FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

Journal Website: https://frontlinejournals.org/journals/index.php/fmspj

Research Article

SIMPLE NEPHRECTOMY AND ITS EFFECT ON KEY RENAL FUNCTIONS IN ADULT MALE ALBINO WISTAR RATS

Submission Date: February 20, 2022, **Accepted Date:** March 06, 2022,
Published Date: March 16, 2022
Crossref doi: https://doi.org/10.37547/medical-fmspj-02-03-06

Uzor F.T.
Department of Human Physiology, Nnamdi Azikiwe University, Nnewi, Nigeria

Nwobodo E.O.
Department of Human Physiology, Nnamdi Azikiwe University, Nnewi, Nigeria

Orjiako R.N
Department of Human Physiology, Nnamdi Azikiwe University, Nnewi, Nigeria

Ikwuka D.C.
Department of Human Physiology, Nnamdi Azikiwe University, Nnewi, Nigeria

Chukwuma C.C.
Department of Human Physiology, Nnamdi Azikiwe University, Nnewi, Nigeria

Okereafo A.I.
Department of Human Physiology, Nnamdi Azikiwe University, Nnewi, Nigeria

Ojiakor A.G.
Department of Internal Medicine, University of Nigeria Teaching Hospital, Enugu, Nigeria

ABSTRACT

Chronic Kidney Disease (CKD) is a significant health concern globally and a growing challenge in low-and-middle-income countries, with about 17 million Nigerians having various stages of CKD. It is associated with reduced life expectancy, hence, the need for kidney donations (transplant). However, potential kidney

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

donors are often generally concerned about a potential compromise of their renal functions after Nephrectomy is carried out. Hence, this study determined the effect of Simple Nephrectomy on the functions of the kidneys in adult male albino wistar rats. Twenty (20) adult male albino wistar rats were randomly divided into three Groups of ten (10) rats for Group A and five (5) rats each for Groups B and C. The study focused on two key indices of electrolyte and blood cell count regulations. Group A (test group) had their left kidneys surgically removed; group B (sham-control) were operated but their left kidneys were not removed, group C (normal control) were not operated, they were then observed for a period of 14 days. The results were analyzed using one-way Analysis of Variance (ANOVA) and was considered statistically significant at $p<0.05$. Normal blood cell levels were observed when compared to the normal control group. There was no significant compromise in electrolyte levels as compared to the normal control group. Also, congestion of blood was observed in the renal arteries of the test group as shown in the histology results. The results therefore showed no significant effect of Simple Nephrectomy on the hematological and electrolyte parameters of the test group.

KEYWORDS

Simple-Nephrectomy, Renal-Functions, Chronic Kidney Disease, Hematological, Electrolyte.

INTRODUCTION

Kidney transplant (Donor-Nephrectomy) is a surgical procedure to place a healthy kidney from a living or deceased donor into a person whose kidneys no longer function properly (Gupta et al., 2005). The kidneys are two bean-shaped organs located on each side of the spine just below the rib cage, each about the size of a fist (Lote, 2012). Their main function is to filter and remove waste, minerals and fluid from the blood by producing urine (Chawla et al., 2013; Ali et al., 2020). Kidneys for transplant come from a living donor or a deceased (cadaver) donor (Gupta et al., 2005). However, kidney donors have the same life expectancy and general health as others (Ekholm et al., 1997). Any healthy person can safely donate a kidney and must be in excellent health. When a

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

kidney is transplanted from a living donor, the donor's remaining kidney enlarges to take over the work of two and as with any major operation, there is a chance of complication (Chawla et al., 2013; Layton and Vallon, 2018). It is important to note that the kidneys are involved in several homeostatic mechanisms such as electrolyte balance, water balance, excretion of toxic substances, endocrine functions and so many more; therefore the transplant of a kidney will have several effects on the functioning of the kidney (Bradly, 2021). Kidney transplant has stood the test of time and proven to be a major cure for kidney failure (Bradly, 2021). With a little or no knowledge on the effects of kidney transplant on renal functions, kidney donors and their recipients may find it challenging adapting to the changes that would occur as a result of the kidney transplant. This study hence, seeks to effectively examine the significant compromise in the hematological parameters and electrolyte balance function of the kidney after simple nephrectomy.

