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Surgical complications associated with hemilaminectomy and intervertebral disc fenestration: Prospective study of 64 dogs

Marcelo Luís Schwab[1] Dênis Antonio Ferrarin[1] Angel Ripplinger[1] Mathias Reginatto Wrzesinski[1] Júlia da Silva Rauber[1] Julya Nathalya Felix Chaves[1] Diego Vilibaldo Beckmann[2] Alexandre Mazzanti[2*]

[1]Programa de Pós-graduação em Medicina Veterinária (PPGMV), Serviço de Neurologia e Neurocirurgia Veterinária (SNNV), Hospital Veterinário Universitário (HVU), Centro de Ciências Rurais (CCR), Universidade Federal de Santa Maria (UFSM), Santa Maria, RS, Brasil. [2]Departamento de Clínica de Pequenos Animais, Programa de Pós-graduação em Medicina Veterinária (PPGMV), Serviço de Neurologia e Neurocirurgia Veterinária (SNNV), Hospital Veterinário Universitário (HVU), Centro de Ciências Rurais (CCR), Universidade Federal de Santa Maria (UFSM), 97105-900, Santa Maria, RS, Brasil. E-mail: alexamazza@yahoo.com.br. *Corresponding author.

ABSTRACT: Hemilaminectomy and intervertebral disc fenestration are commonly used to treat intervertebral disc extrusion (IVDE); however, they are associated with surgical complications. Sixty-four dogs were assessed during the intraoperative, immediate postoperative, and late postoperative periods to evaluate complications resulting from these surgical procedures. During this study, 15.62% (n=10) of the dogs presented with complications during at least one of the evaluations. Iatrogenic rhizotomy, access to the spinal canal contralateral to the lesion, and cardiorespiratory arrest were observed intraoperatively. Abdominal wall flaccidity, neurological worsening, hematoma, dehiscence, and superficial wound infections were observed during the immediate postoperative period. Adverse reactions to the surgical thread, scar adhesion, and superficial wound infection were the most frequent complications during the late postoperative period. Dogs that undergo hemilaminectomy and intervertebral disc fenestration because of IVDE may experience complications during the intraoperative, immediate postoperative, and late postoperative periods. However, these complications are often transitory and rarely cause death.
Key words: herniated disc, intervertebral fenestration, spinal decompression, intervertebral disc extrusion complications.

Complicações associadas à hemilaminectomia toracolombar e fenestração de disco intervertebral: estudo prospectivo em 64 cães

RESUMO: A hemilaminectomia e a fenestração do disco intervertebral são os procedimentos cirúrgicos geralmente empregados no tratamento da extrusão do disco intervertebral (EDIV), os quais podem desencadear complicações cirúrgicas. Foram avaliadas complicações em 64 cães nos períodos intra e pós-operatório imediato e tardio. Dos pacientes incluídos no estudo, 15,62% (n=10) apresentaram alguma ocorrência em pelo menos uma das etapas avaliadas. Das complicações, no período intraoperatório foram observadas rizotomia iatrogênica, abertura do canal vertebral contralateral e parada cardio-respiratória. No pós-operatório imediato foram verificadas a flacidez da parede abdominal lateral, piora neurológica, hematoma, deiscência de ferida cirúrgica e infecção superficial da ferida de pele. No pós-operatório tardio foram verificadas reação ao fio cirúrgico, aderência cicatricial e flacidez da parede abdominal lateral como problemas mais frequentes. Conclui-se que cães submetidos à hemilaminectomia e fenestração do disco intervertebral envolvido em decorrência da EDIV podem apresentar complicações nos períodos intraoperatório, pós-operatório imediato e tardio, sendo transitórias e com mínimas chances de ocasionar óbito.
Palavras-chave: hérnia discal, fenestração intervertebral, descompressão medular, extrusão de disco intervertebral, complicações.

