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Hematobiochemical changes of metacarpal and metatarsal fractures stabilised with external skeletal fixators in goats

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Abstract
The present study was carried out to evaluate the haematobiochemical changes in goats with metacarpal and metatarsal fracture stabilised by novel type II external skeletal fixators. Haematological parameter such as total erythrocyte count, total leucocyte count, differential leucocyte count, haemoglobin, packed cell volume and biochemical parameters such as serum calcium, phosphorus, alkaline phosphatase were determined pre-operatively and on 15th, 30th, and 45th post-operative days. Statistical analysis showed highly significant difference (p<0.01) in lymphocytes (L), calcium (Ca), phosphorous (P) and alkaline phosphatase (ALP) values at different post-operative days. Total white blood cell count (WBC), neutrophil (N), monocyte (M) and eosinophil (E) counts showed significant difference (p<0.05) at different post-operative days. No significant difference was found in haemoglobin (Hb), packed cell volume PCV), total erythrocyte RBC) and basophil (B) count at different post-operative days and the values were within the normal range. Haematological and biochemical parameter along with clinical and radio graphical evaluation gives the detailed information on the fracture healing.

Keywords: Goat, metacarpal, metatarsal, fracture, biochemical

Introduction
Fracture is a break in the continuity of hard tissue. Bone is having unique feature among the tissues; it heals by regeneration and not by scar formation. Clinical evaluation and radiological study are the foundation of fracture union. The study of bone mineral density, scintigraphy and bone histomorphometry provides the information on bone macrostructure, integrity, quantity and outcome of healing. The haematological and biochemical parameters provide a clear picture on the ongoing process of fracture healing, bone resorption and delayed healing (Kumar *et al.*, 2018) [7]. Automobile accident is a major factor for fracture in goats. Other factors such as jumping, fight between animals, falling from height, dog chasing and intentional kicking are responsible for fracture. Fracture of long bones in small ruminants force the owner to sell the animal at lower price, which causes economic loss (Kumar *et al.*, 2016) [6].

The fracture can be treated by external fixation or internal fixation. The external fixation with plaster of Paris or fibre glass is economical however it is having certain constrains like mal union, non or delayed union (Singh *et al.*, 1984; Doijode 2018) [11, 2]. External skeletal fixators (ESF) give greater chance to utilize the biological capacity of healing in the fracture area (Bojrab, 2014) [1]. External skeletal fixators (ESF) are three types *viz* Circular External Skeletal Fixators (CESF), Linear External Skeletal Fixators (LESF) and Hybrid External Fixators (HEF). The design and material utilized to make the fixator determine its stiffness, which differs amongst various fixator designs. (Sravanti *et al.*, 2022) [13]

Haematological values are playing a key role in fracture healing monitoring. Any variation in the normal range is indication of complication with infection and it needs prompt attention; otherwise, the union will be delayed. The haemogram is a reflection of what is occurring in the body and it helps the clinicians to assess the health condition of the body (Kumar *et al.*, 2016) [6]. Additionally, one can utilize the biochemical parameters to track the results of therapy and detect any early signs of a healing process disruption. (Reddy *et al.*, 2020) [10]. Hence the current work was undertaken to study the haematological and biochemical parameters in goats with metacarpal and metatarsal fractures stabilised with external skeletal fixators.

Materials and Methods

The current work was conducted in twenty goats with the history metacarpal or metatarsal fractures presented at Veterinary Clinical Complex, Veterinary College and Research Institute, Tirunelveli and Namakkal, Tamil Nadu. Fractures were immobilised with novel type II external skeletal fixators (ESF). Blood samples were collected from each animal preoperatively and on 15th, 30th and 45th post-operative day in EDTA and non-EDTA vials for haematological and biochemical analysis. Haematological parameters *viz* Hb, PCV, RBC, WBC count and differential leukocyte count were analysed using automated hematology analyser. Serum was separated and biochemical parameters *viz* serum Ca, P and ALP were estimated by automated biochemistry analyser. The data obtained from hemato-biochemical evaluation was analyzed using one-way ANOVA by statistical programme SPSS 20.

Results and Discussion

Hematological parameters

The mean ± SE values of haematological parameters *viz*: Hb, PCV, RBC, WBC and differential leukocyte count were given in Table1.

Table 1: Hematological parameters

S. No.	Days / Parameters	0	15	30	45	F value
1.	Hb	8.99±0.46	9.28±0.37	9.47±0.28	9.90±0.20	1.25
2.	PCV	27.15±1.03^{a}	27.07±0.83^{a}	28.47±0.62^{ab}	29.61±0.53^{b}	2.40
3.	RBC	10.05±0.71	10.06±0.53	10.21±0.43	10.27±0.30	0.22
4.	WBC	17.28±1.10^{b}	16.97±0.83^{b}	16.23±0.62^{b}	12.94±0.51^{a}	6.26*
5.	N	45.11±1.85^{b}	44.17±1.32^{b}	41.61±0.87^{b}	37.94±0.71^{a}	6.39*
6.	L	46.61±2.19^{a}	48.17±1.27^{a}	52.67±0.74^{b}	56.78±0.63^{c}	11.53**
7.	M	3.44±0.39^{b}	3.50±0.22^{b}	2.33±0.29^{a}	2.11±0.23^{a}	6.31*
8.	E	4.56±0.38^{c}	3.78±0.29^{bc}	3.11±0.31^{ab}	2.83±0.23^{a}	6.23*
9.	B	0.28±0.11	0.44±0.12	0.28±0.11	0.33±0.11	0.48

