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Haemato-biochemical variations in dogs undergoing radius fracture fixation by Point Contact Fixator (PC-Fix) plate system

Akshay Mohan, V Mahesh, Manjunatha K, KM Srinivasa Murthy and BN Nagaraja

Abstract
Haemato-biochemical variations were evaluated in six dogs that underwent radius fracture fixation using Point Contact Fixator (PC-Fix) plate system presented to Department of Veterinary Surgery and Radiology, Veterinary College Hospital, Bangalore. Haematological parameters *viz*., total erythrocyte count, haemoglobin, total leukocyte count and differential leukocyte count and biochemical parameters *viz*., serum creatinine, serum calcium, serum phosphorus, serum alanine aminotransferase and serum alkaline phosphatase were recorded pre-operatively & post-operatively on 0^{th}, 7^{th}, 14^{th}, 28^{th}, 45^{th} and 60^{th} days. Hematological parameters showed no significant variations in any of the six dogs. Leucocytosis was observed in the pre-operative period and gradually reduced after two weeks. All other parameters remained within the normal physiological range. Serum biochemical studies revealed no significant variations in the creatinine, alanine amino transferase, calcium and phosphorous values. However, serum alkaline phosphatase were significantly increased from the day before surgery to maximum on 7^{th} day and later the values gradually decreased.

Keywords: Dog, haemato-biochemical, Point Contact Fixator (PC-Fix), radius fracture

1. Introduction
The prevalence of musculoskeletal disorders in pets is a significant concern, with fractures representing a substantial component of these issues. In recent times, the exponential rise in the number of automobiles on roads has led to a corresponding increase in accidental injuries among both pet and stray animals, resulting in fractures and fatalities (Sharma *et al*., 2018) [17]. Radius and Ulna serve as the main weight-bearing bones in the antebrachium. Fractures in these bones typically result from trauma, automobile accidents, fall from height, or may be pathological, arising from conditions like bone weakening or neoplasm. Among dogs, radius and ulna fractures rank as the third most common, with a higher incidence observed in miniature and toy breeds of dogs. This heightened occurrence is attributed to reduced vascular density and arborization of vessels in the distal metaphysis compared to medium-sized dogs (Altissimi *et al*., 1986) [1]. The primary objectives in treating fractures involve preserving intramedullary and periosteal vascularization, achieving anatomical reduction, applying inter-fragmentary compression to bone fragments, and facilitating an early return to normal locomotory function (Newton and Nunamaker, 1985) [9]. When compared to conventional plating, the Point Contact Fixator (PC-Fix) plating may offer considerable benefits, such as less contact with the bone, a better blood supply beneath the plate, better vascularization and localized, isolated points of contact reducing the risk and spread of infection, an improved healing process which does not require internal remodeling of larger necrotic areas of bone (Perren and Buchanan, 1995) [11]. Fracture healing can be assessed by series of radiographic and haemato-biochemical evaluation.

2. Materials and Methods
The present clinical study on stabilisation of radius fractures using Point Contact Fixator (PC-Fix) was conducted in six clinical cases of dogs presented to the Department of Veterinary

Surgery and Radiology, Veterinary College Hospital, Hebbal, Bengaluru. Routine clinical, orthopaedic and radiographic examinations were performed to diagnose the fractures of radius and ulna. After confirming, six cases of radius fractures of skeletally mature animals was selected, and the fracture was reduced and stabilised by the Point Contact Fixator (PC-Fix) plating technique. For heamato-biochemical evaluation, blood samples were collected from either the cephalic or saphenous vein of all six dogs and were analyzed for various parameters including Total Erythrocyte Count (TEC) (10^6 cells/mm3), Total Leukocyte Count (TLC) (10^3cells/mm3), Hemoglobin (Hb) (g/dL), and Differential Leukocyte Count (DLC) (%). The analysis was performed using the Mindray BC-2800 Vet automated hematology analyzer. Biochemical parameters like serum calcium (mg/dL), serum phosphorus (mg/dL), alanine amino transaminase (IU/L), alkaline phosphatase (IU/L) and serum creatinine (mg/dL) were evaluated using RX-50 Biochemical semi auto analyser prior to surgery. The data regarding haematological and biochemical parameters were statistically analyzed by One-way Analysis of Variance (ANOVA), using Graph pad prism software package.

