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RENAL IMPAIRMENT IN ISCHEMIC AND HEMORRHAGIC STROKE: A COMPARATIVE ANALYSIS OF KIDNEY FUNCTION AND ITS CLINICAL SIGNIFICANCE

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ABSTRACT

Background: Renal failure is a leading cause of death in stroke patients, and impaired renal function is a significant predictor of both ischemic and hemorrhagic strokes. Understanding the prevalence of renal dysfunction, associated risk factors, and its impact on long-term outcomes is essential for optimizing stroke patient care.

This study aimed to assess the prevalence of renal dysfunction using estimated glomerular filtration rate (eGFR) in patients presenting with acute stroke (<24h), identify associated risk factors, and evaluate the relationship between renal impairment and mortality as well as cardiovascular events.

Methods: A retrospective analysis was conducted on stroke patients admitted to a hospital. Patients with acute kidney injury, history of renal disease, nephrotoxic drug use, or septicemia were excluded. Renal impairment was determined based on eGFR levels, and demographic details, comorbidities, and risk factors were analyzed. Associations between renal impairment and mortality, as well as fatal and nonfatal cardiovascular events, were investigated.

Results: Of the 136 stroke patients included, transient renal impairment was found in 70 patients (51.47%). Even patients with normal blood pressure showed renal impairment, with 12 out of 27 ischemic and 11 out of 25 hemorrhagic non-hypertensive patients affected. Hypertension was prevalent in 11 out of 21 hemorrhagic stroke patients and 21 out of 33 ischemic stroke patients with renal impairment. Age, gender, diabetes, stress, smoking, and alcohol were identified as potential risk factors for renal impairment. The study also revealed a significant association between renal dysfunction and cardiovascular events, including stroke, due to shared biological mechanisms and vascular injury.

Conclusion: The study highlights a high prevalence of renal impairment in stroke patients, with

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a higher incidence observed in ischemic stroke patients potentially due to factors such as medication use. Renal dysfunction was associated with increased mortality and a higher risk of cardiovascular events. These findings emphasize the importance of assessing renal function in stroke patients and implementing appropriate management strategies.

Keywords: renal impairment, estimated glomerular filtration rate, ischemic stroke, hemorrhagic

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stroke, risk factors, mortality, cardiovascular events.

Conflicts of Interest: Nil
Fund for the study : Self funded

Introduction:

Stroke is a leading cause of mortality and morbidity worldwide[1], encompassing two major subtypes: ischemic and hemorrhagic stroke. While the neurological consequences of stroke have been extensively studied, the impact of stroke on other organ systems, such as the kidneys, has gained increasing recognition. Renal impairment, characterized by a decline in glomerular filtration rate (GFR) and altered kidney function, is a significant concern in stroke patients[2]. Understanding the differential effects of ischemic and hemorrhagic stroke on renal function is crucial for optimizing patient care and improving stroke management outcomes.

Ischemic stroke results from the occlusion of a cerebral artery, leading to inadequate blood supply to the brain. On the other hand, hemorrhagic stroke occurs due to the rupture of blood vessels within the brain, resulting in bleeding and subsequent tissue damage. While these stroke subtypes differ in their underlying mechanisms, both can potentially impact renal function[3] through shared pathways such as systemic inflammation, hemodynamic alterations, and neuroendocrine disturbances.

Several studies have suggested an association between ischemic stroke and renal impairment, indicating a higher prevalence of chronic kidney disease (CKD) in ischemic stroke[4] patients compared to the general population. Ischemic stroke-related renal impairment has been attributed to factors such as reduced renal perfusion, oxidative stress, and endothelial dysfunction. In contrast, the effects of hemorrhagic stroke[5] on renal function remain relatively less explored.