MATERIALS AND METHOD

Animal Selection/Handling

Twenty adult male albino wistar rats weighing 200-250g were obtained from the Animal House of the Department of Human Physiology, Faculty of Basic Medical Sciences, Nnamdi Azikiwe University, Nnewi Campus. They were housed in well-ventilated cages and were acclimatized for two weeks (14days) under standard environmental conditions (12 hour light/dark cycles). During the entire period of the study, animals were fed with standard laboratory chow and had access to water *ad libitum*.

Ethical Approval

The ethical approval for the study was obtained from the Ethical Committee of the Faculty of Basic Medical Science, Nnamdi Azikiwe University, Nnewi campus. Rats handling and treatments conform to the Guidelines of the National Institute of Health (NIH Publication 85-23, 1985) for laboratory animal care and use.

Experimental Design

After two weeks of acclimatization, the animals were randomly divided into three groups. Group A served as the test group, Group B served as the sham-control while Group C served as the normal control group.

Group A had all of one of their kidneys (the left kidney) surgically removed.

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

Group B were operated without having their kidneys removed.

Group C were not operated.

This lasted for two weeks. After which the animals were anaesthetized by making them inhale chloroform causing them to be unconscious.

Sample collection

Fourteen (14) days after surgery, the rats were sacrificed by cervical decapitation, blood samples were collected by ocular puncture method of blood collection (Parasuraman *et al.,* 2017) into plain bottles. The blood was allowed to coagulate and then centrifuged at 3000 revolutions per minute for 15minutes and the serum was collected. The serum was then stored in a refrigerator at a temperature of 4°C until analysis was carried out.

Hematological and Electrolyte Procedure

Serum samples collected were used to assay the hematological and electrolyte parameter using Flame Emission Spectroscopy and Hemocytometer. Burner-Air and fuel combines in the burner to produce the flame. Nebulizer and mixing chamber converts the liquid sample to mist and sprays the fine particles into the flame using the compressed jet of gases (fuel and air). The Hemocytometer chamber is divided into a grid pattern consisting of nine large squares, each square has the same dimensions and contains ten to the negative fourth power milliliters of suspension. The cells were counted and the total numbers of cells were determined.

Histological Procedure

After weighing the harvested organs, the kidneys were immediately fixed in 10% normal saline to preserve the various constituent of the cell in their micro anatomical position and to prevent autolysis and putrefaction. Tissue sections were produced after fixation by normal histochemical methods of dehydration, clearing, impregnation, embedding, sectioning and staining with hematoxylin and eosin (H&E). The micrographs of the relevant stained sections were taken subsequently with the aid of a light microscope.

Data analysis

Data was analyzed using Statistical Package for Social Sciences (SPSS version 23) software package. The results were expressed as Mean ± SEM and analyzed using one-way analysis of variance (ANOVA). Results were considered significant at $p<0.05$.

RESULTS

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

The results obtained from this study were represented using tables and presented as mean ± standard error of mean (SEM) with p-value ≤ 0.05 considered statistically significant and discussed as follows:

Effect of simple Nephrectomy on the Electrolyte Levels of the Experimental Animals

Table 4.1 Effect of simple Nephrectomy on the electrolyte levels of the experimental animals

Groups	Na^+(mmol/L) Mean±SEM	P-Value	K^+(mmol/L) Mean±SEM	P-Value	Cl^-(mmol/L) Mean±SEM	P-Value	$Hco3^-$ (mmol/L) Mean±SEM	P-Value
Control	139.00±1.00		4.33±0.12		99.67±0.88		24.00±0.58	
Test Group	144.25±2.14	0.27	4.50±0.04	0.41	105.00±1.73	0.13	23.50±0.65	0.68
Sham Control	146.67±5.36	0.60	4.57±0.23	0.74	104.33±3.53	0.84	23.33±1.20	0.89

Data was analyzed using ANOVA followed by LSD post-hoc Fisher's test. Values are presented as mean ± SEM. Results are statistically significant at P <0.05.

