International Journal of Livestock Research, Vol. 11 (12) Dec' 2021
http://www.ijlr.org
eISSN: 2277-1964

Original Research

Studies on Variations in Haematobiochemical Profile of Dogs Treated with Titanium Elastic Stable Intramedullary Nailing for Long Bone Fractures

Ankush Kumar[1]*, R. N. Chaudhary[1], Ram Niwas[1], Priyanka[1] and Sandeep Kumar[2]

[1]Department of Veterinary Surgery and Radiology, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, INDIA
[2]Department of Veterinary Physiology and Biochemistry, Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, INDIA

*Corresponding Author: dr.ankushgill@gmail,com

How to cite this paper: Kumar, A., Chaudhary, R. N., Niwas, R., Duggal, P., & Kumar, S. (2021). Studies on Variations in Haematobiochemical Profile of Dogs Treated with Titanium Elastic Stable Intramedullary Nailing for Long Bone Fractures. *International Journal of Livestock Research*, 11(12), 50-54.
https://dx.doi.org/10.5455/ijlr.20211101071122

Received : Oct 17, 2021
Accepted : Nov 27, 2021
Published : Dec 31, 2021

Abstract

The study was conducted on ten dogs presented with diaphyseal fracture of long bones. All the fractures were repaired by titanium elastic stable intramedullary nailing. To study the haemato-biochemical profile of the dogs blood samples were collected in EDTA and serum collecting vials at different time intervals i.e., pre-operative, immediate post-operative, on 15th, 30th and 60th post-operative days. There were statistically significant variations in the mean values of total leucocyte count, neutrophils (%), lymphocytes (%), platelet count, serum calcium and sodium ion levels during the different time intervals of observation. But clinically, all the haematological and serum biochemical parameters were within the normal range for dogs. So it was inferred that application of titanium elastic stable intramedullary nailing does not cause any systemic adverse effects in dogs.

Keywords: Dogs, ESIN (Elastic Stable Intramedullary Nailing), Titanium

Introduction

Fracture is defined as a complete or incomplete break in the continuity of bone or cartilage and has been a long-term concern in the field of veterinary orthopaedics. Long bone fracture is a common orthopaedic condition found in dogs (Harasen, 2001; Schwarz, 1991). In orthopaedics, the primary aim of any method of fracture fixation is to achieve the fastest possible healing and enabling the patient to function normally by allowing early mobility (Aron, 1998; Shahar, 2000). The time required for ‘‘normal’’ fracture healing depends on several local and systemic parameters, mainly location of fracture, age of the animal, type of fixation (implant devices), stabilization, and blood supply (Komnenou *et al.*, 2005). Several factors like hormonal, biomechanical, cellular, pathological and biochemical factors also influence the fracture healing process. Titanium elastic stable intramedullary nailing is a well-accepted method of osteosynthesis of diaphyseal fractures in children and adolescents in medical sciences (Lascombes *et al.*, 2006). The selection of Titanium-based materials for implant is due to the combination of its outstanding characteristics such as high strength, low density, complete inertness to body environment, low modulus and high capacity to join with bone and other tissues (Niinomi, 2001). Titanium is currently the most popular metal used for elastic stable intramedullary nail fixation of pediatric femoral fractures in human, however, references for its use in veterinary practice are still rare. Hence, present study was conducted to evaluate haemato-biochemical parameters during fracture healing in 10 dogs with long bone fractures repaired with titanium elastic stable intramedullary nailing.

Materials and Methods

The study was conducted on ten dogs with long bone diaphyseal fracture. In all the dogs the fracture was repaired with titanium elastic stable intramedullary nailing (Fig. 1); irrespective of their age, sex and breed. Blood samples were collected aseptically from cephalic or saphenous vein in two separate vials containing EDTA (for haematology) and glass beads for serum at each designated interval i.e., preoperative, immediate after the surgery and on 15th, 30th and 60th postoperative day. In haematological analysis, parameters like haemoglobin concentration, total erythrocyte count, total leucocyte count, differential leucocyte count and platelet count were estimated by automatic haematoanalyzer (*MS4se*®, HD consortium India ltd.). For serum biochemical analysis, *Erba EM 200*® (*Transasia*®, Mumbai, India) biochemistry autoanalyzer by using commercially available (*Transasia*®, Mumbai, India) kits were used for the estimation of parameters which include total serum proteins, albumin, globulin, albumin:globulin ratio, alanine aminotransferase, aspartate aminotransferase, serum creatinine, blood urea nitrogen, alkaline phosphatase, serum calcium and phosphorus. For the estimation of serum sodium, potassium and chloride ions, completely automated, microprocessor-controlled electrolyte system that uses ion selective electrode technology (EasyLyte® analyzer, *Transasia*®, Mumbai, India) was used. The data obtained during the study was subjected to statistical analysis by using repeated measures analysis of variance (ANOVA).