This study aims to investigate and compare the occurrence and severity of renal impairment in ischemic and hemorrhagic stroke patients. By assessing renal function parameters, including GFR, serum creatinine levels, and urine output, we seek to elucidate the specific impact of each stroke subtype on kidney health. Furthermore, understanding the factors associated with renal impairment in stroke patients can contribute to risk stratification, early detection, and targeted interventions to prevent or manage kidney complications in this vulnerable population.

AIM AND OBJECTIVE

- To compare renal impairment based on estimated glomerular filtration between hemorrhagic and ischemic stroke patients

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- To observe demographic details comorbidities and other risk factors associated with the progression of renal impairment in stroke patients.

METHODOLOGY

STUDY SITE:

The study was conducted in the General Medicine In-Patient Department at King George Hospital, Visakhapatnam.

STUDY DESIGN:

Hospital based Prospective Observational Study that analyzes data collected from a population.

STUDY POPULATION:

About 136 stroke patients (both ischemic and hemorrhagic) admitted in General Medicine **In•** Patient department in King George Hospital were recruited into the study with their informed consent.

METHODOLOGY:

Our study was a prospective observational study which was conducted in King George Hospital, Visakhapatnam, over a period of 6 months. Renal function tests reports were collected from both types of stroke patients on the day of admission. Estimated glomerular filtration rate was calculated and reported based on grades G I-G5.

G FR categories	GFR range(ml/min/l.73m^{1})
GI	>90
G2	60-89
G3a	45-59
G3b	30-44
G-t	15-29
GS	<15

Based on these grades. patients are categorized and renal impairment was assessed.

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PATIENT SELECTION:

Inclusion criteria-

- Patients of both genders, who were admitted in In-Patient ward of General Medicine department and diagnosed with stroke (both ischemic and hemorrhagic) with or without hypertension and diabetes mellitus were included in the study.
- Patients admitted with stroke whose laboratory tests were performed within 24hrs were included in the study.

Exclusion criteria:

- Subjects with known chronic kidney disease.

STUDY PERIOD:

Patients were recruited over a period of Five-months (November 2018 to March 2019)

STUDY PROCEDURE:

- Stroke patients with HTN or DM or both or none were identified, and the respective patient's permission was taken in the patient consent form prior to inclusion in the study.
- The data related to the patient including the patient's demographics, present complaints, past history was collected in a Data collection form.
- Based on this information patients were divided into 2 groups i.e., hemorrhagic, and ischemic stroke, 4 Subgroups such as patients with HTN alone or DM alone or both or none.
- Renal function test reports were collected from both stroke patients on the day of admission.
- eGFR was calculated and reported based on grades G I-G5.
- Proper statistical analysis tools were applied.

Institutional Ethics committee (IEC) Approval:

Institutional Ethics committee (IEC) of Andhra University clearance was obtained prior to the initiation of the study with the reference number : 32/IEC AMC/FEB 2021

Withdrawal of Subjects:

The investigator may withdraw a subject from the study for any of the following reasons:

- The subject suffers from significant inter-current illness or Undergoes surgery during the study.
- Any subject found to have entered the study in violation of this protocol. This includes the subject

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meeting any one of the exclusion criteria or if he/she does not meet any one of the Inclusion criteria or if the subject is uncooperative during the study.

- Any subject who requires the use of an unacceptable concomitant medication
- If it is felt by the Principal Investigator/Clinical Investigators opinion that it is not in the subject's best interest to continue.
- Any subject who wants to withdraw his consent at any given point of time of the study.

- The details of the withdrawals of the subjects i.e., Date of withdrawal of the subject, reason for the withdrawal etc. will be recorded in a well-designed Data collection form (DCF) and other study documents.

TERMINATION OF THE STUDY:

The Principal Investigator reserves the right to terminate the study for safety reasons of the subjects (if any). Reasons for the termination will be provided to the subjects. The Institutional review Board (IRB) may terminate the study if there are any major violations of ethical considerations.

RESULTS

In the study we included 136 cases (stroke patients), of which 82 were ischemic stroke cases and 54 were hemorrhagic stroke cases.