INTRODUCTION

Intervertebral disc extrusion (IVDE) (Hansen type I) is considered one of the main causes of compressive injuries of the spinal cord in dogs (BERGKNUT et al., 2012; DEWEY & DA COSTA, 2016; MOORE et al., 2020). Clinical signs of injury in the thoracolumbar region vary from spinal hyperesthesia to paraplegia without nociception (MOORE et al., 2020). Surgical treatment is warranted for patients with moderate or severe neurological deficits, patients experiencing relapse, and cases refractory to clinical treatment (DEWEY & DA COSTA, 2016). Hemilaminectomy and fenestration of the intervertebral disc are the most common treatments for IVDE (BRISSON, 2017; SHORES, 2017).

The success of a surgical procedure relies on adequate treatment and patient care during the preoperative, intraoperative, and postoperative

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periods (LEXMAULOVÁ et al., 2008). SHARP & WHEELER (2005) summarized the main surgical complications after thoracolumbar hemilaminectomies; however, information regarding the incidence and characteristics of the surgical complications associated with hemilaminectomy and fenestration of the intervertebral disc is limited. Therefore, this study identified the main surgical complications during the intraoperative, immediate postoperative, and late postoperative periods that were experienced by dogs diagnosed with IVDE that underwent hemilaminectomy and intervertebral disc fenestration.

MATERIALS AND METHODS

Dogs of different breeds, different ages, and both sexes with neurological signs attributable to IVDE in the thoracolumbar region that underwent hemilaminectomy and intervertebral disc fenestration performed using techniques described by SHORES (2017) and BRISSON (2017) were included in this study. The animals were evaluated during the intraoperative period (from the beginning of surgery [incision] until the last suture was stitched), immediate postoperative period (from the time when the last suture was stitched until 72 h after surgery), and late postoperative period (between 72 h and 30 days after surgery).

Clinical and neurological examinations and laboratory tests (complete blood count, serum biochemistry and electrolyte test, prothrombin time test, and activated partial thromboplastin time test) were performed during the preoperative period. Computed tomography (CT) or myelography was performed to diagnose extramedullary compression caused by IVDE. Neurological dysfunction was classified as follows: grade I, hyperesthesia only; grade II, proprioceptive deficits, ataxia, and ambulatory paresis; grade III, non-ambulatory paresis; grade IV, paraplegia with nociception; and grade V, paraplegia without nociception (SHARP & WHELLER, 2005).

Hemilaminectomy followed by intervertebral disc fenestration was performed in only one disc space. Surgical complications were considered unwanted events associated with the surgical procedure or occurring during the postoperative period that were confirmed by physical, laboratory, or imaging evaluations. Abnormalities were recorded using specific forms during the intraoperative, immediate postoperative, and late postoperative periods and an interview with the surgeon.

The following information was determined during the intraoperative period: procedure time (min); access to the vertebral canal or intervertebral space in the correct location and on the correct side; intervertebral disc material in the canal after fenestration; pneumothorax; cardiac arrest; iatrogenic injury of the spinal cord; and iatrogenic rhizotomy (SHARP & WHEELER, 2005; BRISSON, 2017; HETTLICH, 2017; SHORES, 2017; DIAMANTE et al., 2020; MOORE et al., 2020).

During the immediate postoperative period, dogs were clinically and neurologically evaluated every 24 h, and the following changes were observed: flaccidity of the abdominal wall; hematoma; systemic or wound infection; suture dehiscence; and worsening of the neurological condition. A hematoma is defined as the accumulation of blood or clots between tissues in the subcutaneous dead space (MANN, 2011). Flaccidity of the abdominal wall refers to the loss of muscle tone and consequent unilateral or bilateral abdominal bulging (SHARP & WHEELER, 2005). Surgical wound infection was defined based on the criteria established by the Centers for Disease Control and Prevention (Atlanta, GA, USA). Infections were considered superficial if positive bacterial culture results were observed and if they occurred within 30 days after the procedure, affected only the skin and subcutaneous tissue, and were accompanied by clinical signs of superficial drainage of purulent discharge. All dogs received an intravenous bolus of prophylactic antibiotics (sodium cephalothin 30 mg/kg) 30 min before surgery and every 2 hours thereafter at the same dosage until the end of surgery.