The results above (Table 4.1) show that there was no significant difference in the electrolyte levels of the test groups when compared to the control group.

Effect of simple Nephrectomy on Blood Cell Parameters

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

Table 4.2 Effect of simple Nephrectomy on Red Blood Cell parameters

Blood Parameter	Experimental Group	MEAN±SEM	P-Value
	CONTROL	7.15±0.35	
RBC	TEST GROUP	6.85±0.10	0.18
	SHAM CONTROL	7.33±0.18	0.57
	CONTROL	13.00±0.58	
HGB	TEST GROUP	12.67±0.67	0.20
	SHAM CONTROL	14.00±0.58	0.40
	CONTROL	40.33±1.65	
HCT	TEST GROUP	39.53±0.27	0.40
	SHAM CONTROL	42.57±0.39	0.61
	CONTROL	56.47±0.90	
MCV	TEST GROUP	57.70±0.46	0.71
	SHAM CONTROL	58.17±0.88	0.29
	CONTROL	17.93±0.03	
MCH	TEST GROUP	18.63±0.66	0.59
	SHAM CONTROL	19.10±0.98	0.16
	CONTROL	32.00±0.57	
MCHC	TEST GROUP	32.00±1.00	0.30
	SHAM CONTROL	33.00±1.15	0.17
	CONTROL	8.40±0.65	
RDW-CV	TEST GROUP	8.33±0.12	0.91
	SHAM CONTROL	8.67±0.15	0.65
	CONTROL	24.23±0.57	
RDW-SD	TEST GROUP	26.07±0.46	0.02*

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

	SHAM CONTROL	26.03±0.17	0.96

Data was analyzed using ANOVA followed by LSD post-hoc Fisher's test. Values are presented as mean ± SEM. Results are statistically significant at P <0.05.

The results above (Table 4.2) show that there was significant increase in RDW-SD when test group was compared to the control group.

Table 4.3 Effect of Simple Nephrectomy on Platelets parameters

	EXPERIMENTAL GROUP	MEAN±SEM	P-VALUE
	CONTROL	320.67±28.76	
PLT	TEST GROUP	383.00±38.74	0.18
	SHAM CONTROL	362.33±14.50	0.35
	CONTROL	8.23±0.07	
MPV	TEST GROUP	8.43±0.03	0.09
	SHAM CONTROL	8.43±0.09	0.09
	CONTROL	0.27±0.02	
PCT	TEST GROUP	0.33±0.03	0.13
	SHAM CONTROL	0.31±0.02	0.25
	CONTROL	16.57±0.32	
PDW	TEST GROUP	15.76±1.01	0.40
	SHAM CONTROL	16.50±0.32	0.95
	CONTROL	22.80±1.76	
P-LCR	TEST GROUP	28.00±5.08	0.21
	SHAM CONTROL	22.47±1.41	0.95
	CONTROL	73.67±12.25	

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

P-LCC	TEST GROUP	107.67±21.96	0.15
	SHAM CONTROL	81.00±2.08	0.34

Data was analyzed using ANOVA followed by LSD post-hoc Fisher's test. Values are presented as mean ± SEM. Results are statistically significant at P <0.05.

The results above (Table 4.3) show that there was no significant difference in platelets when the test group was compared to the control group.

Table 4.4 Effect of Simple Nephrectomy on White Blood Cell parameters

BLOOD PARAMETER	EXPERIMENTAL GROUP	Mean±SEM	P-Value
TOTAL WBC	CONTROL	7.39±1.67	
	TEST GROUP	14.75±0.26	0.00*
	SHAM CONTROL	9.72±1.68	0.27
LYM%	CONTROL	88.40±1.50	
	TEST GROUP	89.86±0.43	0.04*
	SHAM CONTROL	92.133±0.74	0.27
MID%	CONTROL	4.30±0.36	
	TEST GROUP	5.60±0.29	0.02*
	SHAM CONTROL	4.23±0.13	0.87
GR%	CONTROL	7.30±1.42	
	TEST GROUP	4.53±0.15	0.07
	SHAM CONTROL	3.63±0.67	0.03*
LYM#	CONTROL	6.53±1.45	
	TEST GROUP	13.25±0.22	0.00*
	SHAM CONTROL	8.94±1.50	0.21