Table: 1- Renal impairment in hemorrhagic and ischemic stroke cases:

STROKE TYPE	NON-RENAL (eGFR>=60mL/min)	RENAL (eGFR<60mL/min)	TOTAL
ISCHEMIC	35	47	82
HEMORRHAGIC	31	23	54
TOTAL	66	70	136

From the table 1 , the renal impairment was found to be 57.31% in ischemic stroke cases and 42.59% in hemorrhagic stroke cases.

Figure: 1- Renal impairment in hemorrhagic and ischemic stroke cases:

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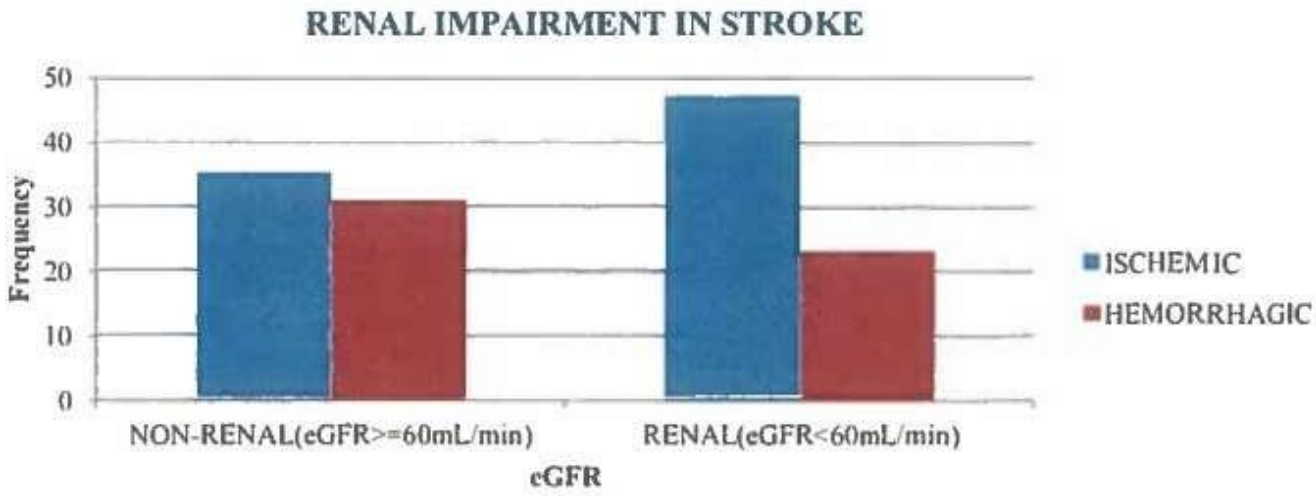

Table: 2 - Renal impairment - age groups

AGE	ISCHEMIC (NR)	ISCHEMIC (R)	HEMORRHAGIC (NR)	HEMORRHAGIC (R)
11-20 YEARS	1	0	0	0
21-30YEARS	1	0	1	0
31-40 YEARS	4	0	4	0
41-50 YEARS	6	4	11	2
51-60 YEARS	11	17	9	6
61-70 YEARS	8	14	6	13
71-S0YEARS	4	7	0	2
81-90 YEARS	0	5	0	0

- NR- Non-Renal, R- Renal

From the table 2, the renal impairment in ischemic stroke patients was more in age group of 5 l-60years. And the renal impairment in hemorrhagic stroke patients was more in age group of 61-7Oyears.

