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Comparison of carprofen and firocoxib as analgesic for post-operative pain management in clinical cases of canine orthopaedic surgery

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ABSTRACT

Canine orthopaedic surgery is always associated with varied degree of pre-operative and post-operative pain, and the assessment of pain in canine is not easy as in humans. This study was carried out in 36 cases of long bone fracture in dogs and which was further managed with locking compression plate and bone substitute. Thirty-six animals were randomly divided into three groups and in each group carprofen and firocoxib used as analgesic in 6 animals to know the analgesic effect of drugs in orthopaedic surgery. Pain assessment in the dogs was carried out using objective assessments, including the Hansen score card and lameness scoring. Result showed no significant differences in the scores between the groups at all measured intervals in behavior and biological variables of Hansen score card. Values of lameness scoring gradually decreased from day 7 to day 90 in all groups of Carprofen and Firocoxib treated group in present study. Values of lameness scoring were found non-significant between groups but differed significantly within groups at different intervals. Based on these, two scoring system there was no significant difference was found between analgesic effect of Carprofen and Firocoxib for pain management in canine orthopaedic cases. However, further study is required for scoring system alongwith it physiological parameters should be correlated and validate to know the effect of the analgesic and its comparison.

Keywords: Canine orthopaedic, Carprofen, Firocoxib, Pain management

Orthopedic surgery consistently induces intense pain, both during and after the surgical procedure. Over the last decade, there has been an increasing recognition of the significance of pain management, leading to the adoption of various therapeutic agents and methodologies in veterinary patients (Macre 2001). Firocoxib, categorized as a COX-2 selective drug, has been demonstrated by several studies to have minimal adverse effects when employed for pain management in dogs. Furthermore, firocoxib has proven to be effective in controlling acute pain in dogs during the post-operative phase (Kondo *et al*. 2012). Carprofen is predominantly employed for addressing musculoskeletal pain and acute pain linked with surgery or injuries in dogs. Carprofen is accessible in tablet form and has been sanctioned for usage in both cats and dogs. It has been noted to be a highly effective analgesic for post-operative pain in both orthopedic and soft tissue cases, with a duration of effectiveness lasting up to 18 h (Papich 2021), while exhibiting minimal adverse effects. If we regard pain solely as a subjective encounter, any reliable measurement should strive to acknowledge this subjective perception. However, the subjective criteria presents a notable limitation in this approach, as the observer has to evaluate the degree based on their own impressions and experiences (Reid *et al*. 2018). Identifying and treating pain promptly poses a significant challenge in veterinary emergency medicine. Integrating a validated pain assessment scale into patient triage and pain management is crucial. However, the utilization of pain-relieving medications is not fully optimized, indicating a need for targeted training in pain assessment and the administration of analgesics (Rousseau-Blass *et al*. 2020).

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MATERIALS AND METHODS

Plan of research work: Groups I, II, and III were additionally divided into pairs of subgroups, designated as A1, A2, A3, A4, A5, and A6, each containing six dogs. Dogs belonging to A1, A3, and A5 subgroups were administered carprofen to manage pain, whereas those in the A2, A4, and A6 subgroups were administered firocoxib for pain management.

Lameness scoring: Lameness was assessed and recorded post-operatively on 7th, 14th, 30th, 60th, and 90th days, following the methodology reported by Quinn *et al*. (2007) with modification as shown below. The degree of lameness was evaluated and documented during these assessments based on following NRS score.

Table 1. Design of study

Group	Technique	
Group 1 (n=12)	Locking compression plate (LCP)	A1 Carprofen 4 mg/kg (n=6)
		A2 Firocoxib 5 mg/kg (n=6)
Group 2 (n=12)	LCP +PRP	A3 Carprofen 4 mg/kg (n=6)
		A4 Firocoxib 5 mg/kg (n=6)
Group 3 (n=12)	LCP + Zinc fluorophosphate	A5 Carprofen 4 mg/kg (n=6)
		A6 Firocoxib 5 mg/kg (n=6)

Numeric Pain Rating Scale (NRS)

1	Clinically sound
2	Barely detectable lameness
3	Mild lameness
4	Moderate lameness
5	Severe lameness (carries limb when trotting)
6	Could not be more lame

Objective assessment of pain: Objective assessment of pain was conducted and recorded for duration of three days following the surgery. The pain assessment was done using a score card developed by Hansen (2003), which consisted of various criteria to evaluate the intensity of pain.