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

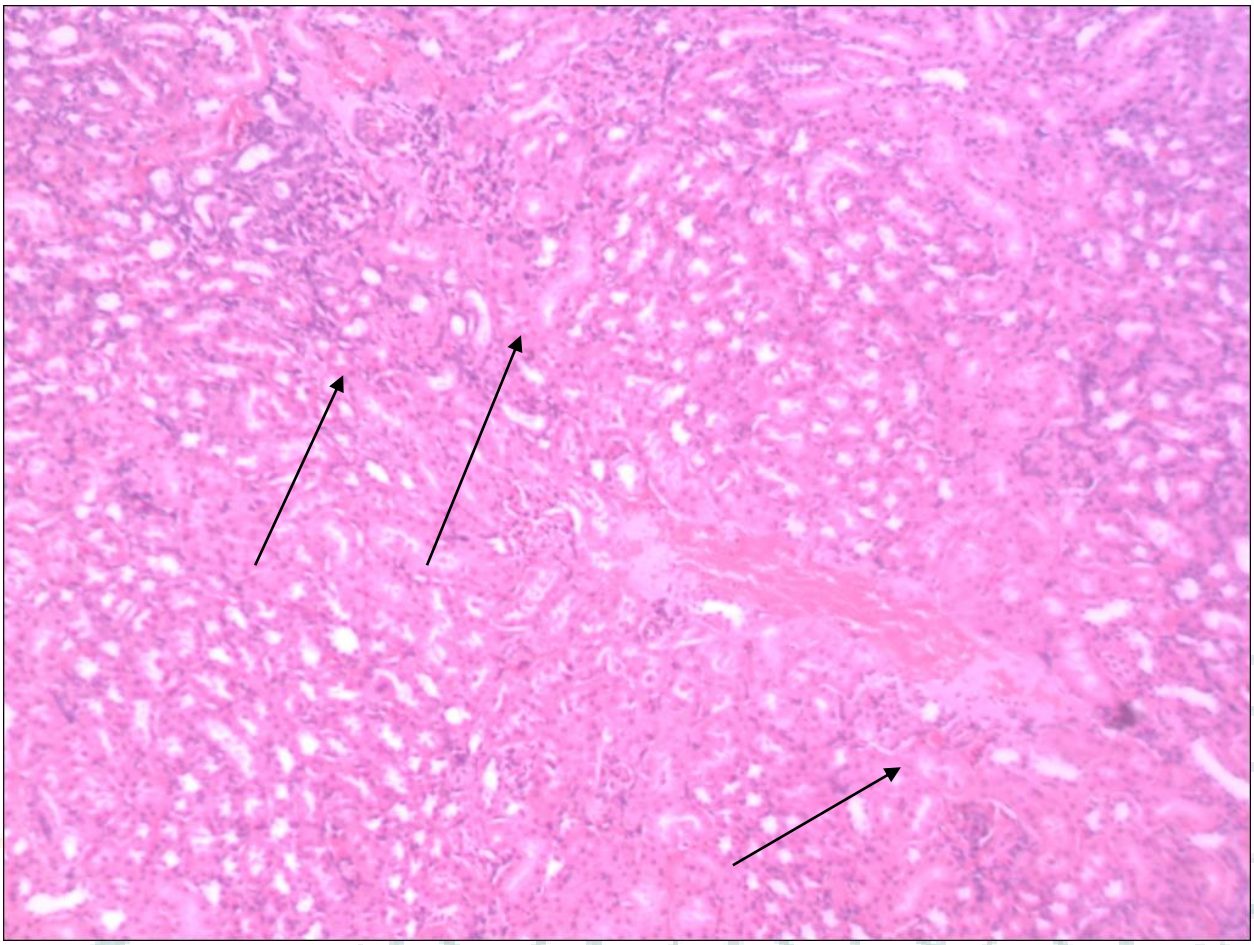
	CONTROL	0.31±0.05	
MID#	TEST GROUP	0.83±0.05	0.00*
	SHAM CONTROL	0.41±0.07	0.25
	CONTROL	0.55±0.20	
GR#	TEST GROUP	0.67±0.03	0.17
	SHAM CONTROL	0.37±0.12	0.56

