hour) for the other four patients. Post-surgery multimodal analgesia protocols ensured pain control during recovery.

***Key words**: analgesia, perianaesthetic management, hemilaminectomy.*

INTRODUCTION

Intervertebral disc disease is a condition where the nucleus pulposus of the intervertebral disc extrudes into the spinal canal causing compression of the spinal cord (Jeffery et al., 2013). Clinical signs depend on the location of the injury and are always associated with manifestations of acute pain. Part of the perianaesthetic management is represented by a good pain management during and also after surgery (Buvanendran et al., 2009).

Sedative agents may be given by intravenous (IV), intramuscular (IM), subcutaneous (SC) and oral routes based on their pharmacokinetic profiles. An IV catheter will be put in place, facilitating IV administration of sedative agents, which will aid in using lowered doses of these drugs. Some sedatives (alpha 2 agonists) will be more beneficial in aggressive animals until IV access is established.

Dexmedetomidine is the active dextro-isomer of the previous medetomidine formulation. Higher doses are indicated to achieve sedation in smaller dogs and lower doses for larger dogs. Doses can be given IM or IV, but the patient should be left undisturbed for 15 minutes for sedation until effect. Decreased doses of dexmedetomidine can be considered in combination with opioid analgesics (Tang et al., 2011).

Due to the widespread location of alpha2 receptors, their effects could promote analgesia at many levels of the pain pathway (Murrell, 2005).

Diazepam and midazolam are most commonly used as sedatives or as co-induction agents in small animal practice. Benzodiazepines are commonly administered with an opioid in sick patients to reduce the risk of excitement. The main reasons for using a co-induction agent with an injectable anesthetic agent are to smooth the overall induction process enabling endotracheal intubation without swallowing or coughing, minimize the negative side effects of propofol and also providing analgesia for the beginning of the procedure (Skelding, 2021).

Fentanyl is a synthetic mu-agonist of rapid onset and short duration. Low doses of fentanyl (1-5 μg/kg IV) result in short duration of analgesic effects (20-30 minutes) because of rapid lowering of the plasma therapeutic

analgesic concentrations, but higher doses can prolong the analgesia to more than 1 hour with a single bolus (Vanderah, 2010).
Bradycardia or associated bradyarrhythmia can be noticed in patients after IV bolus administration and is likely with higher doses. To avoid these effects, you can titrate the initial dose of fentanyl to effect and continue with this dose as a constant rate infusion (3-6 μg/kg/h) (Vanderah, 2010).
Butorphanol is a mixed kappa agonist-μ antagonist opioid. It offers analgesic and sedative effects, but it antagonizes the actions of mu-agonists if administered simultaneous. A pure mu-agonist can be administered for supplemental analgesia an hour after butorphanol administration (Feng et al., 2012).
Lidocaine is primarily used for loco-regional anesthesia, but it is also used as an infusion during anaesthesia to reduce the inhalant required to maintain anaesthesia. Lidocaine has been shown to alleviate neuropathic pain and hyperalgesia and to reduce opioid requirements following surgery when administered as a constant rate infusion (Gutierrez-Blanco et al., 2015). A constant rate infusion (1-3 mg/kg per hour) can be used intraoperatively to reduce the inhalant requirements or post-operatively in combination with opioid and ketamine for the severely painful patient (Gutierrez-Blanco et al., 2015). Ketamine is an adjunctive analgesic recommended for use in a multi-modal regimen for treatment of severe pain (Pozzi et al. 2006).
The analgesic dose is much lower compared with dose that is used for anaesthesia. Ketamine is an NMDA receptor antagonist with anti-hyperalgesic component and as part of a multimodal analgesia protocol reduces the need for opioids post-operatively and the potential adverse effects associated with higher dosages of this class of analgesics when managing severe pain (Costea, 2016).
The aim of this study was to evaluate the perianaesthetic management of eight canine patients that underwent hemilaminectomy and also, the postoperative analgesic effect of fentanyl and meloxicam drug combinations.

MATERIALS AND METHODS

Eight canine patients aged between 3 and 9 years old were presented at the Faculty of Veterinary Medicine in Bucharest for acute onset of posterior bilateral paresis. Breeds presented in the study were represented by crossbreed (3 patients), French Bulldog (3 patients) and Shih Tzu (3 patients) (Figure 1).

