EFFECT OF PARTIAL AND COMPLETE NEPHRECTOMY ON VARIOUS BLOOD PARAMETERS IN DOGS

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ABSTRACT

The present study was conducted to analyze the effects of partial and complete nephrectomy on various blood parameters in dogs. A total of eight dogs were divided into two groups (A and B) comprising four animals each. In group A, complete nephrectomy was performed, while partial nephrectomy was carried out in group B. Post-operatively, the comparative effects of the two techniques were evaluated on the basis of clinical parameters, blood chemistry, hematological findings and radiographic examination. It was concluded that neither of the operations significantly affected the blood chemistry of the animals, hence, these techniques can be used to save the life of patient in proportion to the extent of defect.

Key words: Dogs, Nephrectomy, Clinical, Haematological and Radiographic.

INTRODUCTION

Kidney failure is common sequelae to trauma and a vast number of disease problems, which ultimately arouse the need for partial or complete removal of the damaged kidney in order to save the life of the patient. This is because the damaged kidneys can not adequately clear the blood of certain toxins (e.g. Blood Urea Nitrogen and Creatinine). Besides this, there is also change in urine concentration and in the concentration of blood components, like phosphorus, calcium, sodium, potassium and chloride, the normal regulation of which is carried out by the kidneys (Benjamin, 1983). Kidney failure may also produce extremely dilute urine or urine that contains too much protein. Due to partial or complete removal of one kidney certain biochemical changes occur which may affect the normal physiology of the partner kidney. Its hypertrophy and other physiological adaptations will occur in order to compensate the functions of the removed kidney (Szocs *et al*., 1978). Unilateral nephrectomy initiates a functional adaptation or a growth response in the contra-lateral kidney to compensate for the loss of renal mass (Kairemo *et al*., 1996)

Keeping in view the above-mentioned problems, the present study was carried out to evaluate the effects of partial and complete nephrectomy on the body in terms of Renal Function Tests and Complete Blood Count.

MATERIALS AND METHODS

The study was conducted on eight Mongrel dogs of either sex, ranging in weight between 14 – 17 kg. They were divided into two groups, (A and B) each comprising four animals. In dogs of group A, complete nephrectomy, while in dogs of group B, partial nephrectomy was performed.

In group A, after anesthetizing the animals with Inj. Pentathol sodium @ 15mg/kg body weight, a caudal midline laparotomy was performed. The left kidney was exposed, freed and lifted from its sublumbar attachments by blunt dissection. The whole kidney was removed following the procedure as described by Slatter (2003).

In group B, the surgical procedure for a partial nephrectomy was adopted. For this, the kidney was exposed and isolated in the same way after caudal midline laparotomy, as described for Group A. Only one-forth of the kidney was removed following the procedure as described by Archibald (1974).

The blood and urine samples were collected and processed as described by Benjamin (1983) for haematological and renal function tests. Intravenous urography was performed immediately after the surgery and at 8th week post-operatively, to check any leakage and changes in the remaining kidney (Singh and Singh, 1994). Likewise, haematological studies (Total leukocytic count, differential leukocytic count, hemoglobin, packed cell volume, erythrocyte sedimentation rate), and renal function tests (blood urea nitrogen test and serum creatinine test) through spectrophotometery with commercial kits (Randox Laboratory, UK) were carried out on the 1st week post-operatively, and then successively at 4th and 8th weeks' time (Benjamin, 1983).

The data thus collected were analyzed by analysis of variance technique (Steel *et al*. (1997).

RESULTS AND DISCUSSION

A) Clinical observations: In Group A the pre-operative

mean values ± S. E. of temperature (^{o}F) was 100.50 ± 0.289, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 100.00 ± 0.289, 100.00 ± 0.289, and 100.00 ± 0.204, respectively. In Group B the pre-operative mean value ± S. E. was 100.00 ± 0.00 ^{o}F, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 100.00 ± 0.289, 100.00 ± 0.289, and 100.00 ± 0.204, respectively. The animals of both groups showed rise in temperature till the 5th day post-operatively, however, after this time, the temperature subsided and returned to normal till the end of the experimental period (Table – I). In group A, the rise in temperature was attributed to the contaminated kennels, whereas, hot climate was suggested as the pre-disposing cause of temperature rise in dogs of group B. The difference between the two groups for this clinical parameter was non-significant.