Data was analyzed using ANOVA followed by LSD post-hoc Fisher's test. Values are presented as mean ± SEM. Results are statistically significant at P <0.05.

The results above (Table 4.4) show that there was significant increase in Total WBC when test group was compared to the control group. There was significant increase in LYM% when test group was compared to the control group. There was significant increase in MID% when test group was compared to the control group. There was significant decrease in GR% when sham-control group was compared to the control group. There was significant increase in LYM# when test group was compared to the control group. There was significant increase in MID# when test group was compared to the control group.

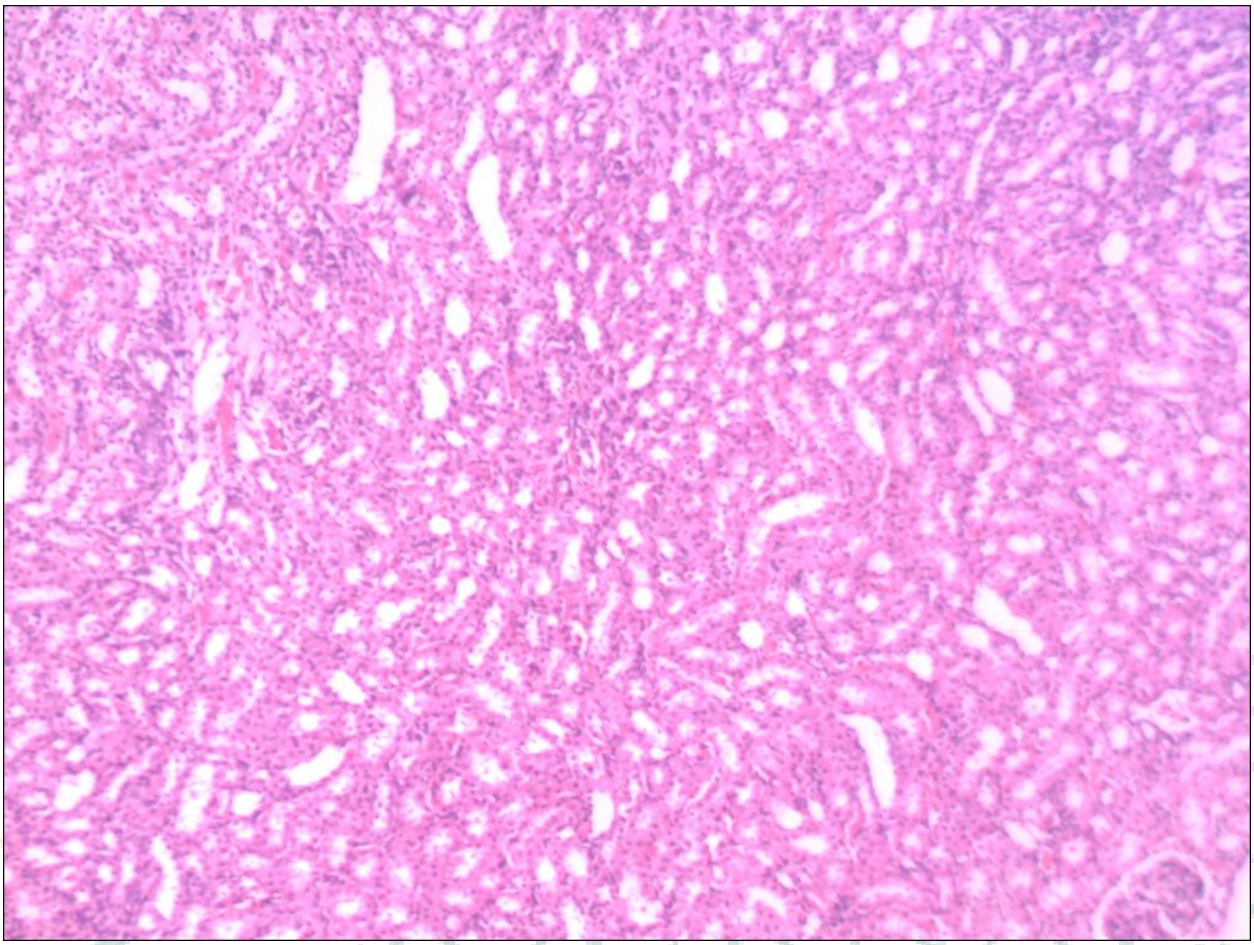
Histological Findings

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals



Slide A1: Showing Photomicrography of Kidney Tissue of the test group with Congested Blood (H&E) X100

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals



Slide B1: Showing Photomicrography of the Kidney Tissue of the control group (H&E) X100

DISCUSSION

This study was aimed at assessing the significant compromise in hematological parameters and electrolyte balance of the kidney after Simple Nephrectomy in male albino rats.Two weeks after Simple Nephrectomy was done, results were compared with those in test group, sham-control and control group and discussed as follows

Electrolyte parameters:

Findings from this study showed no significant change in the Sodium, Potassium and Chlorine levels in the test group when compared to the control group. This may be as a result of an increase in proximal reabsorption of these electrolytes (Kim *et al.,* 2012; Klatte *et al.,* 2005),

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

therefore showing that the electrolyte-balancing function of the single kidney were not altered as Sodium, Potassium and Chlorine levels where unchanged as compared to the control group. This is in agreement with the findings of (Fleck and Braunlich, 1984). It shows that individuals can survive with a single kidney. Although most people have two kidneys, one needs only a functioning kidney to live an active, healthy life (Matt, 2020). Also, Kidney Research United Kingdom posits that unilateral Nephrectomy brings about an increased function in the other kidney and this equates to about 70% of the function of the two normal kidneys (Kidney Research UK, 2022).

