Evaluation of biochemical parameters for assessment of fracture healing in dogs

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Abstract

Biochemical parameters like C-reactive protein and alkaline phosphatase were evaluated during fracture healing in 12 dogs with tibial diaphyseal fractures, which were stabilized with linear external skeletal fixator using light weight, radiolucent carbon connecting rods. Statistical analysis revealed a highly significant difference ($P<0.01$) in serum alkaline phosphatase and C-reactive protein values in different stages of postoperative intervals. The serum alkaline phosphatase values significantly increased from 0^{th}day to 14^{th}day and thereafter reached to normal values by 21^{st} postoperative day. Lower C-reactive protein values were observed in cases stabilized by closed reduction than in fractures that subjects to open reduction and the values decreased by 3 weeks. Fixator complete removal was done on an average 4-7weeks.

Keywords: C-reactive protein; alkaline phosphatase; fracture; dogs.

Introduction

The assessment of biochemical parameters like serum calcium, inorganic phosphorus and alkaline phosphatase enzyme activity during fracture healing to identify fluctuations, if any in fracture healing after rigid stabilization is till date arguable and were regularly evaluated by many authors (Hegade *et al*., 2007). Even though the progress of fracture union can be assessed using clinical examination and radiographic studies, the literal status of bone resorption and bone formation can be achieved over a short time interval using these biochemical markers (Mukhopadhyay *et al*., 2011). Biochemical markers of bone turnover are generally divided into two subclasses: bone resorption and bone formation markers. The bone resorption markers are related to osteoclast resorption of matrix and include tartarate resistant acid phosphatase and degradation products of type I collagen in protein matrix especially hydroxyproline, telopeptides etc. Bone formation markers are osteocalcin and bone specific alkaline phosphatase produced from osteoblasts (Delmas, 1995). C-reactive protein is an acute phase reactant, a protein made by the liver and released into the blood within a few hours after tissue injury, the start of an infection, or other cause of inflammation (Scherer *et al*., 2001). The present study was carried out to assess the degree of bone formation and pain postoperatively using alkaline phosphatase and C-reative protein estimation respectively after stabilizing the tibial diaphyseal fractures with linear external skeletal fixation.

Materials and methods

Twelve owner owned dogs of highly unstable tibial diaphyseal fractures presented to the Department of Veterinary Surgery and Radiology, College of Veterinary Science, Tirupati were selected to study the fracture stabilization technique and were fixed with bilateral uniplanar Type II external skeletal fixators using indigenously designed stainless steel positive profile centrally threaded transfixation full pins, two way AO clamps and carbon fiber rods (Advance Orthopaedic Technology, Chennai) as frame components. In all the dogs, fixation was performed as per the standard procedure described by Canapp (2004). Blood samples were collected and serum was separated in all the cases before and after surgery on day 0 and on 7^{th}, 14^{th}, $28^{th,}$ 45^{th} and 60^{th} day in all the cases and estimated serum alkaline phosphatase and C-reactive protein. Serum alkaline phosphatase (IU) was estimated by IFCC kinetic assay method (Young, 1997). C-reactive protein values (mg/dl) were estimated by following latex slide and tube test with kit from Span Diagnostics Ltd (Young, 1997). The data regarding serum biochemical parameter values were subjected to standard statistical analysis using one way ANOVA as described by Snedecor and Cochran (1994) using SPSS^R 15 software package.

Results and discussion

The changes in mean ± SE values of serum alkaline phosphatase at different time interval are presented in Table. 1. Serum alkaline phosphatase at all the stages (0 day, 7^{th}, 14^{th}, 28^{th}, 45^{th} and 60^{th} day) differed significantly ($P < 0.01$) in different postoperative days. Highest value (117± 1.02) was observed at 14^{th} day postoperative where as the lowest value (52.60± 0.74) on 60^{th} day . The mean ± SE values of C-reactive protein on 0 day , 7^{th} , 14^{th} , 28^{th}, 45^{th} and 60^{th} days was shown in Table. 1. CRP values were differed significantly ($P < 0.01$) at various stages with highest values recorded i.e. 38.65± 1.72 and 23.79± 0.86 on 7^{th} and 14^{th} day of postoperative interval period.

Table 1: Mean ± SE Serum biochemical values in pre and postoperative days

Days	Alkaline phosphatase (IU)	C-reactive protein (mg/dl)
0^{th}	76.51 ± 0.82^{a}	14.23 ± 0.32^{a}
7^{th}	98.48 ± 0.63^{b}	38.65 ± 1.72^{b}
14^{th}	117 ± 1.02^{a}	23.79 ± 0.86^{a}
28^{th}	92.39 ± 0.77^{b}	18.64 ± 0.71^{b}
45^{th}	$66.91 \pm .46^{a}$	14.97 ± 0.43^{a}
60^{th}	52.60 ± 0.74^{b}	9.11 ± 0.39^{b}

Means with different superscripts (a , b) In two rows of each biochemical parameters differ significantly ($P < 0.01$)

The serum alkaline phosphatase values significantly increased from preoperative day to 14^{th} day and there after the levels decreased reaching normal by 21^{st} day. Increase in serum alkaline phosphatase level was due to increased chondroblastic proliferation to cause bone formation during fractured bone repair and also maximum contribution was from the periosteum of destructed bone which was a rich source of serum alkaline phosphatase. The findings were in concurrence with that of Singh *et al*. (1976), Maiti *et al.* (1999) and Hegade *et al*. (2007). Guyton (1981)

reported that in most of the compression method of internal fixation, an increase in alkaline phosphatase due to osteoblastic activity was observed. CRP values differed significantly in different stages of postoperative intervals. These elevated values might be because of initial pain due to fractures as opined by Caspi (1984) and surgical trauma according to Yamamoto *et al.* (1993). Lower values were observed in those cases stabilized by closed reduction than in comminuted fractured cases that underwent open reduction and the values decreased by three weeks after healing. This was in accordance with Maiti *et al.,* (1999).

It was concluded that alkaline phosphatase and C-reactive protein can be used as useful biochemical markers in assessing the bone formation and pain respectively. These biochemical parameters along with clinical and radiographical examination provide sound knowledge on the degree of bone healing.

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