EXPERIMENTAL STUDY ON HEMOGRAM AND CHEMISTRY PROFILE IN SPLENECTOMIZED DOGS

N. I. Chaudhry, M. A. Khan, S. Kausar and K. Iqbal
Department of Clinical Medicine & Surgery,
University of Agriculture, Faisalabad-38040, Pakistan

ABSTRACT

The effect of total and partial splenectomy on hemogram and biochemical profile was investigated on 12 healthy mongrel dogs, divided into two groups (I and II). The total splenectomy (group I) exhibited significant reduction ($P < 0.05$) in Hb, PCV, and total RBC count but increase in ESR values. It also resulted in mild but persistent increase in total leukocyte, neutrophil, and lymphocyte counts. In comparison, partial splenectomy produced non-significant effects on analogous hematological parameters. No significant alteration in serum glucose or total protein concentration was observed after total or partial splenectomy. A significant decrease ($P < 0.05$) in serum iron concentration was observed in dogs of both groups.

INTRODUCTION

Splenic accidents such as rupture, usually rooted from splenic hemangiosarcoma, is a common cause of intra-abdominal hemorrhage in dogs (Prymak *et al.*, 1988). The identification of splenic diseases such as splenomegaly and lymphosarcoma has become easy owing to the advent of improved diagnostic techniques as percutaneous biopsies, radiography, and ultrasonography (Feeney *et al.*, 1984). The hallmark of most splenic affections have been a cure by splenectomy. Justification for splenectomy as a model of therapy in animals is usually parallel to that in human.

The effects on the blood components following removal of normal spleen have remained an enigma. It has to be accepted that examination of the peripheral blood is a crude method of detecting hyposplenism. The available information regarding the consequences of splenectomy in the veterinary patients are not well characterized and most of the knowledge in this regard has originated from human sources. An experimental study was therefore, planned to investigate the effects of total and partial splenectomy on various hematological and biochemical parameters in dogs.

MATERIALS AND METHODS

Experimental Animals

Twelve mongrel healthy dogs of both sexes, between the ages of two and five years, were included in this study. A thorough physical examination was made in all animals to ascertain their health status. All dogs were dewormed and vaccinated against canine distemper and rabies using standard vaccination protocols during the one month acclimatization period. They were housed indoors in individual cages and maintained under uniform managemental and nutritional regimen. These animals were randomly divided into two groups comprising of six dogs each, designated as group I and II. The dogs were monitored for any ill-health during the stretch of experimentation.

Surgical Operations

Total and partial splenectomy were performed harmonious in animals of group I and II, respectively following the standard anesthesia and surgical procedures (Archibald, 1974).

Haematological Samples

Blood samples with EDTA for complete blood analysis and without anticoagulant for serum chemistry profile were collected. A total of 12 samples were drawn from each animal. The first blood sample was drawn prior to surgical intervention to obtain baseline values. The other samples were obtained twice a week, starting on week 2nd to week 6th post-operative.

Blood analysis was determined on each EDTA treated blood samples of dogs of both experimental groups, utilizing standard techniques as described by Benjamin (1978).

Blood Chemistry Profile

Serum samples were used for the determination of chemistry profiles, i.e. glucose, serum protein, and

iron, utilizing composite kits (Merckotest[R]) as directed by the manufacturer.

Statistical analysis

The data obtained was subjected to statistical manipulation using analysis of variance test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

All dogs in the study remained apparently healthy during the trial period. None of the dogs in both groups suffered any post-surgical complication, such as haemorrhage or peritonitis. Several ephemeral changes in blood components and biochemical profiles were identified that persisted for a variable periods following total or partial splenectomy (Table 1).

A persistent anaemia was observed in animals of group I, as noted by a significant reduction ($P < 0.05$) in RBC count, Hb conc. (Fig. 1), and PCV values (Fig. 2) on day-6 post-surgery, as compared to their baseline values and with group II. The anaemia in total splenectomized dogs could be related to loss of the spleen-iron regulatory function as reported in man by earlier workers (Ek and Rayner, 1950).

