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Changes in Body and Hematological Parameters Following the Use of Bone Plates in Management of Tibial Fracture in Kano Brown Goats

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Abstract: Daily body and hematological parameters were recorded following an attempt to manage clinical compound fractures of 18 healthy Kano Brown goats using Sherman's compression plates via internal reduction. The hematological parameters before during and after surgery were determined by full blood count. The results showed that inflammatory cells such as nuetrophils, esinophils and lymphocytes were at their peak when the implants were in the body of the animals. There was significant increase ($p<0.05$) in total leukocyte counts a week after surgery. This increase could be attributed to the presence of bone plates. Other parameters such as body temperature, pulse rate, respiratory rate were recorded for 160 days. Body temperature, respiratory and pulse dropped to normal physiologic rates after implants were removed and healing was complete. It was concluded that implants plays important role in stimulating leukocytosis.

Key words: Sherman's bone plates, hematological parameters, body temperatures, healing, leukocytosis

INTRODUCTION

Body and hematological changes in relationship to foreign objects/metals in the body as it relates to fracture is a product of inflammatory process during healing. The haemogram is a mirror image of the happenings in the body as it particularly guides and directs clinicians towards the health status of the body. Cells such as red blood cells, lymphocytes, monocytes, segmented nuetrophils, esinophils and basophils are important in wound healing. According to MacRae (1981) fracture healing as been divided into three phases, Inflammatory, reparative and re-modeling phases.

The inflammatory phase is further divided into two sub phases; formation and organization of fracture hematoma invasion by inflammatory cells. It is believed that fracture hematoma is formed as soon as the bone breaks (Muller *et al*., 1979). Its source is ruptured blood vessel of the periostium, bone cortex, bone marrow and the surrounding soft tissues. The ends of the ruptured vessels soon cloth with little bleeding into the fracture site within 24 h (Stienidler, 1985). The ends of the fractured bone, robbed of their blood supply, die off (avascular necrosis). This sub phase occurs in the 1st 2 days following fracture.

As reported by Hamblen (1979), fracture hematoma begins to organize within a few hours. After this the fracture site in invaded by inflammatory cells, notably multinuclear phagocytes and monocytes which set off to phagocytose necrotic and other non-necrotic debris including implants as previously observed by Hamblen (1979). This process of phagocytosis continues for days or weeks depending on the amount of tissue to be removed. It is believed that this sub phase occupies mainly the 2nd and 5th post fracture day. The haemogram picture during the period coincided with an increase in level of inflammatory cells in circulation and a rise in body temperature (McKibbin, 1978).

MATERIALS AND METHODS

This study took place in the Faculty of Veterinary Medicine, Ahmadu Bello University Zaria, North West of Nigeria. Eighteen clinical cases of fracture of the tibial bone were used for this study. Animal were divided into 2 groups; A and B by simple random sampling technique. Group A had their fracture immobilized with bone pates without the use of bone cement while group B were the study group had their fractures immobilized with bone plates with the use of bone cement.

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The experimental animals were allowed a 24 h acclimatization before the surgery commenced. Vital parameters such as body temperature, body weight, pulse rate, respiratory rate, age and status of the animal were taken. Blood was taken from all animals to establish the base line haemogram prior to surgery.

The 2 mm of blood were obtained from each goat through the jugular vein using a 21G 1½ needle (Discard IT®, Beton Dickinson, England). Sample was placed in a bottle containing 1 mg of Ethylene Diamine Tetra Acetic acid (EDTA) and divided into two, properly labeled bottles and sent to the protozoology and haematology laboratory of Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria for analysis. Blood sample were analyzed for Packed Cell Volume (PCV) total leukocyte count (WBC), differential WBC counts as well as total plasma protein using an automated analyzer.

Automated hematology counters; automated machines have at least two channels for cell counting. In one channel red blood cells and platelets analyzed and in the other, white blood cells are analyzed. Extra channels are used for the differentials cell counting and reticulocyte counting. There are basically two methods for cell counting and sizing which are electrical impendence and light scattering. Although, automated instruments are sophisticated they cannot recognize all the significant abnormalities that can be recognized by the human eye. Therefore they are designed to produce accurate and precise blood counts on specimens which are either normal or show only numerical abnormalities and to alert the operator when the specimen has unusual measurement or which would required a blood film review (Health, 2012).

Post surgical haemogram were also obtained at 3 and 16 weeks (after implants use removed) after surgery. Rectal temperatures were recorded for 160 days using digital thermometers pre during and post surgery. Respiratory and pulse rates were also recorded pre during and post surgery to 160 days.

Post operative radiographs were taken at 0, 2 (Fig. 1), 4 (Fig. 2), 8, 12(Fig. 3) and 16 weeks to evaluate the extent of healing. After healing, a second surgery was carried out to harvest the implants (Figure 4-6 show tibia bone 4 weeks after bone plates were harvested). Haemogram picture before surgery, 1 week post surgery and 1 week after the implant was removed were properly recorded.

Surgical procedure: The surgery was carried out via the bone plating technique as described by Piematti and Greely.