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Figure: 2 - Renal impairment - age groups

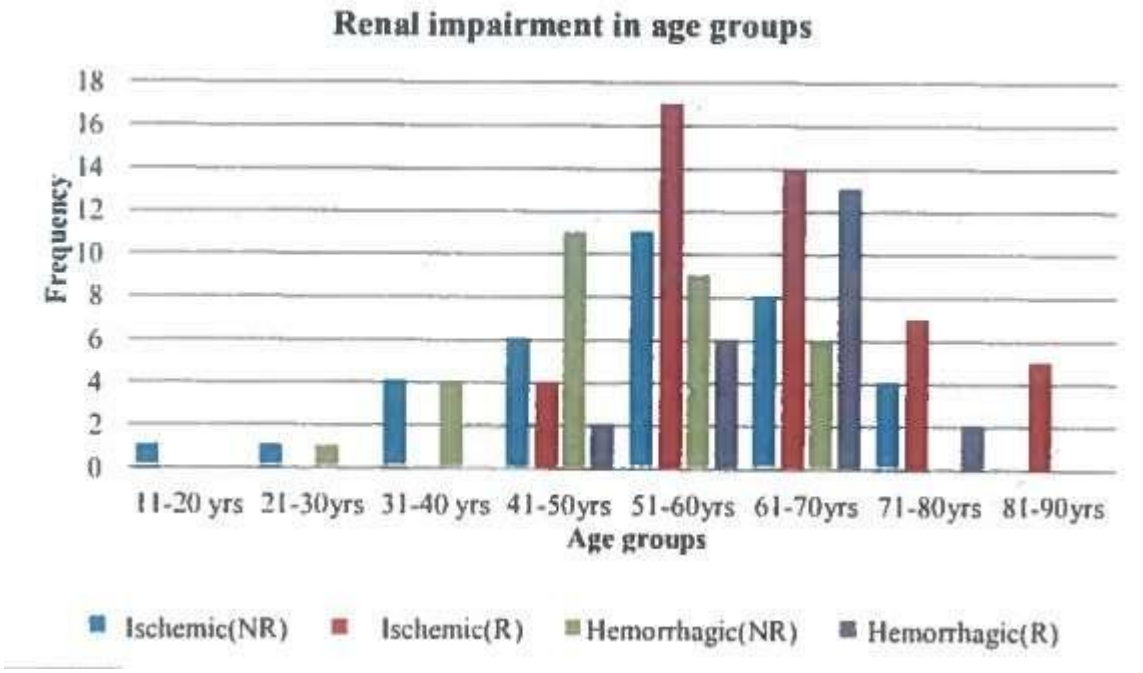

Table: 3-Renal impairment - Gender wise distribution

GENDER	ISCHEMIC(NR)	ISCHEMIC(R)	HEMORRHAGIC(NR)	HEMORRHAGIC(R)
MALE	19	22	18	11
FEMALE	16	25	13	12

From the table 3, the renal impairment in ischemic stroke cases was found to be 53.65% in males and 60.97% in females, similarly in hemorrhagic stroke the renal impairment was found to be 37.93% in males and 48% in females.

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Figure: 3-Renal impairment- Gender wise distribution