Figure 1. A 8-year-old dog, male, cross-breed with medullar compression at L1-L2 level

We excluded from the study aggressive dogs and those that had cardiac, renal or hepatic disease.
Complete clinical evaluation and preanesthetic blood tests were performed along with echocardiology. After complete clinical and neurological assessment of the patients, MRI examination was performed under general anaesthesia and continuous monitoring (Tudor, 2018) at thoraco-lumbar levels (Figure 2).

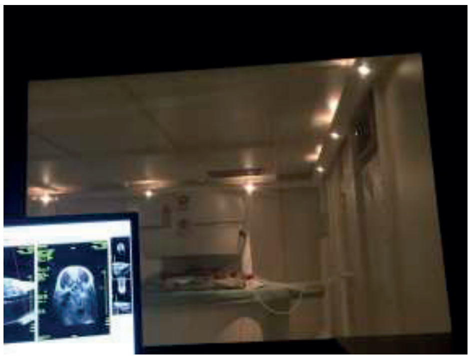

Figure 2. Magnetic Resonance Imaging scan of a 9-year-old dog for medullar compression at thoraco-lumbar level

Following MRI, medullar compression was diagnosed at different thoraco-lumbar levels: T11-T12, T12-T13, T13-L1 and L1-L2 and surgery was recommended (Neagu et al., 2018) (Figures 3-5).

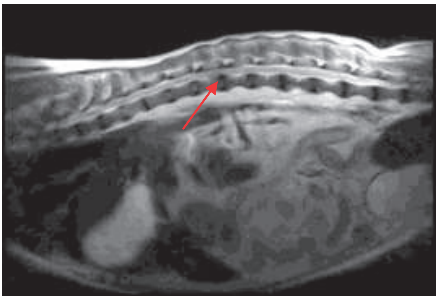

Figure 3. T2 sequence in sagittal plain, medullar compression at T13-L1 level

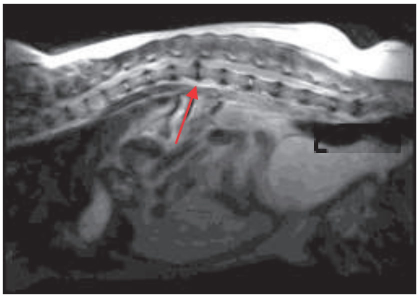

Figure 4. T2 sequence in sagittal plain, medullar compression at L1-L2 level

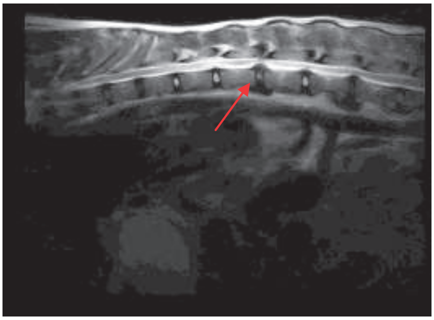

Figure 5. T2 sequence in sagittal plain, medullar compression at T13-L1 level

Prior to surgery intervention, all patients were fasted for 12 hours but had free access to water one hour before premedication. All patients had a peripheral catheter in the cephalic vein.
Five minutes before premedication, baseline values for heart rate (HR), respiratory rate (RR) and rectal temperature were recorded.
Following preanesthetic evaluation two groups were created depending on the anesthetic and analgesic drugs that we intended to use.
American Society of Anesthesiologists (ASA) risk scale scores were recorded for each patient and were included in this study dogs with an ASA score of II.
For the first group (FM) with a total number of 4 patients, age between 6-9 years old, belonging to different breeds (French Bulldog - 2 patients who had medullar compression at T11-T12 and T12-T13; Crossbreed - 2 patients (Figure 6) with medullar compression at T13-L1 and L1-L2 level), premedication with Fentanyl 3 µg/kg and Midazolam 0.2 mg/kg was administered intravenously (IV).

