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Haematological Studies in the Dogs Having Long Bone Fractures Treated with Plate Rod Construct

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A B S T R A C T

Eight cases of long bone fractures of femur and humerus were treated with plate rod construct, whereas, the preoperative anterio- posterior (AP) and lateral radiographs (L) of fractured limb were taken. Diazepam (0.2 mg/kg) was administered intravenously, 10 minutes prior to induction of general anaesthesia with thiopentone sodium (15 mg/kg body weight) followed by maintained with isoflurane (1.5 - 2.0 %). the plate rod construct was applied by craniolateral approach in case of humerus and femur bone in dogs. The mean haematological values of haemoglobin, Packed Cell Volume and Platelates before surgery and on 7th day, 21st day, 30th day, 45th day and 60th day of surgery did not significantly differ within group. The mean alkaline phosphatase increased up to 45 days and subsequently decreased at 60 days. The mean cortisol values were higher before surgery, but the non-significant decrease in mean serum cortisol values were seen during fracture healing period and they returned to normal on 60 days.

Introduction

Plate rod construct is commonly used in canine fracture repair. It provides the double strength to the bone for fracture stabilization. The other advantage of this technique is that the pin used in the combination increases stiffness and rigidity which helps in healing of fracture by plate protection from bending. The combination of plate rod is acting as two bims (Hulse *et al.*, 1997). The advantages of this technique are yet to be popularize in Veterinary practice hence very few people are using this technique

Materials and Methods

The present study was conducted on eight clinical cases in canine having fractures of long bones, presented to the Department of Surgery, Mumbai Veterinary College, Parel and Bai Sakarbai Dinshaw Petit Hospital for

Animals, affiliated animal hospital with the College. The preoperative radiographs of fractured limb in anterio-posterior and lateral position were taken. All the orthopaedic surgeries were performed under general anaesthesia using isoflurane inhalation anaesthesia by giving atropine sulphate (0.04 mg/kg) and dexamethasone (0.5 mg/kg) subcutaneously half an hour prior to surgery. Diazepam (0.2 mg/kg) was administered intravenously, 10 minutes prior to induction of general anaesthesia with Thiopentone sodium (15mg/kg). Following smooth induction of anaesthesia, the surgical anaesthesia was maintained throughout the duration of surgery using isoflurane (1.5 - 2.0 %) inhalation anaesthesia. In this group, the plate rod construct was used for the repair of femoral and humeral fractures in dogs. After anatomical dissection the intramedullary pin of approximately 25- 40% of the diameter of the medullary canal was selected. The Steinman pin or K-wire of 2 mm or 2.5 mm size pin was inserted in a retrograde fashion till it comes out at the top of the skin surface and then the pin was moved down into the distal femoral or humoral fragment. The stainless steel bone plate of 2 mm thick and appropriate length with 2.7 - 3.5 mm hole (DCP) size was selected, and applied on the tensile surface of the bone by fixation of bicortical screws.

Haematological Parameters

In all the cases of all groups the following parameters were studied,

Haematology

In all the animals the blood samples of each dog were collected in two bottles by using 22 gauge needle and 5 ml disposable sterile syringe from cephalic or saphenous vein, of which 2 ml of blood was collected in EDTA vial and 3 ml blood sample was collected for serum (in non EDTA vials). The samples were analyzed for Haemoglobin, Packed cell volume, White Blood Cell Count and Platlates on 7^{th} day and on 21^{st}, 45^{th} day and 60^{th} day of surgery.

Biochemical study

Alkaline phosphatise and cortisol levels were estimated before surgery as well as on 7^{th}, 21^{st}, 30^{th}, 45^{th} and 60^{th} day post operatively.

Results and Discussion

The pre-operative anterio-posterior (AP) and lateral radiographs (L) of affected limb were taken in each case, for the diagnosis of type of fracture following light sedation. Each radiograph was evaluated for the type of fracture as well as for damage to the surrounding tissue. Pre-operative radiography had given an idea about the choice of technique to be used for the repair of fracture and thus it helped the surgeon to plan the surgery in a systemic way for better outcome. Bhalerao (2010), Coutinho (2012) and Chavan (2013) performed preoperative radiography for the evaluation of fracture as well as for selecting the proper technique of fracture repair. In the present study, simple, comminuted and oblique fractures in hyperactive animals were operated with plate rod construct. Bhalerao (2010) used plate rod construct in similar types of fractures.

Proper care was taken to withhold water for 12 hours and food for 18 hours prior to surgery, so as to prevent untoward complications during induction and maintenance of anaesthesia during surgery. Kaur (2011) advised withholding of food for 12 hours and water for 4 hours before performing surgery.