3. Results and Discussion

3.1 Haematological parameters

3.1.1 Total Erythrocyte Count (TEC) (10^6cells/mm^3)

In the current study, Mean ± SE values of total erythrocyte count (10^6 cells/mm^3) post-operatively varied from 5.92±0.46 to 6.92±0.53 (Table.1). All the values of total erythrocyte count were observed to be within the normal physiological limits and were statistically non-significant (P>0.05). The non-significant increase in total erythrocyte count upto 45th post-operative days may be due to erythropoiesis. This was in agreement with the observations of Dayamon (2009) [3], Mahesh (2009) [7], Tembhurne *et al*. (2010) [18] and Rajhans (2013) [15].

3.1.2 Haemoglobin (g/dL)

Mean ± SE values of haemoglobin (g/dL) post-operatively varied from 13.43±1.47 to 14.82±1.35 (Table.1). These variations were within the normal physiological limits and were statistically non-significant (P>0.05). These non-significant fluctuations could potentially result from minimal hemorrhage experienced during the surgery. A non-significant increase in haemoglobin levels upto 45th post-operative day could be due to erythropoiesis. Similar observations were made by Marvania *et al*. (2020) [8], Ranjith (2021) [16] and Pooja (2023) [13].

3.1.3 Total Leucocyte Count (TLC) (10^3cells/mm^3)

Mean ± SE values of total leucocyte count (10^3cells /mm3) post-operatively varied from 9.93±1.61 to 13.56±1.93 (Table.1). Leucocytosis was observed in the pre-operative period and gradually reduced after two weeks. This could be due to the release of cortisol in response to stress, trauma, pain, anaesthesia, surgical manipulation, and inflammation at the surgical site. This was in agreement with Mahesh (2009) [7] who noted leukocytosis upto the third post-operative day. Ojus *et al*. (2022) [10] also had similar findings.

3.1.4 Differential leukocyte count (DLC) (%)

Mean ± SE value of neutrophils (%), lymphocytes (%), monocytes (%) and eosinophils (%) counts post-operatively varied from 65.73±3.62 to 70.08±3.55, 21.87±3.86 to 26.47±2.90, 4.18±0.52 to 5.57±0.41 and 4.78±0.88 to 6.13±0.98 respectively during the study period and there was non-significant (P>0.05) difference in the mean values of the different leucocytes (Table.1). Similar findings were reported by Zama *et al*. (1999), Dayamon (2009) [3], Mahesh (2009) [7], Rajhans (2013) [15], Marvania *et al.* (2020) [8] and Ranjith (2021) [16].

3.2 Biochemical parameters

3.2.1 Serum creatinine (mg/dL)

In the current study, Mean ± SE values of serum creatinine (mg/dL) post-operatively varied from 0.97±0.11 to 1.23±0.10 (Table.2, Fig.1). All the values of serum creatinine were observed to be within the normal physiological limits and were statistically non-significant (P>0.05). This might indicates normal kidney function after surgical intervention. Similar findings were reported by Ranjith (2021) [16] and Pooja (2023) [13].

3.2.2 Alanine Amino Transferase (ALT) (IU/L)

In the current study, mean ± SE values of serum alanine amino transferase (IU/L) post-operatively varied from 29.13±2.12 to 37.03±4.62 (Table.2, Fig.2). All the values of serum alanine amino transferase were observed to be within the normal physiological limits and were statistically non-significant (P>0.05). This might indicates normal hepatic function after surgical intervention. This was in agreement with the observations of Ranjith (2021) [16] and Pooja (2023) [13].