Figure 6. A 9 year old dog, cross-breed male with medullar compression at T13-L1 level

For the second group (DBK) with a total number of 4 patients with age between 3-5 years old belonging to different breeds (French Bulldog - 1 patient with medullar compression at T11-T12 level, Crossbreed - 1 patient with medullar compression at L1-L2 and Shih Tzu - 2 patients with medullar compression at T12-T13 and T13-L1 levels) premedication was made with Dexmedetomidine 2 µg/kg, Butorphanol 0.2 mg/kg and Ketamine 2 mg/kg administered intravenously (IV).
Induction was made with Propofol 3-5 mg/kg intravenously. Patients were intubated and anaesthesia was maintained with Isoflurane and 100% Oxygen.
Spontaneous or intermittent positive-pressure ventilation (IPPV) were maintained by the use of a volume-cycled ventilator delivering 12-15 breaths/minute to achieve a target end-tidal CO_2 of 35-45 mm/Hg. Oxygen flow was initially delivered at 2 L/min with the vaporizer set to achieve an end-tidal concentration C% of 2.0% isoflurane within 10 minutes of induction. After the target concentration was achieved,

oxygen flow was decreased to (500 + 10/kg) L/min, and isoflurane was constantly maintained at 1.5 vol. % in all cases.

For both groups anesthesia protocols were completed with a regional epidural block with Lidocaine (2 mg/kg).

The first group of patients (FM) received for anaesthesia maintenance a constant rate infusion (CRI) of Fentanyl (3 μg/kg/h) and Ketamine (1 mg/kg/h) and for the second group (DBK) a CRI of Lidocaine 3 mg/kg/h and Ketamine 1 mg/kg/h (Tudor R., 2019). Vital signs of the patients were recorded every 5 minutes after induction and until the extubation of the patients. We recorded EKG, heart rate, $EtCO_2$, SpO_2, pulse rate, mean arterial pressure and esophageal temperature (Figure 7).

Figure 7. Patient monitoring

An electric blanket was used to maintain the temperature between 38-39°C.

At the beginning of the surgery (Figure 8), during skin incision if the patient reacted to surgical stimulation by a rapid increase of the heart rate, mean arterial pressure or signs of tachypnea additional analgesic and anaesthetic drugs boluses were given: Fentanyl 3 μg/kg IV, Ketamine 1 mg/kg IV.

Figure 8. Medullar decompression in a 9 year old male at T13-L1 level, intraoperatory hemilaminectomy aspect

At the end of the surgery the Isoflurane was turned off. Dolichocephalic dogs were extubated when they began to breathe spontaneously and had palpebral reflex. Brachycephalic dogs were extubated when they had signs of awareness, chewing on the endotracheal tube (Figure 9).

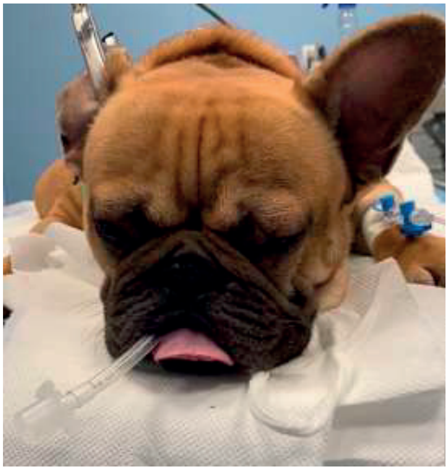

Figure 9. Patient awakening

The patients were moved into the intensive care unit (ICU) where they received as analgesia a bolus of Fentanyl at 3μg/kg and a CRI of Fentanyl (3 μg/kg per hour IV) and Meloxicam 0.2 mg/kg SC every 24 h.

RESULTS AND DISCUSSIONS

Two treatment groups were created with a total number of eight patients. Breed of dogs included mixed breed dogs (n = 3), French Bulldog (n = 3) and Shih Tzu (n = 2) (Figure 10).

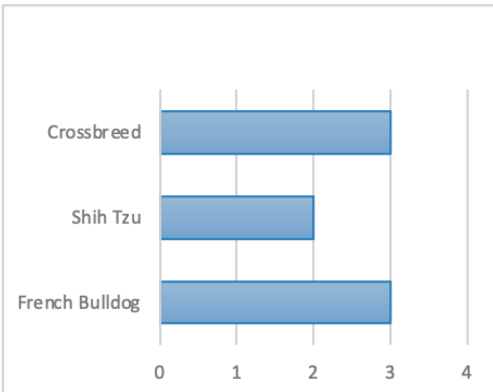

Figure 10. Data about animals included in the study

The perianaesthetic protocols were efficient for pain control throughout the study period. Two dogs from Group 2 (DBK) received additional analgesia during surgery represented by a bolus of Ketamine (1 mg/kg IV) because of a more than 20% increase in the mean arterial pressure and also heart rate.