All the orthopaedic surgeries in all the groups were performed under general anaesthesia using isoflurane. Pre-medication with atropine

sulphate @ 0.04 mg/kg and dexamethasone @ 0.5 mg/kg body weight subcutaneously followed by intravenous injection of Diazepam (0.2 mg/kg) provided smooth sedation in all the dogs. General anaesthesia induced by intravenous injection of thiopentone sodium was smooth in all the dogs. Following smooth induction, the surgical anaesthesia was maintained with isoflurane (1.5 - 2.0 %) anaesthesia. Gupta (2005), Bhagat (2009) reported successful use of ketamine and midazolam combination for induction and maintenance of anaesthesia during orthopaedic procedures in canine.

For fractures of humerus, and femur was used. This approach was found suitable for humerus and there was sufficient exposure of muscles and bone. This made it possible to perform the operative procedure, without any difficulty. The pin insertion in the bone was done properly without any complication. The bone plate placed on cranio-lateral tensile surface of bone had given full rigidity to the assembly in the fixation of fractures of humerus and there was no any tension over the muscle and skin sutures.

The cranio-lateral approach provided the sufficient space for exposure of muscles and bones. The insertion of pin was performed without any complications**.** Guillemot *et al.,* (2002) reported that, if the pin is inserted in retrograde fashion, there are chances of injury to sciatic nerve.

In present study the stainless steel bone plate of 2.7 - 3.5 mm size and of appropriate length and proper size screws were used for the fixation of plate, while intramedullary pin or K-wire of 25 to 40% of the diameter of medullary canal (2.0 mm - 2.5 mm) was used for intramedullary fixation. Bhalerao (2010) used the similar types of intramedullary pins and bone plates for the repair of canine long bone fractures. The intramedullary pin or K-wire of 2.0 - 2.5 mm diameter (25 - 40%) was inserted in retrograde fashion till it come out at the top of the skin surface and then the pin was moved down through normo-grade fixation into the distal femoral or humoral fragment. The application of low man's clamp and bone plate was very much essential for proper insertion of intramedullary pin into the distal fractured fragments. Fixation of bone plate with at least two screws near the fracture and one in corner hole of the plate on either side was done without difficulty. Initially placement of bicortical screws to each corner of hole of plate requires practical experience to avoid its entry at site of intramedullary pin. The combination of intramedullary pin / K-wire and bone plate provided rigid fixation and given strength to plate rod assembly. Ferry *et al.,* (2000) and Roe (2003) stated that the size of intramedullary pin should be 30 - 40% of size of medullary cavity.

Haematology

In all the animals the blood samples of each dog were collected in two bottles by using 22 gauge needle and 5 ml disposable sterile syringe from cephalic or saphenous vein, of which 2 ml of blood was collected in EDTA vial and 3 ml blood sample was collected for serum (in non EDTA vials).

Haemoglobin

The mean haemoglobin levels (gm%) before surgery, 7th day, 21st day,30th days, 45th days and 60th day of surgery did not differ significantly within the group. Similar findings were reported by Patil (2007), Bhalerao (2010), Coutinho (2012) and Rajhans (2013). All the dogs remained healthy throughout the period of fracture healing. Ayappan *et al.,* (2011) reported that the haematological parameters were within the normal range before and after surgery in a dog operated for plate rod construct.

Table.1 Haemoglobin values (gm %) and their mean

Hb	Before	7 Days	21 Days	45 Days	60 Days
Case No.1	16.7	16.1	14.9	15.8	13.6
Case No. 2	13.1	14.3	15.2	13.4	12.8
Case No. 3	15.5	16.3	12.1	13.2	15.6
Case No. 4	12.9	14.1	15.6	16.2	14.9
Case No. 5	13.1	12.6	15.1	14.2	13.4
Case No. 6	13.6	12.0	13.3	14.2	15.3
Case No. 7	13.6	14.9	12.6	12.5	12.8
Case No. 8	13.2	13.2	12.8	14.2	14.3
Mean **S.E ±**	**13.96** **0.48**	**14.18** **0.54**	**13.95** **0.49**	**14.2** **0.44**	**14.1** **0.39**

Table.2 The packed cell volume values in the present study

PCV	Before	7 Days	21 Days	45 Days	60 Days
Case No.1	45.4	48.1	42.1	45.3	40.2
Case No. 2	39.2	42.6	45.8	39.1	38.1
Case No. 3	45.9	48.1	37.2	39.2	45.3
Case No. 4	40.2	43.7	47.1	50.6	42.6
Case No. 5	41.7	37.8	44.5	45.9	42.
Case No. 6	42.9	42.1	43.2	42.3	45.2
Case No. 7	42.2	42.3	43.8	45.3	45.6
Case No. 8	43.3	42.4	42.9	45.6	42.6
Mean **S.E ±**	**42.6** **0.81**	**43.38** **1.19**	**43.33** **1.04**	**44.2** **1.36**	**42.8** **0.93**

Table.3 Total White Blood Cells (WBC): The total WBC values are given in following table