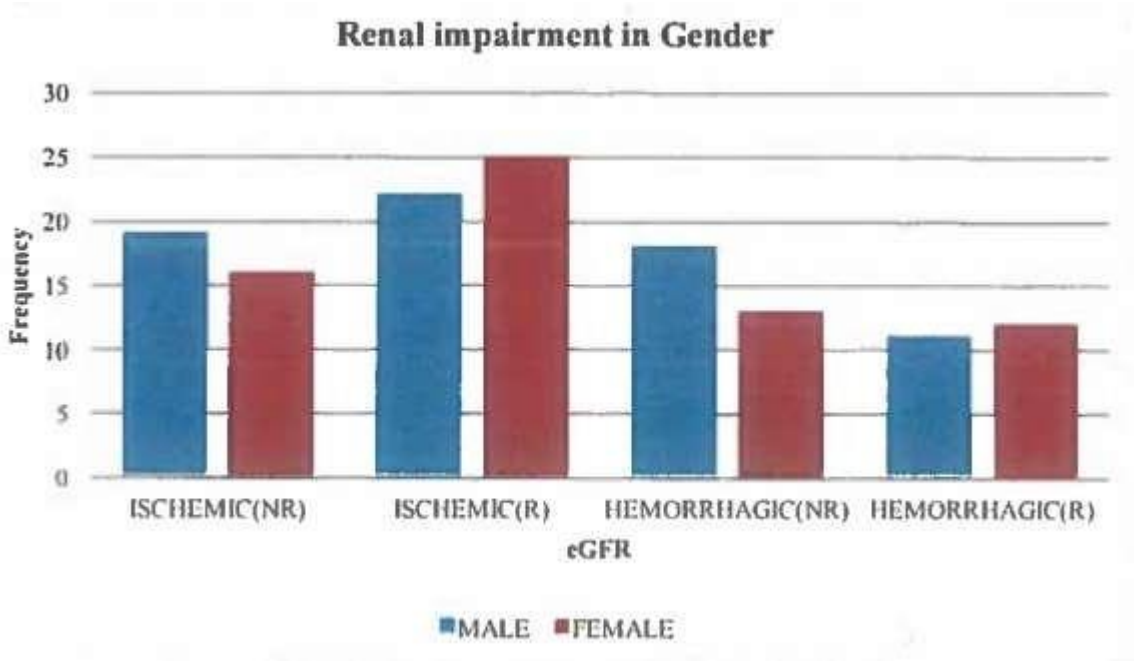

TABLE: 4.1- Renal impairment and co-morbidities in males

COMORBITIES IN MALE STROKE POPULATION				
CONDITION	**ISCHEMIC(NR)**	**ISCHEMIC(R)**	**HEMORHAGIC(NR)**	**HEMORHAGIC(R)**
Only HTN	5	7	*5*	7
Only DM	2	3	1	0
Both DM&HTN	3	*5*	3	0
None	9	7	9	4

From the table 4.1, the renal impairment of male stroke cases along with other co-morbidities was observed. Hypertension and type 2 diabetes mellitus are the major co-morbidities associated with stroke. Renal impairment was observed in patients with HTN alone and both HTN and DM.

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Figure: 4.1- Renal impairment and co-morbidities in males