The anesthesia time for group 1 (FM) had a mean time of 59 minutes (from the time we intubated the patients till the extubation). For group 2 (DBK) mean anesthesia time was of 58 minutes (Figures 11 and 12).

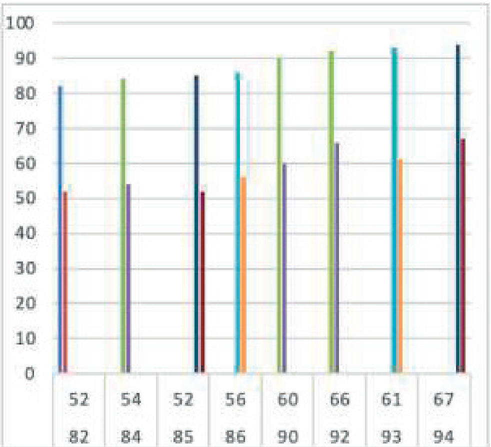

Figure 12. Anesthesia and surgery time for each animal

Figure 13. Patient with no pain manifestation 1 hour after surgery

The results for the groups were compared and analyzed at 12 hours after the first administration.

All dogs were observed for adverse reactions following pain medication therapy. Records of pain manifestation for each patient were assessed at 15 min, 30 min, 45 min, 1, 2, 6 and 12 hours after the analgesic drug was given. All patients were evaluated using the Glasgow Composite Pain Scale (GCPS). Behavior categories used to assess pain included vocalization, attention to wound area, mobility, response to touch, demeanor and posture/ activity. A categorical score was assigned within each behavior category based on the severity of the behavior or the response observed (Table 1). Potential cumulative pain scores ranged from 0 (least painful) to 23 (most painful). To ensure interpretative consistency, a single person was trained in evaluating the dogs for pain. The person first observed the dog`s behavior from a distance so as not to disturb the dog, then the assessor increased his interaction with the dog, including manipulation of the surgical site and removing the dog from the cage.

Table 1. Glasgow Composite Pain Scale (GCPS)

Behavior Category	Score	Definition
Vocalization	0	Quiet
	1	Whimpering or crying
	2	Groaning
	3	Screaming
Attention	0	Ignoring
	1	Looking
	2	Rubbing
	3	Chewing
Mobility	0	Normal
	1	Lame
	2	Slow or reluctant
	3	Stiff
	4	Refuses to move
Response to touch	0	Do nothing
	1	Looks around
	2	Flinch
	3	Growl or guard area
	4	Snap
	5	Cry
Demeanor	0	Happy and content and bouncy
	1	Quiet
	2	Indifferent or nonresponsive to surroundings
	3	Nervous, anxious or fearful
	4	Depressed or nonresponsive to stimulation
Posture/activity	0	Comfortable
	1	Unsettled

In the intensive care unit (ICU) patients were in a steady plane with no further analgesic requirements (Figure 14).

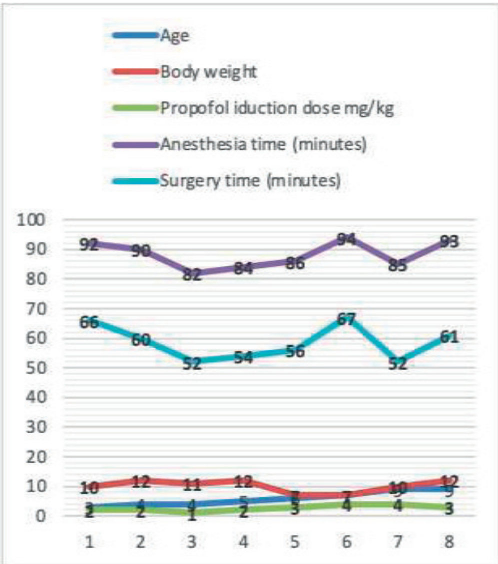

Figure 14. Description of patients anesthetized for hemilaminectomy at thoraco-lumbar level

At discharge all patients received Meloxicam 0.2 mg/kg per os for 5 days along with Tramadol 3 mg/kg every 12 h for 3 more days. A multimodal approach is recommended as this helps minimize the side effects that may occur (Costea, 2016).