A significant ($P < 0.01$) increase in ESR values was observed in animals of both groups, respectively, compared to their baseline values. However, among groups there was non-significant difference (Fig. 3). This higher ESR values might be associated with persistence anaemia and has also been explained by Benjamin (1978).

A significant ($P < 0.05$) and continual increase in total leukocyte, neutrophil, lymphocyte, and eosinophil counts, a transient increase in monocyte, and normal basophil numbers were observed post-operatively in group I dogs compared to baseline values and with

Table 1: Pre- and Post-operative haematological values in splenectomized dogs.

		Post-operative days										
	0	15	18	21	24	27	30	33	36	39	42	45
Group-I												
RBC	5.98	4.10	4.08	4.02	3.98	3.86	4.08	4.28	4.06	3.97	4.13	4.23
Hb	14.2	11.8	11.8	12.1	10.8	9.9	11.2	11.0	10.7	12.0	12.4	12.0
PCV	40.0	39.2	28.2	28.7	27.0	29.0	29.5	30.2	29.7	29.6	30.8	30.3
ESR	08.2	35.2	33.3	36.5	40.5	39.0	34.2	32.7	35.3	29.7	31.8	37.7
Group-II												
RBC	6.46	5.55	5.62	5.65	5.72	5.83	5.98	6.06	6.08	6.04	5.95	6.0
Hb	14.5	14.0	14.4	14.7	14.1	14.5	15.4	15.2	15.2	15.0	14.8	15.4
PCV	39.0	38.2	38.8	44.0	37.2	39.2	39.6	39.8	37.7	37.5	37.0	38.4
ESR	09.5	32.5	30.5	29.6	29.2	28.0	29.4	28.4	28.3	28.2	27.5	26.8
Group I												
TLC	8.2	14.5	14.4	14.6	14.6	14.4	14.6	14.4	14.0	15.0	14.6	15.0
N	4883	8465	8709	7549	7578	8254	8656	7645	7925	8661	8574	8964
L	2477	3863	3175	3424	3664	3980	3974	4332	4025	4223	4034	4054
M	365	738	879	629	308	332	448	426	438	665	490	299
E	595	138	1635	2429	1669	1747	1591	1747	1533	1379	1350	1365
B	68	44	27	20	77	95	0	24	23	61	48	56
Group II												
TLC	8.7	9.8	9.4	9.4	8.9	9.2	9.0	10.3	9.3	9.1	9.5	9.7
N	5383	5893	5839	5282	5498	5449	5269	3951	5250	5195	5415	5410
L	2117	2471	2300	2660	2328	2683	2362	3143	3227	2993	3144	3514
M	419	417	380	395	324	398	360	422	318	382	339	274
E	598	935	980	1230	857	673	682	752	606	478	607	547
B	90	31	12	10	13	30	0	5	0	0	0	0

RBCs= Red blood cells, millions/cmm; Hb= Haemoglobin gm/dl; PCV= Packed cell volume per cent;
ESR= Erythrocyte sedimentation rate, mm/h; TLC= Total leukocytic counts thousand/cmm;
N= Neutrophils absolute values; L= Lymphocytes absolute values; M= Monocytes absolute values;
E= Eosinophils absolute values; B= Basophils absolute values; (n= 6)

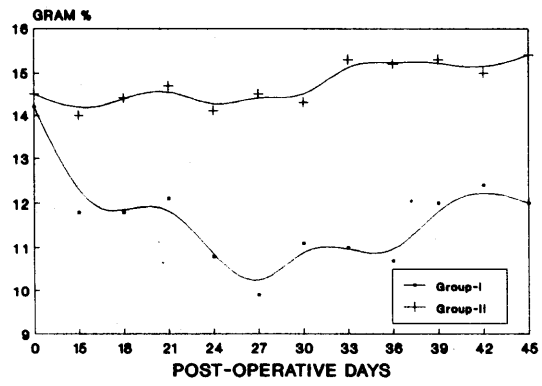

Fig. 1: Haemoglobin values in total and partial splenectomized dogs.