Red blood cell parameters:

The results from this present study showed no significant compromise in the red blood cell parameters as there was no significant change in hemoglobin (HGB) level in the test group when compared to the control group. There was also no significant change in Hematocrit (HCT) and Mean Corpuscular Volume (MCV) in the test group when compared to the control. There was no change in the Mean Corpuscular Hemoglobin (MCH) level in the test group when compared to the control group. It also showed no significant change in the Mean Corpuscular Hemoglobin Concentration (MCHC) in the test group when compared to the control group. There was no significant change in the Red Blood Cell Distribution Width (RDW-CV) in the test group when compared to the control group. The balance in Red Blood Cell parameters were brought about by an increased Erythropoietin production, which is a stem cell for blood production thereby maintaining proper levels of blood cells. Kidneys stimulate the production of erythrocytes by secreting Erythropoietin. Erythropoietin is the important stimulating factor for Erythropoiesis. This shows that the Erythropoietin-production function of the single kidney were not altered as a result of the Nephrectomy (Park and Kim, 2009; Mertyna *et al.,* 2008). This confirms the possibility of surviving with a single kidney as the blood cell parameters did not show any significant change due to the increased Erythropoietin production.

Platelets parameters:

The results from this present study showed no significant compromise in blood platelet parameters as there was no significant change in the Mean Platelet Volume (MPV) in the test group when compared to the control group. Also, there

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

was no significant change in the Platelet Distribution Width (PDW) in the test group when compared to the control group.

White blood cell parameters:

There was a significant change in the White Blood Cell count in the test group when compared to the control group. This may be a sign of developing infection in the early postoperative period; it may also be part of a normal surgical response (Jung *et al.,* 2019).