At 1 month after surgery (the late postoperative period), the patients underwent clinical and neurological evaluations. The complications investigated during this evaluation were signs of systemic or surgical wound infection, adverse reactions to the surgical thread, deformities (adhesions of the incision in the subcutaneous tissue and muscular tissue, atrophy of the epaxial muscles, and flaccidity of the abdominal wall), and worsening of the neurological status.

During the preoperative and immediate postoperative periods, the patients were hospitalized in a kennel, housed in individual cages, and treated by the same professionals. Postoperative analgesia was ensured by the administration of methadone (0.3 mg/kg administered subcutaneously [SC] every 4 hours for 24 hours), meloxicam (0.1 mg/kg administered SC for 3 days), and dipyrone sodium (25 mg/kg administered SC every 8 hours for 5 days). Patients were discharged 3 days after surgery.

The results and frequency of changes observed during each evaluation were tabulated

and subjected to a descriptive analysis. A statistical analysis using a binomial test was performed to evaluate the significance of each complication. Furthermore, each complication was correlated with sex, age, and weight using the chi-square test, with $P < 0.05$ indicating significance.

RESULTS AND DISCUSSION

Sixty-four dogs that underwent hemilaminectomy and fenestration of the intervertebral disc to treat IVDE were included in this study. Of these, 39.06% (n = 25) were male and 60.93% (n = 39) were female. All procedures were performed in the thoracolumbar region (T3 – L3). The mean age, weight, surgical time, and incision size were 5.9 years (standard deviation [SD], ± 1.98 years), 7.85 kg (SD, ± 4.11 kg), 95.55 min (± 30.06 min), and 77.38 mm (± 21.84 mm), respectively. The neurological dysfunction of the 64 dogs was classified as follows: grade II, 1.56% (n = 1); grade III, 6.25% (n = 4); grade IV, 28.13% (n = 18); and grade V, 64.06% (n = 41). No variable (sex, age, weight) significantly influenced the occurrence of complications. Of the 64 patients, 15.62% (n = 10) had at least one complication during at least one of the evaluation periods (Figure 1). The frequency of complications can be explained by the performance of two procedures (hemilaminectomy and fenestration of the intervertebral disc), which increased the probability of complications. The prospective nature of this study, which limited the evaluation methodology, may have contributed to the complication rate, which was higher than that reported by retrospective studies; retrospective studies tend to underestimate the occurrence of complications because the data are not carefully evaluated or recorded (DEKUTOSKI et al., 2010).

During the intraoperative, immediate postoperative, and late postoperative periods, complication rates of 7.81% (n = 5), 10.93% (n = 7), and 6.25% (n = 4), respectively, were observed. Of the 64 dogs, only three (4.69%) experienced complications during all periods; two of those dogs experienced iatrogenic rhizotomy during the intraoperative period and flaccidity of the abdominal wall during the immediate postoperative and late postoperative periods. The complications and their frequencies are presented in figure 1. None of the complications caused death. One dog (1.56%) experienced cardiac arrest during surgery; however, satisfactory recovery was achieved after resuscitation.

During the intraoperative period, the opening of the vertebral canal was contralateral to the lesion in two dogs (3.12%). We believed that this complication was not related to the surgical treatment; instead, it likely resulted from erroneous image interpretation attributable to the limitation of myelography for detecting lateralization of compressions, especially in the presence of edema and contrast failure in the subarachnoid space. Oblique projections are necessary for identifying circumferential lesions in the vertebral canal (GIBBONS et al., 2006). Such views were used when examining these dogs; however, they were not able to demonstrate lateralization of compressions. CT and magnetic resonance imaging can be used to obtain multiplanar images (ROBERTSON & THRALL, 2011).