WBC	Before	7 Days	21 Days	45 Days	60 Days
Case No.1	8500	12000	9000	12000	13200
Case No. 2	9300	9900	11200	10100	9900
Case No. 3	13100	9900	11200	12300	14200
Case No. 4	11700	12400	12000	9900	10500
Case No. 5	11700	12400	12000	9900	10500
Case No. 6	11100	12300	12700	13200	14300
Case No. 7	14900	16200	15000	15400	15500
Case No. 8	15000	10300	16600	12400	14600
Mean **S.E ±**	**12363** **934.45**	**11950** **731.19**	**12475** **835.97**	**12788** **858.87**	**13125** **704.01**

Table.4 Platelate values observed in the present study are given in following table

Platelet	Before	7 Days	21 Days	45 Days	60 Days
Case No.1	261000	249000	210000	320000	312000
Case No. 2	220000	250000	280000	250000	270000
Case No. 3	331000	280000	320000	240000	320000
Case No. 4	268000	310000	280000	229000	257000
Case No. 5	271000	205000	236000	221000	270000
Case No. 6	263000	280000	230000	240000	280000
Case No. 7	256000	261000	267000	252000	252000
Case No. 8	246000	298000	285000	260000	280000
Mean **S.E ±**	**264500** **11088.93**	**266625** **11680.17**	**263500** **12643.46**	**251500** **10747.09**	**280125** **8594.92**

Table.5 The alkaline phosphatase values observed in the present study

ALP	Before	7 Days	21 Days	45 Days	60 Days
Case No.1	78.2	239	433.2	690.3	188
Case No. 2	88	386	720.1	843.6	431.2
Case No. 3	124	343.12	613	646	214
Case No. 4	49	229	489	339	131
Case No. 5	64.34	365	601	176	57.93
Case No. 6	156.9	373.3	516.1	643.2	240
Case No. 7	156	1294.3	398.3	247.7	154.
Case No. 8	221	351	1354	543.3	313.5
Mean **S.E ±**	**117.18** **20.58**	**447.59** **122.80**	**640.58** **108.38**	**516.14** **83.49**	**216.24** **40.79**

Table.6 The Serum Cortisol values observed in the present study

Cortisol	Before	7 Days	21 Days	45 Days	60 Days
Case No.1	42.69	42.7	42.1	42.09	42.01
Case No. 2	49.25	46.3	49.3	45.1	47.3
Case No. 3	41.4	42.2	41.6	41	40.2
Case No. 4	25	25.5	25.9	25	25
Case No. 5	26.8	26	26	25	26.96
Case No. 6	26.3	26.6	26.2	26.3	26.1
Case No. 7	32.1	30.2	31.1	31.7	32
Case No. 8	41.6	41.8	42.1	42.2	42.4
Mean **S.E ±**	**35.64** **3.25**	**35.16** **3.13**	**35.53** **3.28**	**34.79** **3.06**	**35.24** **3.08**

Packed Cell Volume

The packed cell volume values in the present study are given in following table

No significant changes in Packed Cell Values were observed I throughout monitoring period of 60 days. Similar observations were also reported by Bhalerao (2010), Coutinho (2012) and Rajhans (2013) in dogs

No significant changes were observed in mean total White Blood Cells (cmm) values throughout monitoring period of 60 days.

Platelets

No significant changes were observed in the mean total platelet throughout monitoring period of 60 days.

Biochemical study

Alkaline phosphatise and cortisol levels were estimated before surgery as well as on 7^{th}, 21^{st}, 30^{th}, 45^{th} and 60^{th} day post operatively.

Alkaline Phosphatase

The alkaline phosphatase values observed in the present study were as follows

The mean total alkaline phosphatase values were 117.18 ± 20.58, 447.59 ± 122.80, 640.58 ± 108.38, 516.14 ± 83.49 and 216.24 ± 40.79, respectively the mean alkaline phosphatase increased significantly up to 45 days and subsequently it decreased and came to normal levels up to 60 days. Alkaline phosphatase is an enzyme which is important in the process of biomineralization. The increase in serum alkaline phosphatase after surgery upto 45 days could be attributed to increased osteoblastic activity, fibrous tissue formation at the fracture site, which assists in mineralization of soft callus. These observations are corroborating with the findings of Singh *et al.,* (1976), Meller *et al.,* (1984) and Coutinho (2012).

Serum Cortisol

The Serum Cortisol values observed in the present study were as follows

The mean Cortisol values were 35.64 ± 3.25, 35.16 ± 3.13, 35.53 ± 3.28, 34.799 ± 3.06 and 35.24 ± 3.08, respectively. In the present study the mean cortisol values (nmol /L) estimated before surgery were higher but later on, the non-significant decrease in mean serum cortisol values was during monitoring period was observed and were normalized on 60 days. Coutinho (2012) reported that there is decrease in mean cortisol level in all the cases of bone plating in dogs.

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