Superscript a, b and c depicting significant change (p<0.05 and p<0.01on different days

The mean ± SE values of Hb, PCV and RBC on various post-operative days fluctuated non-significantly (p>0.05) around their normal reference range. When compared to pre-operative readings, these values were greater on the 45th post-operative day. The non-significant increase in the Hb and PCV values from 0th day to 45th day was within the normal reference range. The increase of Hb, PCV and RBC from pre-operative days to post-operative days was observed. These values were greater on the 45th post-operative day indicates of well-balanced diet and proper care of the affected animals. The low Hb, PCV and RBC values on 0th day (preoperative) may be due to blood loss, stress at the time of surgery and fracture. These observations were in accordance with the results of Uwagie-Ero *et al.* (2016) [17] in dogs and Sravanti *et al.* (2022) [13] in sheep and goats.

The results of hematological parameters showed that the WBC count was significantly (p<0.05) high on 0th day and gradually decrease from 15th day and 30th day. On 45th day the WBC count significantly decreased and remained within the normal range. This is in agreement with Reddy *et al.* (2020) [10]; Gabriel *et al.* (2014) [3] and Kumar *et al.* 2016 [6]. The leukocytosis may be due the acute inflammation and bacterial infection on 0th day and this was reduced in consecutive days by treatment that leads to reduction in the leukocyte and indicate complete recovery of fracture.

Significant raise in the N count was seen on the 0th day then significant (p<0.05) decrease was seen from 15th day onwards. This was in compliance with Hoque (1996) [4] and Kumar *et al.* (2016) [6] also find increase in neutrophil value, immediately after surgery then decrease, after which it varied within normal reference range. Increased neutrophil values on 0th day and after surgery might be due inflammation and chemical mediators. In all animals, the neutrophil count was greater before surgery then it decreased. This might be the result of a diminished inflammatory response that promotes fracture healing.

Highly significant decrease in lymphocyte count was seen on 0th day then, highly significant increase (p<0.01) was seen from 15th day. These results were accordance with Tembhurne, (2010) [14] in canines, Kumar *et al.* (1999) [8] in calves and Kumar *et al.* (2016) [6] in goats. Lymphocyte count was low in on 0th and 15th day may be due to relative increase in neutrophil count it was due to surgical manipulation and inflammatory response, which in turn activates the production of cytokines by macrophages. The production of gulcocoticoides is increased and the adrenal axis is activated by cytokines. Lyses of lymphoid tissue and circulating lymphocytes could result from an increase in the concentration of gulcocorticoids. (Kaneko, 1997) [5].

The mean monocytic and eosinophilic count showed significant (p<0.05) changes at various time points in the animals but fluctuated within the normal range whereas Sravanti *et al.* (2022) [13] observed that during fracture healing in sheep and goats, the monocyte and eosinophil count showed non-significant fluctuations at various time intervals.

Serum Biochemical Parameters

The mean ± standard error of biochemical values *viz* Ca, P and ALP are given in Table 2.

Table 2: Biochemical parameters

S.No.	Days / Parameters	0	15	30	45	F value
1.	Ca	10.09±0.19^{b}	9.13±0.14^{a}	9.96±0.08^{b}	10.09±0.15^{b}	10.12**
2.	P	5.03±0.16^{b}	4.16±0.09^{a}	4.96±0.08^{b}	4.99±0.09^{b}	15.09**
3.	ALP	123.53±3.64^{ab}	145.51±3.12^{c}	126.81±2.52^{b}	117.98±1.96^{a}	17.17**

Superscript a, b and c depicting significant change (p<0.01) on different days

The mean ± SE values of Ca on various post-operative days fluctuated significantly (p<0.01) around normal reference range. The calcium values were decrease gradualy by 15th post-operative day then start increasing and reached the normal level at 45th postoperative day. The calcium values in all the animals varied within normal reference range. This is in accordance with sesults of Soliman and Hassan (1964) [12]; Sravanti *et al*. (2022) [13] they observed that after initially decreasing, the mean calcium concentration increase once again, reaching or exceeding initial values. however Umarani and Ganesh (2003) [16] showed that goats treated for fractures experienced a significant decrease in serum calcium levels on the seventh post-operative day, which was followed by a noticeable increase from the 15th to 60th day.

The mean ± SE phosphorus values on various post-operative days fluctuated significantly (p<0.01) around their normal reference range. The present observations were in line with those of Uma Rani and Ganesh (2003) [16]; Sereventhi *et al.* (2022) [13].

The serum alkaline phosphatise values on different post-operative days varied significantly (p<0.01) around normal reference range. The alkaline phosphatase readings gradually increase by the 15th post-operative day, then fell and returned to normal range by the 45th postoperative day. From the pre-operative day to the 15th post-operative day, serum alkaline phosphatase values increased significantly, indicating enhanced chondroblastic and osteoblastic activity and bone production during fracture healing. (Maiti *et al.,* 1999) [9]. The findings were in line with Uma Rani *et al.* (1999) [15] and Sravanti *et al.* (2022) [13] in goats they stated that by the 45th post-operative day, serum alkaline phosphatase levels returned to normal, indicating that the fracture site had fully healed.

Conclusion

According to the findings of the current study, haematological and biochemical values can be used as a marker in evaluating fracture healing. Clinical and radiographic evaluation, together with haematological and biochemical parameters offer detailed information on the degree of fracture healing.

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