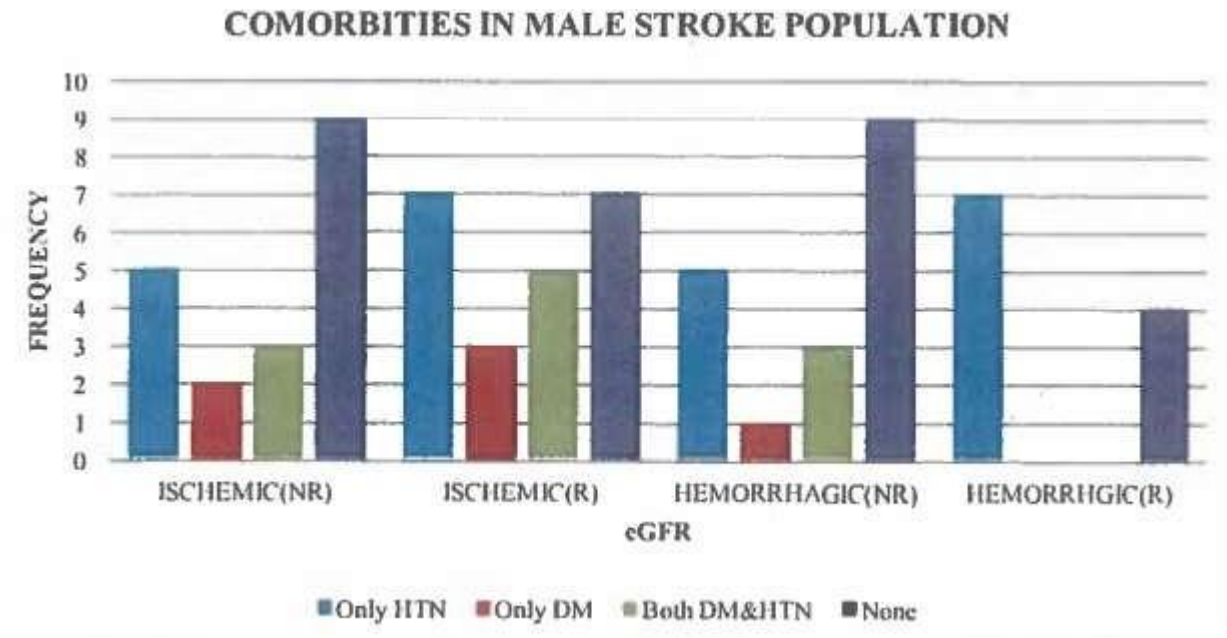

TABLE: 4.2- Renal impairment and co-morbidities in females

COMORBITIES IN FEMALE STROKE POPULATION				
CONDITION	**ISCHEMIC(NR)**	**ISCHEMIC(R)**	**HEMORHAGIC(NR)**	**HEMORHAGIC(R)**
Only HTN	7	14	5	4
Only DM	I	0	I	0
Both DM&HTN	2	6	2	I
None	6	5	5	7

From the table 4.2, the renal impairment of female stroke cases along with other co• morbidities was observed. Hypertension and type 2 diabetes mellitus are the major co• morbidities associated with stroke. Renal impairment was observed in patients with HTN alone and both HTN and DM.

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Figure: 4.2- Renal impairment and co-morbidities in females

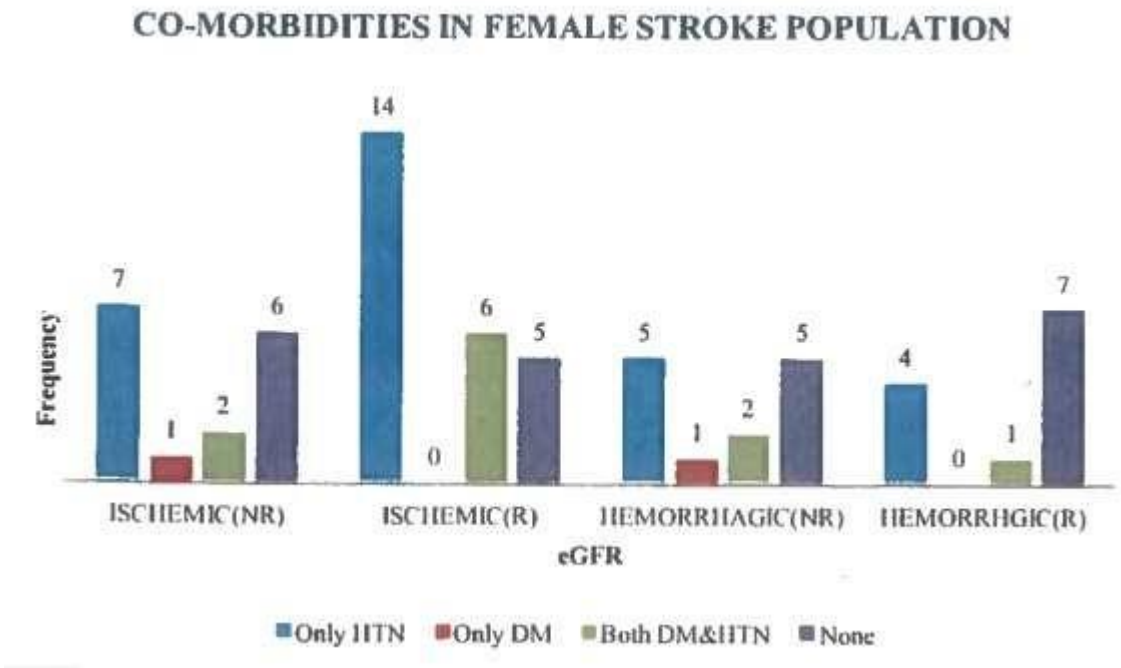

TABLE: 5.1- Renal impairment - Smoking and Alcohol in male stroke population

CONDITION	ISCHEMIC(NR)	ISCHEMIC(R)	HEMORHAGIC(NR)	HEMORHAGIC(R)
Only smoking	2	4	0	0
Only alcoholic	7	2	10	2
Both smoking & alcohol	10	15	5	7
None	0	1	3	2