RESULTS AND DISCUSSION

The mean values of the objective assessment score in dogs of both the analgesics have been shown in Table 2 and Table 3. The values of score decreased gradually and regularly in all the groups from day 0 to day 3. The most reliable indicators of pain after repairing long bone fractures in dogs were the responses to palpation, vocalization, mental state, and facial expression (Fazili *et al*. 2008). Watson *et al*. (1996) also reported that Australian veterinarians identified vocalization as the most frequently mentioned indicator for assessing pain in dogs and cats.

The objective evaluation of pain using behavior variables revealed a consistent trend in both carprofen and firocoxib treatment groups. In carprofen-treated groups (A1, A3, A5), initial pain scores on day 1 gradually decreased over the subsequent 2nd and 3rd days post-surgery. Similarly, in firocoxib-treated groups (A2, A4, A6), initial pain scores on day 1 also gradually decreased over the subsequent observation days. These findings suggested a steady reduction in pain scores over the observation period, indicating the efficacy of both carprofen and firocoxib in managing post-operative pain management. In carprofen and firocoxib treated group, physiological parameters indicated that pain started getting normalized on 2nd post-operative day. The values of behavior variables of Hansen score card exhibited a consistent and gradual decline across all groups from day 1 to days 3. On the 3rd day of observation, the scores in all the three groups dropped below the initial baseline values. However, values in Group A2 and A6 was lower than rest of the four groups although between groups values of pain score differed non-significantly indicating that in the present study firocoxib and carprofen provided equal analgesic effect based on the behavior variables of score card. Similar to this study, Rajhans (2018) also compared the efficacy of carprofen and meloxicam and there was no significant difference in the objective pain assessment scores between dogs treated with Meloxicam and Carprofen. This suggests that both NSAIDs provided an equal level of analgesic effect. Firocoxib in the form of a chewable tablet proved to be effective, safe, and well-received for managing pain and inflammation related to osteoarthritis in dogs under field conditions. In this study, no any side effect were seen after administration of Firocoxib tablet in dogs and this was sufficient to abolish the post-operative orthopaedic pain in dogs (Hanson *et al*. 2006).

The objective assessment of pain based on biological variables showed a consistent decline in pain scores over the post-operative period for both Carprofen and Firocoxib treatment groups. In carprofen-treated groups (A1, A3, A5), mean pain scores decreased gradually from day 1 to day 3, while in firocoxib-treated groups (A2, A4, A6), a similar trend of decreasing pain scores was observed. These findings underscore the efficacy of both analgesics in managing post-operative pain. Similar to behavior variables observations, values of biological variables were also differed non- significantly between groups at all

Table 2. Objective assessment of pain score of behavior variables

	A1	A2	A3	A4	A5	A6	P-value
1 Day	7.83±0.49^{a}	6.500±0.36^{a}	7.167±0.42^{a}	7.833±0.41^{a}	8.000±0.51^{a}	6.500±0.36^{a}	0.146
2 Day	6.33±0.49^{a}	5.333±0.36^{a}	5.333±0.42^{b}	5.500±0.41^{b}	5.167±0.51^{b}	4.667±0.36^{b}	0.1947
3 Day	4.00±0.49^{b}	3.833±0.36^{b}	3.000±0.42^{c}	2.667±0.41^{c}	2.667±0.51^{c}	2.333±0.36^{c}	0.0066
P-value	0.0003	0.0004	<.0001	<.0001	<.0001	<.0001	

Different superscripts differ significantly within groups (P<0.05), NS: Non-significant.

Table 3. Objective assessment of pain score of biological variables

	A1	A2	A3	A4	A5	A6	P-value
1 Day	3.16±0.48	2.83±0.25^{a}	3.50±0.34^{a}	2.66±0.26^{a}	4.16±0.31^{a}	2.83±0.23^{a}	0.1500
2 Day	2.16±0.48	1.66±0.25^{b}	2.50±0.34^{a}	1.50±0.26^{b}	1.50±0.31^{b}	1.66±0.23^{b}	0.1285
3 Day	1.50±0.48	0.50±0.25^{c}	1.00±0.34^{b}	0.66±0.26^{b}	0.83±0.31^{b}	1.16±0.23^{b}	0.0665
P-value	0.0806	<.0001	0.0005	0.0003	<.0001	0.0005	

Different superscripts differ significantly within groups (P<0.05), NS: Non-significant.