In Group A the pre-operative mean value ± S. E. of pulse rate (no. / min) was 80.25 ± 0.63, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 86.00 ± 0.41, 86.00 ± 0.41, and 86.25 ± 0.48, respectively. In Group B the pre-operative mean value ± S. E. was 80.00 ± 0.41, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 83.25 ± 0.48, 80.00 ± 0.58, and 80.00 ± 0.00, respectively. In dogs of group A, a high pulse rate was recorded post-operatively till the end of the experimental period. On the other hand, the dogs of group B showed rise of pulse rate only till the 1st week after the surgery. From then onwards, the pulse rate in these dogs started receding and finally returned to normal from 4th to 8th week post-surgically. The change in pulse rate in dogs of group A, was found to be significant as compared with pre-operative values when recorded at first week till the completion of the experimental period. This was considered to be due to the Rennin enzyme, which is secreted by the kidney and acts on Angiotensin II enzyme, thus causing hypertension. These findings were in correlation with Tapson *et al*. (1985).

In Group A the pre-operative mean value ± S. E. of respiration rate (no. / min) was 24.00 ± 0.41 whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 27.00 ± 0.41, 25.00 ± 0.71, and 24.00 ± 0.41, respectively. In Group B the pre-operative mean value ± S. E. was 24.00 ± 0.41, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 24.00 ± 0.41, 24.00 ± 0.41, and 24.00 ± 0.41, respectively. In dogs of both groups, only a gradual rise in respiratory rate was observed till the 5th day post-operatively. This was followed by a period of normal respiratory rate till the end of the study. The statistical analysis showed no significant increase in the respiratory rate of the dogs and the transient change observed earlier in the post-operative period was attributed to the high body temperature and stress after surgical manipulation.

All dogs in group A showed vomiting at 4th week post-operatively. Gradually, the signs improved but were still shown by the animals till the end of the experimental period. This was attributed to the high level of nitrogenous metabolites, specifically urea, in blood. These findings were in agreement with the findings of Shin *et al*. (2000). In group B this parameter was insignificant as only one – fourth of the kidney was surgically severed and the remaining part behaved as intact kidney.

B) Biochemical Studies

I) Blood chemistry: Blood chemistry included blood urea nitrogen and serum creatinine. Both these parameters showed significant changes in both groups, when compared with values noted from blood samples taken pre-operatively.

In Group A the pre-operative mean value ± S. E. of blood urea nitrogen (mg / dl) was 23.50 ± 1.04 whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 69.00 ± 0.91, 57.50 ± 2.60, and 38.00 ± 0.41, respectively. In Group B the pre-operative mean value ± S. E. was 22.50 ± 1.49, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 55.00 ± 0.91, 42.50 ± 0.65, and 25.25 ± 1.11, respectively. In group A, increase in blood urea nitrogen and serum creatinine values was observed at 1st week, 4th week and at the end of the experimental period. These high values showed the incomplete excretion of the nitrogeneous metabolites and creatinine, which was due to the decrease in the number of nephrons and is in accordance with the findings of Jennings *et al*. (1992) and Shin *et al*. (2000).

In Group A the pre-operative mean value ± S. E. of serum creatinine (mg /dl) was 1.175 ± 0.048 whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 3.625 ± 0.085, 4.425 ± 0.138, and 1.775 ± 0.048, respectively. In Group B the pre-operative mean value ± S. E. was 1.175 ± 0.063, whereas the post-operative mean valued ± S. E. at 1st, 4th and 8th week were 2.900 ± 0.108, 3.600 ± 0.091, and 1.350 ± 0.063, respectively. In group B, high values of serum creatinine and blood urea nitrogen were recorded at 1st and 4th week post-surgery. The values became normal at the end of the experimental period, as a result of functional and structural hypertrophy of the partially resected kidney. Such results have also been reported in the past (Lhotta *et al*. 1991).