3.2.3 Calcium (mg/dL)

In the current study, Mean ± SE values of serum calcium (mg/dL) post-operatively varied from 9.04±0.42 to 9.79±0.92 (Table.2, Fig.1). Slight rise in serum calcium was observed in initial two weeks of surgery reaching maximum on 7th post-operative day. Even though all the values of serum calcium were observed to be within the normal physiological limits and were statistically non-significant (P>0.05). The increased levels of serum calcium in the initial week of surgery may be due to increased osteoclastic activity, which leads to resorption of necrotic bone. The gradual reduction in serum calcium after first week of surgery may be due to lowered extracellular calcium levels, thus stimulating the release of calcium metabolizing hormones, as documented by Bush (1991) [2], Kumar *et al*. (2018) and Ojus *et al.* (2022) [10].

3.2.4 Phosphorous (mg/dL)

In the current study, Mean ± SE values of serum phosphorous (mg/dL) post-operatively varied from 2.55±0.61 to 3.66±0.39 (Table.2, Fig.1). Slight reduction in serum phosphorous was observed in initial two weeks of surgery reaching minimum on 7th post-operative day. The gradual decrease in serum phosphorus concentration could potentially be attributed to osteoblastic activity occurring at the fracture site, which was associated with the process of fracture healing, as documented by Bush (1991) [2], Kumar *et al.* (2018) [5] and Ojus *et al.* (2022) [10].

3.2.5 Serum alkaline phosphatase (IU/L)

In the current study, Mean ± SE values of serum alkaline phosphatase (IU/L) post-operatively varied from 110.28± 8.48 to 157.75±13.01 (Table.2, Fig.2). The Mean ± SE values of serum alkaline phosphatase (IU/L) were significantly (P< 0.05) increased from the day before surgery to maximum on 7th day and later the values gradually decreased. All the values obtained were within the normal physiological limits. The

increased levels of ALP could be linked to the proliferation of osteogenic cells present at the fracture site. It's likely that the periosteum of the damaged bone makes the most significant contribution to the elevated serum ALP levels. Similar results were documented by Prachasilpchai *et al.* (2003) [14], Hegade *et al.* (2007) [4], Mahendra *et al.* (2007) [6] and Phaneendra *et al.* (2018) [12].

Table 1: Mean ± SE values of total erythrocyte count (10^6 cells/mm^3), haemoglobin and total leukocyte count (10^3 cells/mm^3) and differential leukocyte count (%) in dogs

Days	TEC (10^6 cells/mm^3)	Haemoglobin (g %)	TLC (10^3 cells/mm^3)	Neutrophils (%)	Lymphocytes (%)	Monocytes (%)	Eosinophils (%)
Before surgery	7.03±0.27	15.68±0.86	15.47±1.30	76.53±4.84	17.73±4.21	3.70±0.27	5.25±1.39
0	5.92±0.46	13.43±1.47	9.93±1.61	70.08±3.55	21.87±3.86	4.18±0.52	5.03±0.95
7	6.23±0.45	13.83±1.33	13.56±1.93	67.52±4.53	25.40±3.80	4.52±0.61	5.37±1.06
14	6.55±0.46	14.50±1.35	12.07±1.67	65.73±3.62	26.47±2.90	5.08±0.18	5.10±0.92
28	6.65±0.45	14.82±1.35	10.77±1.78	68.88±3.94	25.27±3.99	5.18±0.33	5.18±0.88
45	6.92±0.53	14.73±1.56	10.80±1.26	66.10±4.19	26.35±3.51	5.57±0.41	6.13±0.98
60	6.50±0.56	14.12±1.63	10.28±1.91	67.17±3.13	24.82±1.99	4.35±0.42	4.78±0.88

Table 2: Mean ± SE values of serum creatinine (mg/dl), serum calcium (mg/dl) serum phosphorous (mg/dl), serum alkaline phosphatase (IU/L) and serum alanine amino-transferase (IU/L) in dogs