Table 4. NRS values for cases treated with carprofen and firocoxib

	A1	A2	A3	A4	A5	A6	P-value
7 Day	4.50±0.40^{a}	4.00±0.25^{a}	4.17±0.17^{a}	4.00±0.21^{a}	4.17±0.25^{a}	4.17±0.22^{a}	0.7737
14 Day	3.33±0.40^{ab}	2.83±0.25^{b}	2.83±0.17^{b}	3.17±0.21^{a}	3.17±0.25^{a}	3.17±0.22^{b}	0.825
30 Day	2.67±0.40^{bc}	2.00±0.25^{bc}	2.00±0.17^{c}	1.67±0.21^{b}	1.50±0.25^{b}	1.83±0.22^{c}	0.0743
60 Day	1.83±0.40^{bc}	1.50±0.25^{c}	1.17±0.17^{d}	1.17±0.21^{b}	1.17±0.25^{b}	1.33±0.22^{c}	0.4046
90 Day	1.50±0.40^{c}	1.33±0.25^{c}	1.00±0.17^{d}	1.00±0.21^{b}	1.00±0.25^{b}	1.00±0.22^{c}	0.4346
P-value	0.0001	<.0001	<.0001	<.0001	<.0001	<.0001	

three days but within groups values differed significantly. Values were consistently declined from day 1 to day 3 and physiological and behavioral parameters also showed normal from 2nd day of surgery. Similar to present study, Pollmeier *et al*. (2006) also compared the Firocoxib and Carprofen in cases of canine osteoarthritis with same dose which was used in this study and they observed overall scores after the treatment period. This assessment was based on veterinarian's evaluations of factors such as lameness, pain upon manipulation or palpation, range of motion and joint swelling. Results showed that 92.5% of the dogs treated with Firocoxib and 92.4% of those treated with carprofen demonstrated improvement. These findings are compatible with findings of present study. Some authors also used combination of these two drugs, Firocoxib and Tramadol combination in canine orthopedic surgical procedures which exhibited reduced pain scores, lower instances of rescue opiate administration, and improved limb function as compared to tramadol alone (Davila *et al*. 2013). Phuwapattanachart and Thengchaisri (2017) also suggested lower dose of Firocoxib to control post-operative pain in ovariohysterectomized cats. Ranpariya (2012) reported analgesic efficacy of Meloxicam was better than ketoprofen and carprofen in post-operative orthopaedic pain management using University of Melbourne Pain Scale (UMPS) and he revealed that Carprofen does not appear to be a suitable option for managing post-operative pain, particularly in orthopedic cases which is in contrast to the findings of present study. In the present study, pain evaluation or assessment in the dogs was conducted through the utilization of objective pain assessment *via* Hansen score card and lameness scoring. While Laredo *et al*. (2004) used Visual Analogue Scale (VAS) score for comparison of meloxicam and carprofen and observed it to be equal effective in controlling post-operative pain.

Lameness Scoring: Subjective scales such as the NRS can be employed to assess and characterize the degree of lameness in animals. NRS is a simple descriptive scale. When assessing lameness, the divisions or categories on the scale can encompass different clinical indicators of pain and/or lameness. Typically, evaluators select the degree of lameness or a descriptive term that best represents their observation of the animal's gait or the condition of the limb, in similar manner score of NRS was analyzed in present study (Impellizeri *et al*. 2000).

Lameness assessments were conducted on the 7th, 14th, 30th, 60th, and 90th days following the surgery, utilizing the lameness scoring system described by Quinn *et al*. (2007). The results are presented in Table 5.

Lameness scores decreased steadily from day 7 to day 90 in both Carprofen and Firocoxib treatment groups. For Carprofen (A1, A3, A5), scores decreased from approximately 4.5 to 1.5 over 90 days post-operatively. Similarly, in Firocoxib-treated groups (A2, A4, A6), scores declined from around 4 to 1 over the same period.

The values of lameness scoring was found non-significant between groups but differed significantly within groups at different intervals. Similar types of observations were also noted by Rajhans (2018) using the NRS scores between dogs treated with Meloxicam and Carprofen. This suggests that both NSAIDs yielded equal and effective analgesic effects by the 90th day after surgery, with all dogs being clinically sound and displaying no detectable lameness.

Effective peri-operative pain management is crucial in veterinary orthopedic surgery, demanding regular assessment and tailored treatment. Both carprofen and firocoxib have demonstrated sufficient efficacy in alleviating pain following orthopedic procedures, as indicated by objective assessment scores, thus emphasizing their comparable effectiveness in pain management. Further, the objective assessment of pain is also not as reliable as it may vary from person to person. Hence the further research is suggested to frame clinical proven scale or score of assessment and management of pain.

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