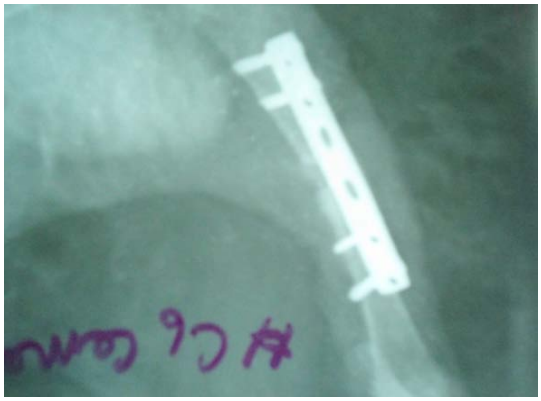

Fig. 1: Study group B, plated with compression bone plate

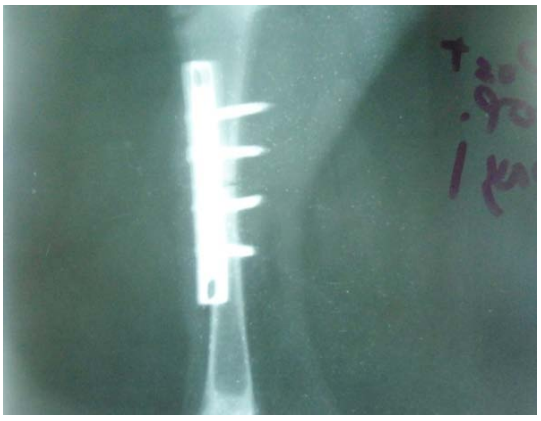

Fig. 2: Control group A, plated with compression bone plate

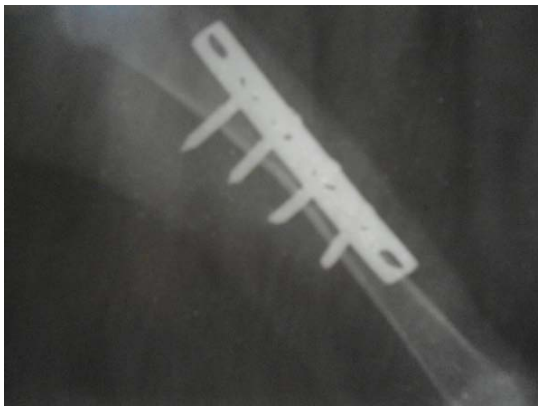

Fig. 3: Study group B, plated with compression plate

Statistical analysis: Statistical analysis using two tailed student test was used to compare the mean values between and within groups and was found to be significant ($p<0.05$).

Fig. 4: Study group B, 4 weeks after implant was harvested. Black arrow indicates fracture site

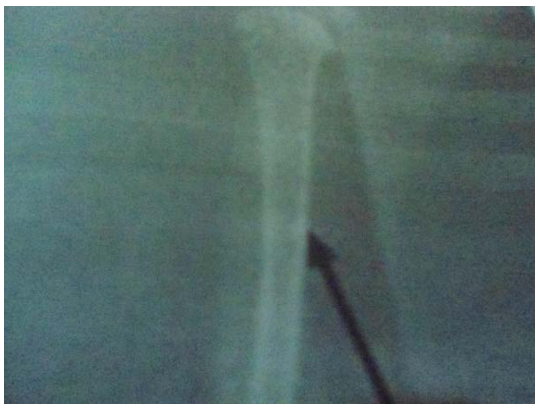

Fig. 5: Control group A, 6 weeks after the implant was harvested. Black arrow indicates fracture site

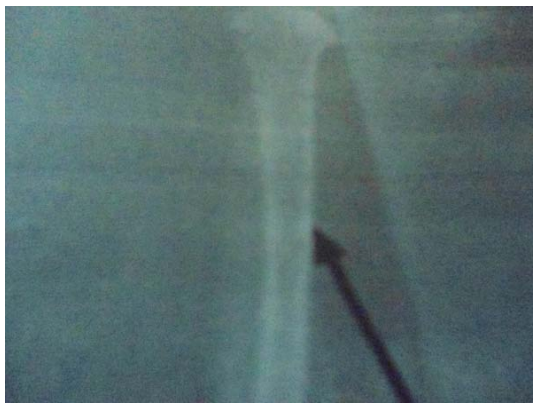

Fig. 6: Study group B, 3 weeks after implant was harvested. Black arrow indicates fracture site

RESULTS AND DISCUSSION

Packed Cell Volume (PCV) pre-surgery dropped from 28.5, 25.5% during surgery to 27.1% post-surgery with a mean PCV of 26.9% for group A goats, White Blood Cells (WBC) was 8.2% before surgery, rose to 10.1% and later dropped to 8.0% post surgery with a mean WBC 8.7%. Total protein before surgery was 5.6 g dL^{-1} during surgery 3.9 g dL^{-1} and post surgery 4.6 g dL^{-1} (Table 1).