II) Hematological studies: In Group A the pre-operative mean value ± S. E. of total leukocytic count was 14500 ± 645.50 whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 17600 ± 1592.17, 18100 ± 1448.56, and 18600 ± 834.66, respectively. In Group B the pre-operative mean value ± S. E. was 13400 ± 355.90 per cmm, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 14225 ± 361.42, 15000 ±

663.32, and 13750 ± 638.36 per cmm, respectively. When compared with pre-operative values, the post-operative total and differential leukocytic count values, in dogs of group A, were found significantly increased. In Group A the pre-operative mean value ± S. E. of lymphocytes was 15.25 ± 1.58 percent whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 11.00 ± 0.41, 9.75 ± 0.41, and 14.50 ± 0.65 percents, respectively.

In Group B the pre-operative mean value ± S. E. was 20.75 ± 0.82 percent whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 11.00 ± 0.58, 18.50 ± 0.51, and 17.75 ± 0.46 percent, respectively. In Group A the pre-operative mean value ± S. E. of neutrophils (percent) was 68.75 ± 1.97 whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 79.75* ± 1.74, 86.75 ± 2.27, and 80.50 ± 0.84, respectively. In Group B the pre-operative mean value ± S. E. was 70.75 ± 0.87, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 80.75 ± 2.06, 79.00 ± 1.47, and 71.00 ± 0.91, respectively. In Group A the pre-operative mean value ± S. E. of basophils (percent) was 1.50 ± 0.65 whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 1.25 ± 0.41, 0.75 ± 0.10, and 1.0 ± 0.20, respectively. In Group B the pre-operative mean value ± S. E. was 1.75 ± 0.10, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 0.50 ± 0.10, 0.50 ± 0.11, and 1.25 ± 0.10, respectively. In Group A the pre-operative mean value ± S. E. of eosinophils was 6.0 ± 0.71 percent whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 3.25 ± 0.10, 2.00 ± 0.20 and 1.50 ± 0.20 percent, respectively. In Group B the pre-operative mean value ± S. E. was 7.25 ± 0.14, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 4.00 ± 0.58, 5.70 ± 0.10, and 6.00 ± 0.21, respectively. Regarding differential leukocytic count, post-operative blood samples from group A, showed increase in leukocytes and neutrophils and a decrease in lymphocytes. Leukocytosis and neutrophilia in this group, are attributed to surgical stress, anemic signs and existence of nitrogeneous metabolites in blood. These results are in accordance with the findings of Frederick and James (1974).

On the contrary, the leukocytic profile of Group B showed no significant change when compared with the pre-operative values.

In Group A the pre-operative mean values ± S. E. of total erythrocytic count (x 10/cmm) was 6.30 ± 0.235 whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 5.03 ± 0.229, 4.4 ± 0.220, and 4.75 ± 0.312, respectively. In Group B the pre-operative mean value ± S. E. was 6.08 ± 0.239 (x10/ cmm), whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 5.70 ± 0.147, 5.60 ± 1.220, and 5.62 ± 0.312, respectively. Significant difference in the erythrocytic profile of group A was observed when compared with pre-operative values. Initial decline in the erythrocytic count at 1st and 4th post-operative week was prominent. Decrease in erythrocytic count was because of reduced amount of erythropoietin excretion from the kidney that affects the process of erythropoeisis from the bone marrow. At 8th week, there was a slight increase in erythrocytes recorded, which is credited to a good erythropoeitic response from the bone marrow. Guyton and Hall (2006) have also reported similar findings.

On the other hand, the dogs of Group B showed no significant difference between the pre-operative and post-operative values of total erythrocytic counts throughout the experimental period. This is attributed to the average erythropoietin excretion from the partially resected kidney.