Histology:

The Histological findings showed blood congestion in the kidneys of the test group which signifies acute hyperemia. This shows an increase in blood volume. This was as a result of an increased blood flow into the single kidney which resulted in an increased Glomerular Filtration Rate (GFR) at the glomerular bed. This shows that the rate at which waste was filtered from the kidney was not altered since there was an increase in Glomerular Filtration Rate.

CONCLUSION

Findings from this study showed that Simple Nephrectomy has no significant effect on the hematological and electrolyte balancing function of the residual kidney. This is attributed to an increase in the overall activities of the residual kidney through increasing the Glomerular Filtration rate and Reabsorption rate.

RECOMMENDATIONS

Further studies should be carried out for a longer period of time so as to ascertain the significant compromise in kidney function that may arise at a later time.

Studies should be conducted towards determining the long-term effects of Simple Nephrectomy or late presentations of sequelae following Simple Nephrectomy.

REFERENCES

1. Ali, H., Daoud, A., Mohamed, M.M., Salim, S.A., Yessayan, L. and Baharani, J. (2020). Survival Rate in Acute Kidney Injury Superimposed COVID-19 Patients: A Systematic Review and Meta-Analysis. *Renal Failure* 42 (1):393-397. Doi: 10.1080/0886022X.2020.1756323. 16 February, 2022.
2. Atwell, T.D., Schmit, G.D., and Boorjian, S.A. (2013). Percutaneous Ablation of Renal Masses Measuring 3.0cm and Smaller:

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

Comparative Local Control and Complications after Radio Frequency Ablation and Cryo-ablation. *American Journal of Roenterology.* 200(2):461-466. Doi:10.2214/AJR.12.8618. 16 February, 2022

3. Boss, A., Clasen, S., Kuczyk, M., Schick, F., Pereira, P.L. (2007). Image-Guided Radiofrequency Ablation of Renal Cell Carcinoma. *European Radiology*. 17(3):725-733. 16 February, 2022.
4. Bradley, H.C. (2021). Kidney Transplantation. Retrieved from http://www.emedicine.medscape.com/article/430128-overview
5. Chawla, L.S., Davison, D.L., Brasha, M.E., Koyner, J.L., Arthur, J.M. and Shaw, A.D. (2013). Development and Standardization of a Furosemide Stress Test to Predict the Severity of Acute Kidney Injury. *Journal of Critical care.* 17 (5):R207. Doi: 10.1186/cc13015
6. Ekholm, F.I., Elinder. C.G., Stenbeck, M., Tyden, G. and Groth, C.G. (1997). Kidney donors live longer. Journal of Transplantation. 64(7): 976-978. Doi: 10.1097/00007890-199710150-00007. 16 February, 2022.
7. Fleck, C. and Bräunlich, H. (1984). Kidney Function after Unilateral Nephrectomy. *International Journal of Clinical and Experimental Pathology.* 25(1):3-18. Doi: 10.1016/s0232-1513(84)80002-x. 16 February, 2022
8. Gupta, N., Raina, P. and Kumar, A. (2005). Laparoscopic donor nephrectomy. Journal of Minimal Access Surgery. 1(4):155-164. Doi: 10.4103/0972-9941.19262. 16 February, 2022
9. Kidney Research UK: Living with One Functioning Kidney. Retrieved from https://www.kidneyresearchuk.org/kidney-health-information/ on 10 November,2021
10. Kim, S.P., Thompson, R.H., Boorjian, S.A., Weight, C.J., Han, L.C., Murad, M.H., Shippee, N.D., Erwin, P.J., Costello, B.A., Chow, G.K. and Leibovich, B.C. (2012). Comparative Effectiveness for Survival and Renal Function of Partial and Radical Nephrectomy for Localized Renal Tumors: A Systematic Review and Meta-Analysis. *Journal of Urology*. 188(1):51-57. Doi: 10.1016/j.juro.2012.03.006. 12 January, 2022
11. Klatte, T., Mauermann, J. and Heinz, P. (2011). Perioperative, Oncologic, and Functional