Days	Creatinine (mg/dL)	Calcium (mg/dL)	Phosphorus (mg/dL)	Alkaline Phosphatase (IU/L)	Alanine Amino-Transferase (IU/L)
Before surgery	1.18±0.09	10.01±0.41	3.97±0.46	109.80±9.62[a]	39.82±8.71
0	0.97±0.11	9.48±0.48	3.61±0.56	110.28±8.48[a]	31.85±4.28
7	1.01±0.08	9.79±0.92	2.55±0.61	157.75±13.01[b]	29.13±2.12
14	1.10±0.09	9.65±0.50	3.09±0.62	146.62±10.73 [a]	37.03±4.62
28	1.23±0.10	9.69±0.44	3.66±0.39	137.90±8.67 [a]	35.35±6.95
45	1.16±0.15	9.26±0.63	3.08±0.33	139.48±9.85 [a]	34.62±5.04
60	1.03±0.12	9.04±0.42	3.20±0.34	150.78±5.30 [a]	29.22±2.45

Note: Data was analysed by one-way ANOVA followed by *Tukey's post hoc* multiple comparison test. Values bearing dissimilar superscripts within the column vary significantly ($p<0.05$)

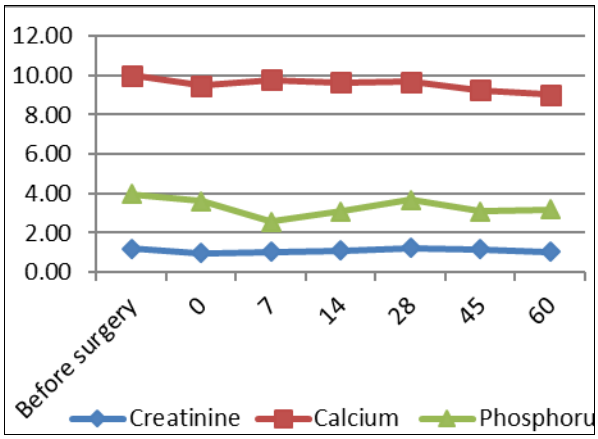

Fig 1: Changes in Serum Creatinine, Calcium, Phosphorus values during the study period.

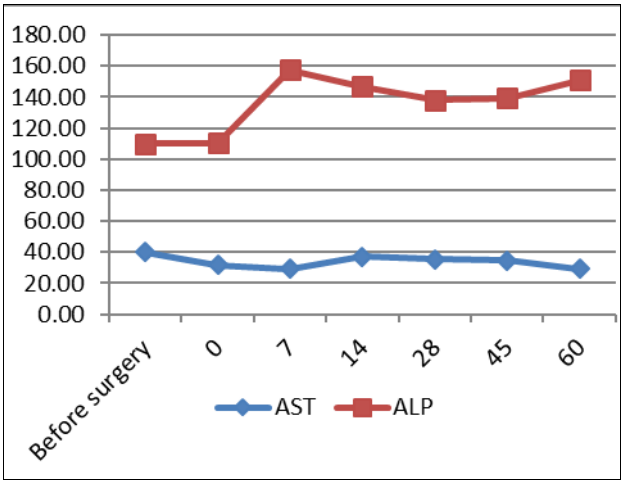

Fig 2: Changes in Serum Alkaline Phosphatase (IU/L) and Serum Alanine Amino-Transferase (IU/L) during the study period

4. Conclusion

The current study details the changes in haemato-biochemical parameters throughout the various stages of fracture healing. Hematological parameters showed no significant deviations in any of the six dogs. Leucocytosis was observed in the pre-operative period and gradually reduced after two weeks. All other parameters remained within the normal physiological range. Serum biochemical studies revealed no significant variations in the creatinine, alanine amino transferase, calcium and phosphorous values and varied within the normal physiological range. However serum alkaline phosphatase were significantly increased from the day before surgery to maximum on 7th day and later the values gradually decreased. The changes in biochemical parameters were attributed to osteoblastic activity, new bone matrix formation, and mineralization. Their correlation with the stages of fracture healing provides a valuable tool for assessing bone healing, alongside physical and radiographic examinations