For group B goats that were treated with bone cement as the study group, PCV pre-surgery was 29.5, 25.5% during surgery and 27.7% post-surgery with a mean pcv of 27.4%. White blood cells pre-surgery was 8.3% during surgery 11.6% and post surgery 9.3% with a mean WBC 9.3%. Total protein before surgery was 5.1 g dL^{-1} during surgery 4.1 g dL^{-1} and post surgery 4.6 g dL^{-1} (Table 2).

Mean body temperature, pulse rate and respiratory rates for both group A and B were temperature pre-surgery 38.7°C during surgery, 39.4°C and post surgery 38.1°C. While pulse rates were 75.1, 75.6 and 75.4 beats/min pre during and post surgery. Respiratory rates 29.8, 30.7 cycle/minute pre during and post surgery (Table 3).

Radiographic evaluations of Fig. 1-3 indicate perfect alignment and commencement of callus formation with evidence of healing. Figure 4-6 show complete bone healing 4 weeks after implants were harvested with evidence of bone remodeling in progress.

The significant increase ($p<0.05$) in total leucocytes count weeks after artificially creating the fractures could be attributed to the presence of bone plates. This feature occurred in both groups of goats, suggesting the role of the implant in stimulating leukocytosis response similar to the observation of McKibbin (1978). The leukocytosis response disappeared as the implants were removed one week after surgery in all the animals used for study. The PCV values also dropped 1 week post operatively for both groups. For example, the mean PCV before surgery was 29.5±0.5% this dropped to 25.3±03% 1 week after surgery and subsequently rose to 27.1±0.3% 1 week after the implant were harvested. The initial decrease in PCV level immediately after the surgery could be attributed to blood loss during the surgical procedure. The hematopoietic activity probably picked up as the normal physiologic activity was restored. The rise in total protein post surgery for both groups indicate post surgery recovery as the animals appetite improved considerably as healing progressed.

Mean values recorded during surgery indicate a mean temperature of 39.4±0.5°C, pulse rate 75.6±0.3 beats min^{-1} and respiratory rate of 30.7±0.8 cycles min^{-1} these were the values when the implants were in the animal these values dropped to normal physiologic level when the implants were removed. From literature and in this study, the rise in temperature at the time the implant was in the animal coincided with the

Table 1: Mean hematological parameters in Kano Brown Goats with tibial fractures treated within out Bone cement (Group A; 9 animals aged between 6-11 months)

Blood parameters	PCVS (%)	WBC (%)	N (%)	L (%)	E (%)	M (%)	BAS	Total protein (g dL^{-1})
Pre surgery	28.5	8.2	37.5	51.8	1.1	0.7	0	5.60
During surgery	25.5	10.1	26.4	60.3	1.6	0.5	0	3.90
Post surgery	27.1	8.0	27.4	56.1	1.5	0.6	0	4.60
Mean	26.9	8.7	30.4	56.0	1.4	0.6	0	4.70
SD	±0.3	±0.2	±0.4	±0.4	±0.1	±0.1	-	±0.15

PCV: Packed Cell Volume; WBC: White Blood Cell; N: Nuetrophils; L: Lymphocytes; E: Eosinophis; M: Monocytes; g/dL: gram per decilitre; SD: Standard Deviation; BAS: Baseophil

Table 2: Mean hematological parameters in Kano Brown Goats with tibial fracture and bone cement application (Group B; 9 animals aged 15-20 months)

Blood parameters	PCV (%)	WBC (*10^5/2)	N (%)	L (%)	E (%)	M (%)	BAS	Total protein (g dL^{-1})
Pre surgery	29.5	8.3	37.5	55.7	1.3	1.0	0	5.10
During surgery	25.3	11.6	31.0	71.4	2.0	0.7	0	4.10
Post surgery	27.7	8.1	31.2	53.2	1.1	0.6	0	4.60
Mean	27.4	9.3	33.9	60.1	1.4	0.7	0	4.60
SD	±0.3	±0.2	±0.4	±0.4	±0.1	±0.1	-	±0.15

PCV: Packed Cell Volume; WBC: White Blood Cell; N: Nuetrophils; L: Lymphocytes; E: Eosinophis; M: Monocytes; g/dL: gram per deciliter

Table 3: Mean body temperature, pulse rate and respiratory rate changes in Kano brown goat treated with or without bone cement

Blood parameters	Temperature (°C)	Pulse rate (B m^{-1})	Respiratory rate (c m^{-1})
Pre surgery	36.7	75.1	29.8
During surgery	39.4	75.6	30.7
Post surgery	38.3	75.4	30.5
Overall mean	38.1	75.7	30.3

period when inflammatory cells were at their peak as indicated by the haemogram of this study. According to Patel and Geerts (2011), the *in vitro* study they carried out on temperature change along dental implant supports the hypothesis that body temperature rises with presence of implants.

After the implants were removed body temperature reverted back to normal probably because the implant being an exogenous material had initiated a marked inflammatory response. Statistical analysis using two tailed student was used to compare the mean values between and within groups and was found to be significant ($p<0.05$).

CONCLUSION

The body and hematological parameters recorded were at its peak when the implants were in the animal this could be concluded to mean that exogenous materials like bone plates can cause leukocytosis and rise in other body parameters like temperature, pulse and respiratory rates.

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