Postoperative abdominal wall flaccidity may occur as a result of manipulation or sectioning of the nerve roots (rhizotomy) that innervate the abdominal muscles. During this study, four dogs (6.25%) experienced this complication during the immediate postoperative period. Furthermore, two dogs (3.12%) experienced iatrogenic rhizotomy as a result of the attempt to remove the disc material that had adhered to the nerve root; this abnormality persisted during the late postoperative period. In one dog, manipulation of the nerve roots during surgical decompression possibly caused functional loss (neuropraxia) with interruption of the motor pathways; however, this was considered transient because flaccidity was not noted during the late postoperative evaluation. In another dog, flaccidity persisted during the late postoperative period even though complete sectioning of the nerve root was not performed; therefore, the manipulation may have caused a more severe injury. BARTELS et al. (1983) reported that abdominal wall flaccidity was observed during the immediate postoperative period in 10% of animals that underwent fenestration; furthermore, this change persisted during the late postoperative period in three animals. For humans, the recovery process can last weeks to months (ASHBY et al., 1974).

Hematomas result from poor physiological or surgical hemostasis (SHARP & WHEELER, 2005). Only one patient (1.56%) in our study developed a hematoma. That dog did not have a platelet count below the physiological parameters or altered prothrombin time or activated partial thromboplastin time values. Other tests, such as the buccal mucosal bleeding time test and thromboelastography, were not performed. However, coagulopathy that culminated in hematoma formation occurred in this patient. Additionally, it is possible that intraoperative hemostasis failed, thus culminating in hematoma formation during the immediate postoperative period.

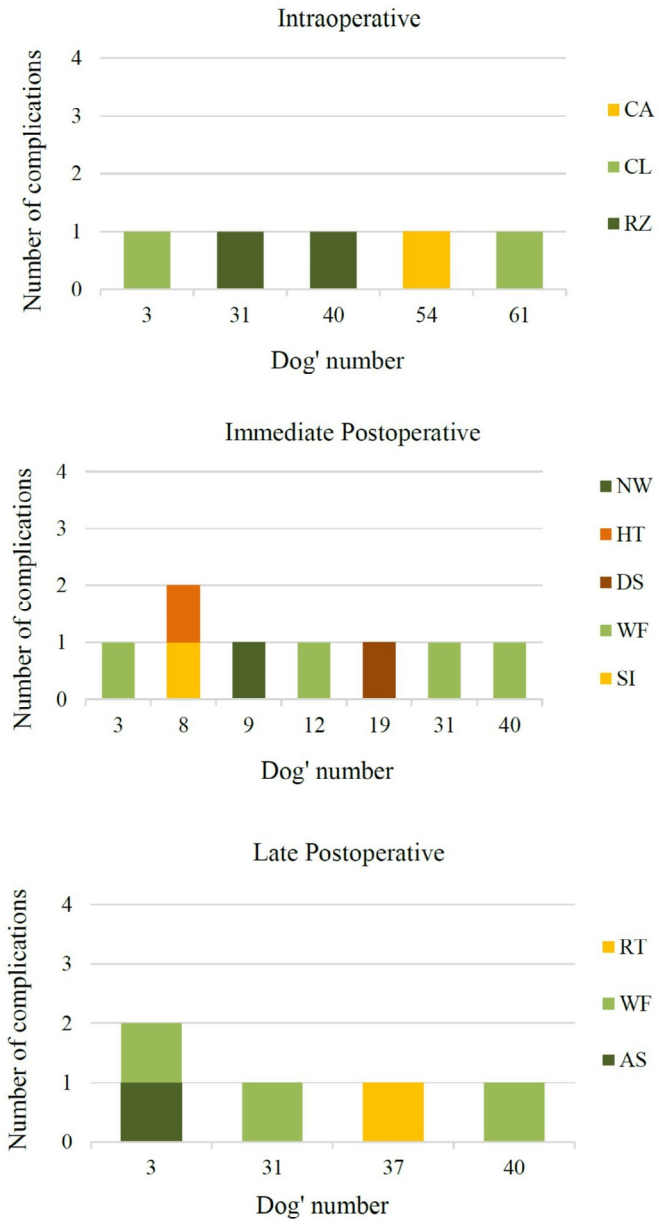

Figure 1 - Surgical complications during the intraoperative, immediate postoperative, and late postoperative periods experienced by dogs with intervertebral disc extrusion that underwent hemilaminectomy and intervertebral disc fenestration.