Figure 1: Immediate post-operative radiograph of tibia of dog treated with ESIN by using titanium elastic nails (anterio-posterior view)

Results and Discussion

The mean values of the haematological parameters at different time intervals of observation were within the normal clinical range (Table 1). There was non-significant variation in the mean haemoglobin concentration and total erythrocyte count. Hansda *et al*. (2012) also reported non-significant variation in mean values of haemoglobin concentration and total erythrocyte count postoperatively. There was statistically significant variation in the mean values of total leucocyte count (TLC), neutrophils (%), lymphocytes (%) and platelet count although all were within normal physiological limits. There was a statistically significant decline in the total leucocyte count on 15th post-operative day as compare to both the pre-operative and the immediate post-operative period followed by non-significant decline upto 60th post-operative day. This decline in TLC was an indication of resolution of inflammation and surgical stress as also observed by Maiti *et al*. (1999). The significant decline in the mean value of neutrophils (%) on 15th post-operative day as compare to both the pre-operative and immediate post-operative period followed by non-significant decrease in the mean values from 15th to 60th post-operative day were observed in the study. Mean value of lymphocytes (%) had shown statistically significant increase on 15th post-operative day as compare to both the pre-operative and immediate post-operative period followed by non-significant increase from 15th to 60th post-operative day. These indicate gradual decrease of inflammatory reaction. There was no significant variation in the mean the values of monocytes (%), eosinophils (%) and basophils (%) at different time intervals. The mean values of platelet count (x10^3 /µl) had shown statistically significant variation (significant increase) on 30th and 60th post-operative day as compare to the pre-operative and immediate post-operative period.

The mean values of serum biochemical parameters were within the normal range at different time intervals of observation but there was statistically significant variation in the mean concentrations of serum calcium and sodium ion levels during different time intervals of observation (Table 2). Mean values of serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total proteins, serum albumin, globulin and albumin: globulin ratio (A:G ratio)**,** serum creatinine, blood urea nitrogen (BUN), serum phosphorus, serum potassium and chloride ions had no significant variation at any time interval of examination. Statistically significant rise in the mean value of serum calcium level was observed on 30th post-operative day as compare to both the pre-operative and immediate post-operative period followed by significant decline on 60th post-operative day as compare to the 30th post-operative day. The increase in serum calcium level on 30th post-operative day might be due to mobilization of the calcium towards the fracture site for healing which normalized after mineralization of the callus on 60th day. The significant decline in serum sodium level from pre-operative to immediate post-operative period might be due to preoperative fasting (as recommended for anaesthesia) which again increased significantly on 15th post-operative day as dogs started normal feeding then the homeostatic mechanism of body leads it to non-significant decrease on both 30th and 60th post-operative days.

Table 1: Mean ± S.E. values of different haematological parameters of all the cases at different time intervals of examination

Time interval	Pre-operative	Immediate post-operative	15th day	30th day	60th day
Haemoglobin (mg/dl)	12.52±0.67	11.53±0.49	12.33±0.46	12.71±0.43	13.20±0.54
TEC (x10^6/ µl)	6.13±0.14	6.48±0.17	6.63±0.18	6.92±0.32	7.71±0.79
TLC (x10^3/µl)	14.97^a±0.96	15.71^a±0.96	11.35^b±0.70	10.09^b±0.90	8.88^b±0.92
Neutrophils (%)	76.81^a±1.26	79.31^a±1.55	66.11^b±2.08	63.56^b±1.49	63.08^b±1.29
Lymphocytes (%)	16.16^b±1.20	14.37^b±1.27	25.59^a±1.81	28.53^a±1.40	29.90^a±1.46
Monocytes (%)	5.20±0.70	4.66±0.51	6.53±0.65	6.41±0.44	5.58±0.45
Eosinophils (%)	1.37±0.33	0.84±0.24	1.30±0.28	1.09±0.22	1.06±0.23
Basophils (%)	0.46±0.15	0.52±0.17	0.47±0.11	0.41±0.14	0.38±0.14
Platelet count (x10^3 /µl)	345.40^c±23.49	314.30^c±20.71	378.60^{cb}±23.91	429.50^{ab}±19.03	466.30^a±21.89

Means with different superscripts (a, b, c) vary significantly (p<0.01) within group.

