SHORT COMMUNICATION

Biomarkers for Assessment of Fracture Healing in Dogs with Tibial Fracture

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Abstract

The study was conducted in 12 clinical cases of dogs presented to the Department of Veterinary Surgery and Radiology in Bidar. They were randomly divided into two groups consisting of 6 animals each. In group I fracture was repaired using interlocking nail (ILN) and in group II with locking compression plate. The fracture healing was studied after the operation on day 0 (immediate), 15th, 30th and 60th. In both groups, calcium, phosphorus and alkaline phosphatase levels were estimated pre-operatively and on the above days for assessment of fracture healing**.** The mean values of serum calcium and alkaline phosphatase gradually increased from the pre-operative day reaching significantly the highest ($p<0.05$) level on the 15th post-operative day, after which the concentration gradually reduced till the 60th post-operative day in both the groups. The increase in serum alkaline phosphatase was significantly higher at day 15th post-operative in group I than in II, and all the values were within the physiological limit.

Key words: Alkaline phosphatase, Calcium, Biomarkers, Dog, Fracture healing, Phosphorus.

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Introduction

Biochemical markers of bone turnover are often classified into two subclasses: bone resorption markers and bone formation markers. The bone resorption markers are related to osteoclast resorption of matrix and include tartrate-resistant acid phosphatase and degradation products of type I collagen in protein matrix, especially hydroxyproline, telopeptides, etc. Osteocalcin and bone-specific alkaline phosphatase, both produced by osteoblasts, are bone formation indicators (Delmas, 1995). Physical and serial radiologic examinations of the fracture site are primarily used to monitor the healing, however using these biochemical indicators, the literal status of bone resorption and bone growth can be determined in a short period of time (Mukhopadhyay *et al*., 2011). This study was carried out to evaluate biochemical parameters in dogs that underwent tibial fracture repair by interlocking nail (ILN) and locking compression plate (LCP).

Materials and Method

Research work was conducted on clinical cases, hence no approval of IAEC was required.

The clinical study was done on the interlocking nail and locking compression plate for tibial fracture repair in 12 dogs, regardless of breed or age, presented to the Department of Veterinary Surgery and Radiology, Veterinary College, Bidar (India). Clinical, physical, physiological and radiographic examinations were conducted to diagnose tibial fracture in all the dogs. The dogs were divided randomly into two equal groups. Fractures in all the dogs were immobilized by open reduction and internal fixation using ILN in group I and LCP in group II. Food was withheld for 12 h and water for 6 h before surgery. The standard procedure for the preoperative site preparation, general anaesthesia (butorphanol @ 0.2 mg/kg b.wt. i/v, atropine sulphate @ 0.045 mg/kg i/m, dexmedetomidine @ 10 µg/kg i.v, propofol @ 3 mg/kg i/v, maintained with isoflurane at 2 to 3%) and fracture repair was followed.

In both groups, the post-operative dressing was changed every alternate day until the sutures were removed on day 14th. Injection amoxicillin-sulbactum was administered at

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Table 1: Mean±SE values for serum biochemical attributes of fractured dogs in group I and II at different post-operative intervals

Seum Parameter	Group	Pre-operative	0 day	15th day	30th day	60th day
Calcium (mg/dL)	I	10.19±0.16^{A}	10.52±0.04^{A}	11.01±0.01^{B}	10.13±0.24^{A}	10.06±0.22^{A}
	II	10.23±0.25^{A}	10.50±0.18^{A}	11.00±0.00^{B}	10.16±0.18^{A}	10.02±0.07^{A}
Phosphorus (mg/dL)	I	5.42±0.11^{A}	5.39±0.05^{A}	5.38±0.07^{A}	5.41±0.15^{A}	5.31±0.14^{A}
	II	5.43±0.20^{A}	5.38±0.13^{A}	5.36±0.15^{A}	5.37±0.10^{A}	5.30±0.10^{A}
Alkaline phosphatase (IU/L)	I	75.29±0.90^{AB}	76.58±0.98^{B}	113.88±1.04^{D}	93.25±0.81^{C}	74.29±0.57^{A}
	II	74.47±0.84^{AB}	75.65±0.93^{AB}	108.59±1.33^{D}	92.04±0.78^{C}	73.05±0.90^{AB}

Mean-SE bearing different superscripts within the row are statistically significant at $p<0.05$. Group I- Interlocking nail (ILN), Group II- Locking compression plate (LCP)

the rate of 10 mg/kg intravenously preoperative and twice a day for 5 days post-operatively and tab. carprofen at 4 mg/kg orally for 3 days to control infection and inflammation.

Blood was collected pre-operative day and after the operation on day 0 (immediate), 15th, 30th and 60th day in both groups, and calcium, phosphorus and alkaline phosphatase (IU/L) levels were estimated using standard procedures and kits for assessment of fracture healing. The data obtained were tabulated and statistically analysed using the student's t-test for mean differences between groups, and by ANOVA and Duncan's post hoc test variation between periods within the group as outlined by Snedecor and Cochran (1994).

Result and Discussion

In both the groups, the mean values of serum calcium gradually increased from the pre-operative day up to the 15th post-operative day reaching the peak and it was significant ($p<0.05$) on the 15th day. Calcium level decreased significantly ($p<0.05$) on the 30th and 60th day in both the groups when compared to the 15th day and there was no significant difference between group I and group II at corresponding days (Table 1). Similar findings were reported by Kumar *et al*. (1999), Nagaraja *et al.* (2003), Kumar *et al.* (2018) and Phaneendra *et al.* (2018). The early decline in serum calcium was most likely caused by increased urinary excretion following traumatic bone injury (Kumar *et al*., 1999).

In both group I and group II, the mean values of serum phosphorus decreased gradually and there was no significant difference between pre-operative and on days 0, 15th, 30th and 60th post-operative and there was no significant difference between group I and group II at corresponding days. All the values recorded were within the normal physiological levels (Table 1). Similar observations were recorded by Mahendra *et al.* (2007) and Uma Rani and Ganesh (2003).

Further in both groups, the mean values of serum alkaline phosphatase gradually increased from the pre-operative day up to the 15th post-operative day reaching a peak like calcium and it was significant ($p<0.05$) on the 15th day. On the 30th day and 60th day, it decreased significantly ($p<0.05$) when compared to the 15th day coming to the preoperative status. There was no significant difference between group I and group II at corresponding days; however, the peak value achieved on the 15th post-operative day was slightly greater in group I than in group II (Table 1). Similar findings were reported by Kumar *et al.* (2018), Yadav *et al.* (2021) and Ajjodi and Nagaraja (2022). The rise in serum alkaline phosphatase level could be attributed to increased chondroblastic activity since the periosteum of damaged bone is a rich source of serum alkaline phosphatase.

Thus the biochemical evaluation revealed significantly increased serum calcium and alkaline phosphatase on day 15th post-operative compared to pre-operative day and then came down to pre-operative values on day 60 post-operative in both the groups indicating the progression towards the fracture healing.

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