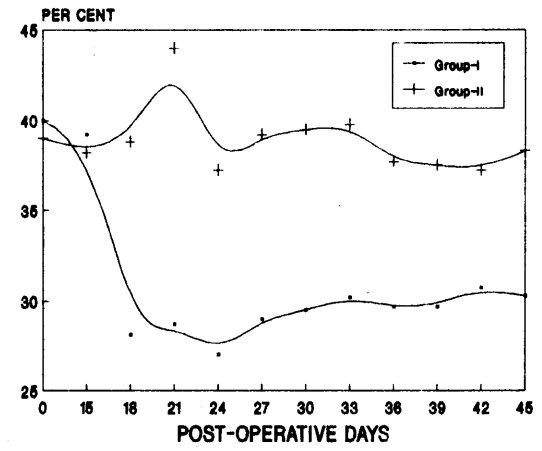

Fig. 2: Haematocrit values in total and partial splenectomized dogs.

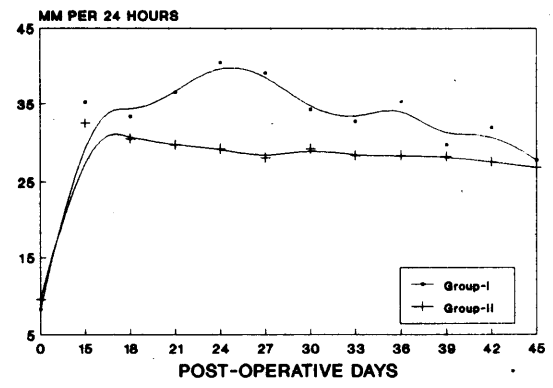

Fig. 3: Erythrocyte sedimentation rate in total and partial splenectomized dogs.

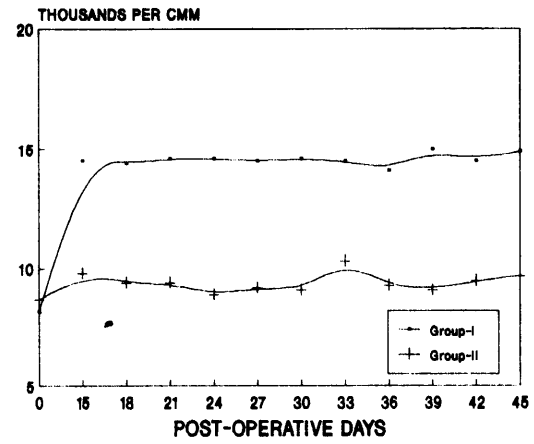

Fig. 4: Leukocytic counts in total and partial splenectomized dogs.

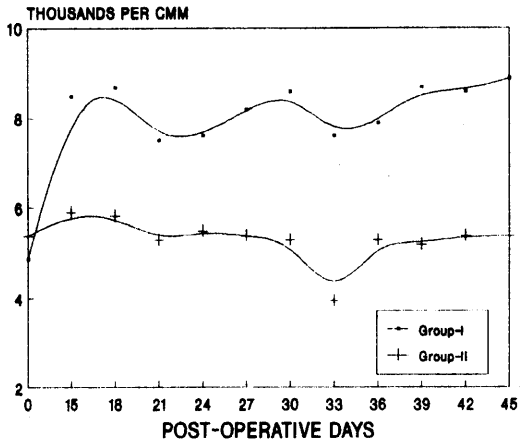

Fig. 5: Neutrophil counts in total and partial splenectomized dogs.