5. Conflict of Interest

Not available

6. Financial Support

Not available

7. References

1. Altissimi M, Antenucci R, Fiacca C, Mancini GB. Long-term results of conservative treatment of fractures of the distal radius. Clin Orthop Relat Res. 1986;206:202-210.
2. Bush BM. Plasma biochemistry. In: Interpretation of laboratory results for small animal clinicians. USA: Blackwell Science Ltd; c1991. p. 94-95.
3. Dayamon DM. Comparison of type Ia single and double connecting bar external skeletal fixation for femoral fracture repair in dogs. M.V.Sc. thesis, Karnataka

Veterinary Animal and Fisheries Sciences University, Bidar, India; c2009.
4. Hegade Y, Dilipkumar D, Usturge S. Comparative evaluation of biochemical parameters during fracture healing in dogs. Karnataka J Agric Sci. 2007;20:694-695.
5. Kumar KM, Prasad VD, Lakshmi ND, Raju NK. Evaluation of biochemical parameters for assessment of fracture healing in dogs. J Pharm Innov. 2018;7(3):577-580.
6. Mahendra AM, Ranganath L, Vasanth MS. Effect of polymethylmethacrylate in femoral fracture repair on hemato-biochemical parameters in dogs. Indian Vet J. 2007;84:587-589.
7. Mahesh V. Studies on external skeletal fixation for radius fracture treatment in dogs. Ph.D. thesis, Karnataka Veterinary Animal and Fisheries Sciences University, Bidar, India; c2009.
8. Marvania NT, Tank PH, Vadalia JV, Singh VK, Kamaliya RU. Comparative assessment of minimally invasive plate osteosynthesis and open plating for repair of long bone fractures in dogs. Indian J Vet Surg. 2020;41(1):1-5.
9. Newton CD, Nunamaker DM. In: Textbook of Small Animal Orthopaedics. 1st ed. Philadelphia: J.B. Lippincott Co.; c1985. p. 185-94, 261-2.
10. Ojus S, Dilipkumar D, Bhagvantappa B, Vijaykumar M, Halmandge S, Manjunath P, Venkatgiri. Physiological and biochemical analysis of dogs undergoing femoral fracture repair using advanced LCP system II and locking compression plate. Pharma Innov. 2022;11:1137-1141.
11. Perren SM, Buchanan JS. Basic concepts relevant to the design and development of the point contact fixator (PC-Fix). Injury. 1995;26:1-4.
12. Phaneendra M, Lakshmi N, Nath M, Raju N, Adilaxmamma K. Evaluation of biochemical and haematological parameters for assessment of compound fracture healing in dogs with local antibiotic treatment. Int J Livest Res. 2018;8(4):138-143.
13. Pooja D. Supracondylar femoral fracture treatment using a modified dynamic condylar screw (DCS) plate with a lag screw in dogs. M.V.Sc. thesis, Karnataka Veterinary Animal and Fisheries Sciences University, Bidar, India; c2023.
14. Prachasilpchai W, Bupha-Intr T, Kalpravidh M, Sarikaputi M. Serum bone-specific alkaline phosphatase of dogs with various bone conditions. Thai J Vet Med. 2003;33:81-90.
15. Rajhans M. Stabilisation of splinters of long bone fracture in dogs. M.V.Sc. thesis, Nanaji Deshmukh Veterinary Science University, Jabalpur, India; c2013.
16. Ranjith KM. Studies on the use of reconstruction plates for pelvic fractures repair in dogs. M.V.Sc. thesis, Karnataka Veterinary Animal and Fisheries Sciences University, Bidar, India; c2021.
17. Sharma M, Sarma DK, Boro PK. Fixation of distal end femoral fracture in a dog with arrow pinning: a case report. Int J Curr Microbiol App Sci. 2018;7(3):2161-2164.
18. Tembhurne RD, Gahlod BM, Dhakate MS, Akhare MS, Upadhaye SV, Bawasker S. Management of femoral fracture with the use of horn peg in canine. Vet World. 2010;3(1):37-41.
19. Zama MMS, Gupta OP, Singh GR, Swarup D. Post-operative acupuncture therapy in fracture of femur. Indian J. Vet. Surg. 1999;20(2):86-87.

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