Table 2: Mean ± S.E. values of different serum biochemical parameters of all the cases at different time intervals of examination

Time interval	Pre-operative	Immediate post-operative	15th day	30th day	60th day
ALT (IU/L)	24.22±3.34	22.72±3.64	25.52±3.06	22.82±3.51	25.57±3.72
AST (IU/L)	27.26±2.43	29.08±2.93	26.44±3.48	29.63±2.85	29.73±3.73
ALP (IU/L)	79.70±13.06	64.20±11.37	62.60±8.93	53.90±9.49	41.90±4.26
Creatinine (mg/dl)	0.59±0.07	0.52±0.06	0.59±0.04	0.49±0.07	0.62±0.07
BUN (mg/dl)	10.76±1.23	10.64±0.93	10.28±0.77	9.13±0.89	9.28±1.02
Total protein (g/dl)	4.59±0.43	4.11±0.35	4.58±0.37	4.78±0.51	4.82±0.35
Albumin (g/dl)	2.60±0.24	2.31±0.13	2.61±0.19	2.56±0.28	2.77±0.26
Globulin (g/dl)	1.99±0.25	1.80±0.27	1.97±0.22	2.22±0.29	2.05±0.23
A:G ratio	1.42±0.18	1.56±0.27	1.46±0.18	1.22±0.13	1.50±0.22
Calcium (mg/dl)	9.23^{b}±0.23	9.02^{b}±0.36	9.54^{ab}±0.31	10.17^{a}±0.29	9.10^{b}±0.27
Phosphorus (mg/dl)	4.23±0.37	4.00±0.52	4.10±0.45	4.25±0.65	3.59±0.43
Sodium (mEq/L)	154.83^{a}±4.15	136.86^{c}±4.51	159.07^{a}±5.43	152.73^{ab}±3.55	141.78^{cb}±2.79
Potassium (mEq/L)	4.82±0.35	4.65±0.31	4.82±0.36	4.99±0.43	4.71±0.41
Chloride (mEq/L)	125.18±3.89	124.34±5.60	123.36±3.77	120.28±2.86	121.33±3.08

Means with different superscripts (a, b, c) vary significantly ($p<0.05$) within group.

Clinically all the fracture healed successfully with minor complication of pin migration in four animals at pin insertion site which was managed easily with antiseptic dressing. The dogs started bearing weight on the affected limb from 7 days to 16 days postoperatively. Complete weight bearing on affected limb was achieved on 30th postoperative day in nine animals while on 60th day in all the animals.

Conclusion

The haemato-biochemical status of dogs treated with Titanium elastic stable intramedullary nailing for long bone fracture remains within normal limits. So, its application does not have any systemic adverse effects in dogs. Hence, the titanium elastic nails were used for the long bone fracture repair in dogs without any adverse effect on haemato-biochemical status of the treated animals post-operatively.

Conflict of Interests

There is no conflict of interest.

Publisher Disclaimer

IJLR remains neutral concerning jurisdictional claims in published institutional affiliation.

References

1. Aron, D.N. (1998). Practical techniques for fractures. In: Bojrab M.J. ed. Current techniques in small animal surgery. *4th ed. Philadelphia, Williams & Wilkins*. pp. 934-941.
2. Hansda, P., Gahlod, B.M., Akhare, S.B., Dhakate, M.S., Upadhye, S.V. and Panchbhai, V.S. (2012). Comparative evaluation of Steinmann pin, Kuntscher nail and interlocking nail for femur fracture repair in dog. *Indian Journal of Veterinary Surgery*. 33(1): 53-54.
3. Harasen, G. (2001). Fractures involving the distal extremity of the femur. Part 1–The immature patient. *The Canadian Veterinary Journal*, 42(12): 949–950.
4. Komnenou, A., Karayannopoulou, M., Polizopoulou, Z.S., Constantinidis, T.C. and Dessiris, A. (2005). Correlation of serum alkaline phosphatase activity with the healing process of long bone fractures in dogs. *Veterinary Clinical Pathology*, 34(1): 35–38.

5. Lascombes, P., Haumont, T. and Journeau, P. (2006). Use and abuse of flexible intramedullary nailing in children and adolescents. *Journal of Pediatric Orthopedics*, 26(6): 827–834.
6. Maiti, B.K., Sen, T.B., Singh, B. and Sanki, S. (1999). Haematobiochemical changes following application of internal fixation technique in treatment of femur fracture in dog. *Indian Journal of Animal Health*, 38: 133-134.
7. Niinomi M. (2001). Ti based biomaterials, the ultimate choice for orthopaedic implants- A review. *Metallurgical and Materials Transactions*, 32(1): 477–486.
8. Schwarz, P.D. (1991). Biomechanics of fractures and fracture fixation. *Seminars in Veterinary Medicine and Surgery (Small Animal)*, 6(1): 3–15.
9. Shahar, R. (2000). Relative stiffness and stress of type I and type II external fixators: acrylic versus stainless-steel connecting bars--a theoretical approach. *Veterinary Surgery*, 29(1): 59–69.

****