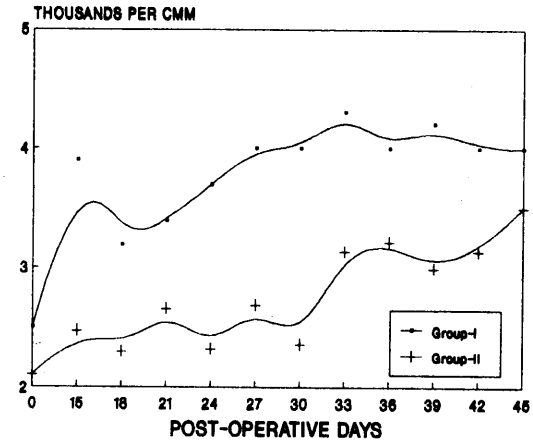

Fig. 6: Lymphocyte counts in total and partial splenectomized dogs.

group II dogs (Figs. 4-7). Modifications in these blood cells could be coupled with total splenectomy and its predisposition for transient and intermittent type of non-specific bacteremia or septicemia (Weinstein *et al.*, 1983).

In healthy individuals bacteria are cleared off from circulation rapidly and effectively through phagocytosis by fixed tissues macrophages in the spleen and liver. Persistent bacteremia can occur when bacteria can multiply at a rate that exceeds the ability of the reticulo-endothelial system to remove them (Dow and Jones, 1989). In addition, non-infectious factors such as corticosteroid excess caused by fear or other stresses, anesthesia, laparotomy, or exercise may also be associated with moderate changes in leukogram (Randy, 1991a). In the present study all animals apparently remained clinically healthy throughout the study period and therefore, alteration in leukogram could be a normal body response. This is also supported by earlier reports indicating that a WBC count between 10,000 and 30,000/μL represents a moderate response to inflammation in dogs (Randy, 1991b).

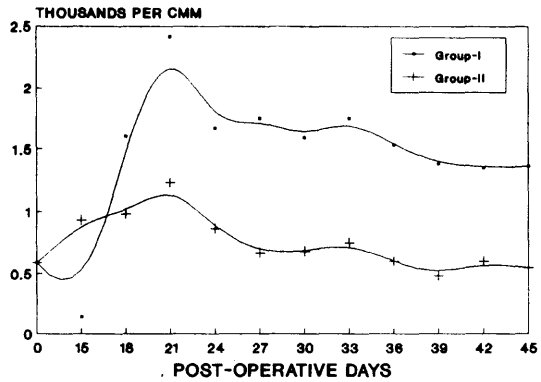

Fig. 7: Eosinophil counts in total and partial splenectomized dogs.

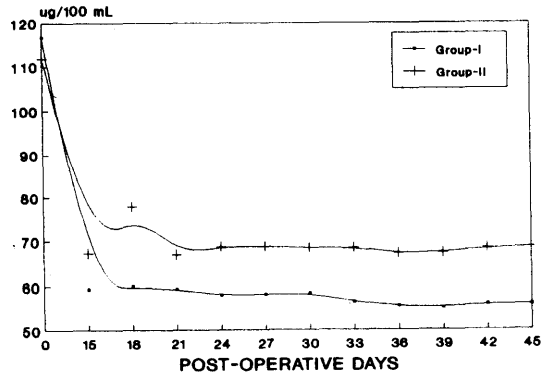

Fig.8: Serum iron concentration in total and partial splenectomized dogs.

The presence of mild eosinophilia in dogs of group I has been a unique observation in the present study. Eosinophils are known to be an integral components of hypersensitivity and defense against certain parasites. In cat, eosinophilia has been reported to occur along with polycythemia and pernicious anemia after splenectomy (Center *et al.*, 1990). Similarly, leukocytosis has been reported in man and dog as a result of splenectomy and were attributed to an increase in neutrophils, lymphocytes, and eosinophils (Singer *et al.*, 1941; Boer *et al.*, 1972). Therefore, it seems as the eosinophilia in the present study was either due to splenectomy or might have occurred as an influx of bone marrow reserve as seen in man (Weller and Goetzl, 1979).