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

Outcomes of Laparoscopic Renal Cryo-ablation and Open Partial Nephrectomy: A Matched Pair Analysis. *Journal of Endourology*. 25(6):991-997. Doi: 10.1089/end.2010.0615. 12 February, 2022

12. Layton, A.T. and Vallon, V. (2018). Renal Tubular Solute Transport and Oxygen Consumption: Insights from Computational Models. *Current Opinion in Nephrology and Hypertension.* 27(5):384-389. Doi: 10.1097/MNH.0000000000000435. 13 February, 2022

13. Lote, C.J. (2012). *Principles of Renal Physiology*. 5th edition. Springer. p.21

14. Matt, C. (2020). *Living with One Kidney: What to know*. Retrieved from https://www.healthline.com/health/can-you-live-with-one-kidney on 16 February, 2022

15. Merkle, E.M., Nour, S.G. and Lewin, J.S. (2005). MR Imaging Follow-Up after Percutaneous Radiofrequency Ablation of Renal Cell Carcinoma: Findings in 18 Patients during First 6 Months. *Radiology*. 235(3):1065-1071. Doi: 10.1148/radiol.2353040871 11 February, 2022

16. Mertyna, P., Dewhirst, M.W., Halpern, E., Goldberg, W. and Goldberg, S.N. (2008). Radiofrequency Ablation: The Effect of Distance and Baseline Temperature on Thermal Dose Required for Coagulation. *International Journal of Hyperthermia*. 24(7):550-559. Doi: 10.1080/02656730802035662. 18 October, 2021

17. Mitchell, C.R., Atwell, T.D. and Weisbrod, A.J. (2011). Renal Function Outcomes in Patients Treated with Partial Nephrectomy versus Percutaneous Ablation for Renal Tumors in a Solitary Kidney. *Journal of Urology*. 186(5):1786-1790. Doi: 10.1016/j.juro.2011.07.036. 10 November, 2021

18. Mukkamala, A., He, C. and Weizer, A.Z. (2014). Long-Term Renal Functional Outcomes of Minimally Invasive Partial Nephrectomy for Renal Cell Carcinoma. *Journal of Urology and Oncology*. 32(8)1247-1251. Doi: 10.1016/j.urolonc.2014.04.012. 11 August, 2021

19. Oefelein, M.G. (2006). Delayed Presentation of Urinoma after Radio Frequency Ablation-Assisted Laparoscopic Partial Nephrectomy. *Journal of Endourology*. 20(1):27-30. Doi: 10.1089/end.2006.20.27. 15 November, 2021

FRONTLINE MEDICAL SCIENCES AND PHARMACEUTICAL JOURNAL
(ISSN – 2752-6712)
VOLUME 02 ISSUE 03 Pages: 51-66
SJIF IMPACT FACTOR (2021: 5.14) (2022: 5.605)
OCLC – 1272874727 METADATA IF – 6.986
Publisher: Frontline Journals

20. Parasuraman, S., Raveendran, R. and Kesavan, R. (2017). Blood ample collection in small laboratory animals. Journal of Pharmacology and Pharmacotherapeutics. 8(3):153. Doi: 10.4103/0976-500X.215702. 16 February, 2022

21. Park, B.K. and Kim, C.K. (2009). Complications Of Image-Guided Radio Frequency Ablation of Renal Cell Carcinoma: Causes, Imaging Features and Prevention Methods. *Journal of Eurology and Radiology*. 19(9): 2180-2190. Doi: 10.1007/s00330-009-1399-1. 10 October, 2021

22. Park, S. and Cadeddu, J.A. (2007). Outcomes of Radiofrequency Ablation for Kidney Cancer. *Cancer Control*.14(3):205-210. Doi: 10.1177/107327480701400302. 12 October, 2021

23. Weizer, A.Z., Raj, G.V., O'Connell, M., Robertson, C.N., Nelson, R.C. and Polascik, T.J. (2005). Complications after Percutaneous Radiofrequency Ablation of Renal Tumors. *Journal of Urology.* 66(6):1176-1180. Doi: 10.1016/j.urology.2005.06.125. 20 August, 2021