RZ, rhizotomy; CL, contralateral side; CA, cardiac arrest; SI, superficial wound infection; WF, abdominal wall flaccidity; DS, skin suture dehiscence; HT, hematoma; NW, worsening of the neurological status; SA, scar adhesion; RT, adverse reaction to the surgical thread.

During an epidemiological study of wound infections in humans, CRUSE and FOORD (1980) concluded that extensive incisions were associated with a higher risk of contamination by bacteria. Another study also reported an association between long surgical times and surgical wound infections

(NICHOLSON et al., 2002), and that the duration of anesthesia may be associated with a deficient immune response. During our study, superficial infection of the surgical wound was observed in only one dog (1.56%) during the immediate postoperative period. However, the incision length and surgical time of that dog were not superior to those of the other dogs in this study.

Prophylactic antibiotics were used for all dogs in this study because their use has been recommended for all procedures lasting longer than 90 min (VASSEUR, 1988). However, a more recent publication questioned the use of antibiotics for dogs subjected to hemilaminectomy and/or laminectomy because of the low (0.6%) infection rate (DYALL & SCHMÖKEL, 2018). According to another study that used prophylactic antibiotics, the infection rate for dogs that underwent hemilaminectomy and laminectomy was 4.2% (VÄLKKI et al., 2020).The infection rate of 1.56% observed during our study was considered satisfactory and similar to those reported by other studies (DYALL & SCHMÖKEL, 2018; VÄLKKI et al., 2020).

Suture dehiscence occurred in one dog (1.56%) without a concomitant superficial wound infection. Another dog (1.56%) experienced an adverse reaction to the surgical thread during the late postoperative period. LEXMAULOVÁ et al. (2008) also evaluated the frequency of suture dehiscence in dogs that underwent spinal procedures and considered it to be low.

In one dog (1.56%), scarring occurred during the late postoperative period. Adherence affects skin mobility and, in humans, can often cause itchiness and discomfort (LI et al., 2021). However, such cases have not been reported in veterinary medicine. Notably, pain, discomfort, and itchiness were not observed during the late postoperative evaluation of the dogs.

Regarding the neurological outcomes, 76.56% (n = 49) experienced neurological improvement and 23.44% (n = 15) had grade V neurological dysfunction. One patient (1.56%) experienced worsening of the neurological status during the immediate postoperative period; however, it was transient. This deterioration probably occurred as a result of spinal cord manipulation during decompression that led to material adhering to the dura mater. Such complications have been reported by AIKAWA et al. (2012). Another study reported that 5% of dogs affected by IVDE experienced neurological deterioration attributable to the secondary effects of spinal cord compression and manipulation during hemilaminectomy (MARTIN et al., 2020); these findings were similar to those of our study.

This study was limited by the small number of included animals. Different frequencies of complications could be observed if larger samples are studied. Furthermore, evaluation times longer than 30 days could also reveal other complications or adverse effects.

Knowledge of complications associated with spinal cord decompressive surgery is important to the appropriate management of patients. Delicate manipulation of the spinal cord and nerve roots can prevent abdominal wall flaccidity or worsening of the neurological status. Smaller incisions that do not compromise access during surgery and allow the shortest possible surgical time, in addition to adherence to the principles of asepsis throughout surgery, may prevent infections and surgical wound dehiscence.

CONCLUSION

Dogs that undergo surgical procedures of the spine to treat IVDE may experience complications during the intraoperative, immediate postoperative, and late postoperative periods. These complications are often transitory and rarely cause death. Some of these complications can be avoided. The surgical team is responsible for minimizing the frequency of complications and their consequent effects on patient recovery.

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ETHICS AND BIOSAFETY COMMITTEE

This research was approved by the regulatory institution after scientific, ethical and animal welfare consideration (CEUA 3512090617/UFSM).

AUTHORS' CONTRIBUTIONS

The authors contributed equally to the manuscript.

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