The serum glucose and total protein concentration stayed within normal ranges throughout following splenectomy in dogs of both groups (Figs. not shown). The serum iron concentration remained at significant ($P < 0.05$) decline in dogs of both groups, compared to their respective control values, but non-significant between groups, (Fig. 8). The role of spleen in iron metabolism is reputed in the destruction of RBCs. Hemoglobin from the red cells is degraded and iron is retained to the erythroblasts reuse. Crosby (1959) observed that after splenectomy the storage of iron was temporarily impaired due to increased loss of iron by the kidneys. This could result in decrease in plasma and red blood cell iron turnover, as well as, a decrease in RBC synthesis (Waldmann *et al.*, 1960).

It was deduced from this study that total splenectomy in dogs lead in leukocytosis mainly due to increase in neutrophils and lymphocytes and iron deficiency anemia. However, the hematological changes associated with partial splenectomy were less apparent. No untoward fatal complication was observed in partial or total splenectomized dogs.

REFERENCES

Archibald, J., 1974. Canine Surgery. 2nd Ed. American Veterinary Publications, Santa Barbara, CA. U.S.A.

Benjamin, M.M. 1978. Outline of Veterinary Clinical Pathology. 3rd Ed. Iowa State Univ. Press, Ames, IA., U.S.A.

Boer, J., S.F. Summer and J. Downie, 1972. Partial splenectomy technique and some hematological consequences in the dog. J. Ped. Surg., 7: 378.

Center, S.A., J.F. Randolph, H.N. Erb and S. Reiter, 1990. Eosinophilia in the cat: A retrospective study of 312 cases. J. Am. Ani. Hosp. Assoc., 26(4): 349-358.

Crosby, W.H., 1959. Normal functions of the spleen related to the red blood cells. Blood, 14: 339.

Dow, S.W. and R.L. Jones, 1989. Bacteremia: Pathogenesis and diagnosis.Comp. Cont. Edu., 11(4): 432-443.

Ek, J.J. and S. Rayner, 1950. An analytical study of splenectomized cases after traumatic rupture of healthy spleen. Acta. Med. Scand., 137: 417-435.

Feeney, D.A., G.R. Johnston, and R.M. Hardy, 1984. Two-dimensional, grey-scale ultrasonography for assessment of hepatic and splenic neoplasia in the dog and cat. J. Am. Vet. Med. Assoc., 184: 68-81.

Prymak, C., L.J. McKee, M.H. Goldschmidt, and L.T. Glickman, 1988. Epidemiological, clinical, pathologic, and prognostic characteristics of splenic hemangiosarcoma and splenic hematoma in dogs: 27 cases (1985). J. Am. Vet. Med. Assoc., 193(6): 706-712.

Randy, K., 1991a. Interpreting the leukogram: Non-infectious factors that affect leukocyte production. Vet. Med. 86(5): 472-479.

Randy, K., 1991b. Interpreting neutrophil numbers. Vet. Med., 86(10): 975-982.

Singer, K., E.G. Miller, and W. Dameshek, 1941. Hematological changes following splenectomy in man. Am. J. Med. Sci., 202: 171.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics. McGraw Hill Book Co. Inc., New York. U.S.A.

Waldmann, T.A., S.M. Weissman and N. Berlin, 1960. The effect of splenectomy on erythropoiesis in the dog. Blood, 15: 873.

Weinstein, M.P., L.B. Ruller and R.J. Murphy, 1983. The clinical significance of positive blood culture: A comprehensive analysis of 500 episodes of bacteremia and fungemia in adults. 1. Laboratory and epidemiological observations. Rev. Infect. Dis., 5: 35-53.

Weller, P.F. and E.J. Goetzl, 1979. The regulatory and effector roles of eosinophils. Adv. Immunol., 27: 339-371.