CONCLUSIONS

Premedication with Fentanyl and Midazolam, induction with Propofol and maintenance with Isoflurane and a CRI of Fentanyl and Ketamine represents a good multimodal analgesic pain for patients that underwent hemilaminectomy.
Very important in order to achieve a good level of analgesia and a predictable recovery of the patient is represented by a good and well documented perianaesthetic management during hemilaminectomy for medullar decompression.

REFERENCES

Buvanendran A., Kroin J.S. (2009). Multimodal analgesia for controlling acute postoperative pain. *Curr Opin Anesthesiology*, 22:588–93.

Costea, R. (2016). Anesthesia considerations for critically ill patients. *Analgesia for the emergency/critical care patient - part 1: Pain assessment 4-7*, *26*, 27.

COSTEA, R., DEGAN, A., & TUDOR, R. (2017). Crystalloids/colloids ratio for fluid resuscitation during anesthesia. *Scientific Works. Series C. Veterinary Medicine*, *63*(1), 65–66.

Feng, Y., He, X., Yang, Y., Chao, D., H Lazarus, L., & Xia, Y. (2012). Current research on opioid receptor function. *Current drug targets*, *13*(2), 230–246.

Gutierrez-Blanco E, Victoria-Mora JM, Ibancovichi-Camarillo JA et al. (2015). Postoperative analgesic effects of either a constant rate infusion of fentanyl, lidocaine, ketamine, dexmedetomidine, or the combination lidocaine-ketamine-dexmedetomidine after ovariohysterectomy in dogs. *Veterinary Anaesthesia and Analgesia*, 42, 309–318.

Jeffery N.D., Levine J.M., Olby N.J. et al. (2013) Intervertebral disk degeneration in dogs: consequences, diagnosis, treatment, and future directions. *Journal of Veterinary Internal Medicine*, 27, 1318–1333.

M Savescu, AG Neagu, C Vlagioiu, N Tudor, G Predoi, I Raus, (2017). MRI findings in intervertebral disc disease on thoracolumbar spine in dogs, *Journal of Biotechnology*, 256, S47

Murrell, J. C., & Hellebrekers, L. J. (2005). Medetomidine and dexmedetomidine: a review of cardiovascular effects and antinociceptive properties in the dog. *Veterinary anaesthesia and analgesia*, *32*(3), 117–127.

Neagu, A.G., Săvescu, M., Tudor, R.G., Tudor, N. and Vlăgioiu, C., 2018. MRI findings of the cervical spine in three beagle dogs. *AgroLife Scientific Journal*, *7*(1), pp. 92–96.

Pozzi, A., Muir III, W. W., & Traverso, F. (2006). Prevention of central sensitization and pain by N-methyl-D-aspartate receptor antagonists. *Journal of the American Veterinary Medical Association*, *228*(1), 53–60.

Skelding, A. M., Valverde, A., & Kilburn, G. (2021). Evaluation of the analgesic effect of fentanyl–ketamine and fentanyl–lidocaine constant rate infusions in isoflurane-anesthetized dogs undergoing thoracolumbar hemilaminectomy. *Veterinary Anaesthesia and Analgesia*.

Savescu, M., Neagu, A. G., Vlagioiu, C., Tudor, N., Predoi, G. and Raus, I. (2017). MRI findings in intervertebral disc disease on thoracolumbar spine in dogs. *Journal of Biotechnology*, *256*, p. S47.

Tang, J. F., Chen, P. L., Tang, E. J., May, T. A., & Stiver, S. I. (2011). Dexmedetomidine controls agitation and facilitates reliable, serial neurological examinations in a non-intubated patient with traumatic brain injury. *Neurocritical care*, *15*(1), 175–181.

Tudor, R., Degan, A., Costea, R., & Predoi, G. (2018). Postoperative analgesic management of geriatric dogs that underwent soft tissue surgery. *Scientific works. Series c. Veterinary medicine*, *64*(2), 82–87.

Tudor, R., Degan, A., Neagu, A. G., Carstinoiu, Ll., & Predoi, G. (2019). Hemilaminectomy for T11-T12 medullar compression-perianaesthetic management of a geriatric dog. *Scientific Works. Series C. Veterinary Medicine*, *65*(1), 94–95.

Vanderah, T. W. (2010). Delta and kappa opioid receptors as suitable drug targets for pain. *The Clinical journal of pain*, *26*, S10–S15.