In Group A the pre-operative mean value ± S. E. of packed cell volume (%) was 45 ± 0.323 whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 35.25* ± 1.250, 28.5 ± 0.645, and 36.0 ± 1.958, percent, respectively. In Group B the pre-operative mean value ± S. E. was 42.25 ± 0.736, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 33.25* ± 0.750, 35.75 ± 0.289, and 40.5 ± 0.250, respectively. Packed cell volume values initially showed significant difference from pre-operative values in dogs of both groups. Decline in packed cell volume was observed at 1st and 4th week, however towards the end of the experimental period, the values were found to be normal. The decrease was considered to be caused by the presence of nitrogenous metabolites in the blood and decrease in the number of erythrocytes. This is in agreement with the findings of Gibb and Hamilton (1985).

In Group A the pre-operative mean value ± S. E. of hemoglobin (gm / dl) was 15.50 ± 0.274 whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 12.82* ± 0.409, 10.42 ± 0.368, and 12.73 ± 0.661, respectively. In Group B the pre-operative mean value ± S. E. was 15.13 ± 0.575 gm/dl, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 14.20 ± 0.187, 13.82 ± 0.180, and 14.67 ± 0.111 gm/dl, respectively. A significant difference ($P < 0.05$) was observed in the pre-operative and post-operative values of hemoglobin, in all the dogs. In group A, at the start of the experiment, decline in hemoglobin values was observed at 1st and 4th week, however, the values became normal at the end of the experimental period. This changeability in the hemoglobin profile of Group A indicates signs of anemia up to the 4th week, owing to the low blood production from the bone marrow. Anemia was prominent only in one animal, i.e. dog no. 3 of group A.

Similar pattern regarding change in hemoglobin content was recorded in dogs of Group B. These findings

are in agreement with the results of Lirtzman and Gregory (1995).

In Group A the pre-operative mean value ± S. E. of erythrocyte sedimentation rate was 16.75 ± 0.854 mm/hr whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 24.75* ± 0.854, 35.00 ± 1.472, and 29.00 ± 2.04 mm/hr, respectively. In Group B the pre-operative mean value ± S. E. was 16.50 ± 0.645, whereas the post-operative mean values ± S. E. at 1st, 4th and 8th week were 20.25* ± 0.629, 24.50 ± 0.645, and 19.75 ± 0.479, respectively. Erythrocyte Sedimentation Rate was recorded high at 1st, 4th and 8th weeks, in dogs of Group A, and these values were found to be significant, when compared with pre-operative values. The higher values of Erythrocyte Sedimentation Rate in these dogs were attributed to the anemic condition and accumulation of nitrogenous metabolites in the body.

On the other hand, the dogs of Group B showed only slight increase from normal pre-operative erythrocyte sedimentation rate values. Such findings have also been reported by Lirtzman and Gregory (1995).

C) Intravenous urography

In all the animals, intravenous urography was performed immediately after the surgery. The radiograph clearly depicted that there was no leakage from the operated/ ligated renal vessels (renal artery, renal vein and ureter). At the end of the experimental period, intravenous urography was performed in dogs of Group B. In these animals, the radiograph verified the compensatory hypertrophy in the remaining kidney, which is a physiological response of the body (Schindler, 1982).

Keeping in view all the above findings, it is concluded that if a pole of kidney is damaged upto one-fourth portion, not involving any other structure like the renal pelvis, then Partial Nephrectomy can be performed as a solution to the problem. This procedure does not affect the body's physiology or that of the kidney. Similar findings have also been reported by Kairemo *et al*. (1996) and stated that two-thirds of the kidney volume can be removed without danger, but the study was conducted in pigs.

On the other hand, complete nephrectomy is indicated in cases of severe kidney damage. In cases when there are major pathological lesions in the kidney or if damage to the renal tissue extends beyond one-forth, i.e. involving the renal pelvis or even the whole kidney, then complete nephrectomy can be performed as the sole method of relief without any untoward effects.

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