From the table 5.1, the renal impairment of male stroke cases along with other risk factors i.e., smoking and alcohol was observed. Renal impairment was observed in patients of both smoking and alcohol condition.

Figure: 5.1-Renal impairment- smoking and alcohol in male stroke population

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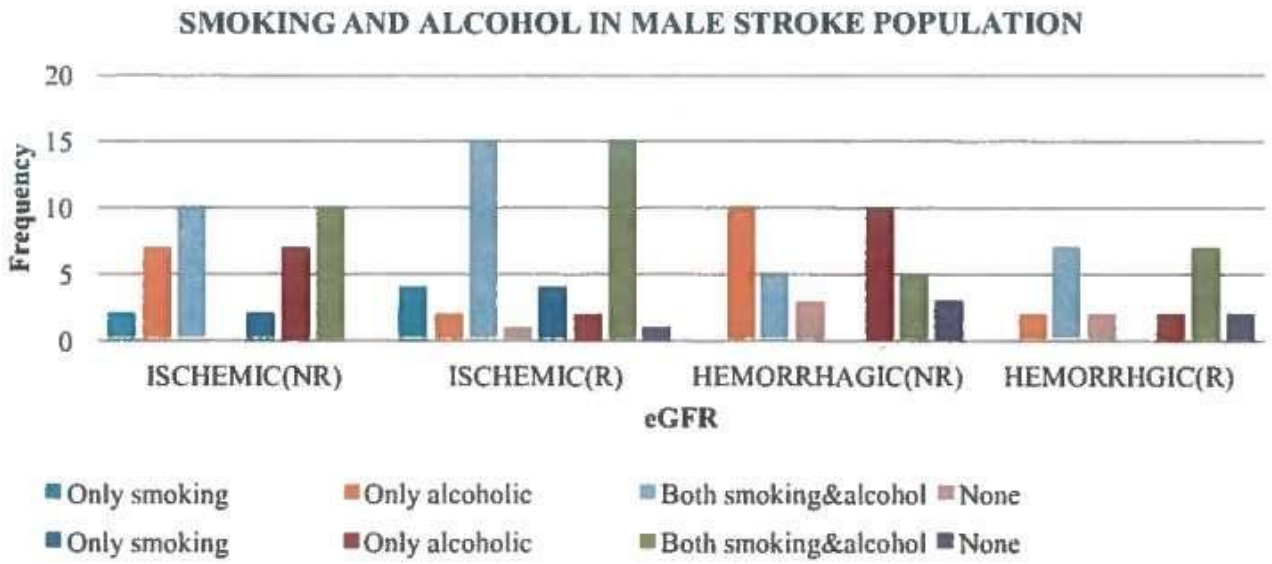

TABLE: 5.2: Renal impairment - smoking and alcohol in female stroke population

HABITS IN STROKE FEMALE POPULATION				
CONDITION	**ISCHEMIC(NR)**	**ISCHEMIC(R)**	**HEMORRHAGIC(NR)**	**HEMORRHGIC(R)**
Only smoking	3	9	2	6
Only alcoholic	0	0	0	0
Both smoking &alcohol	0	0	0	0
None	13	16	11	6

From the table 5.2, the renal impairment of female stroke cases along with other risk factors i.e., smoking and alcohol was observed. Renal impairment was observed in patients of, smoking alone and patients having none of the condition.

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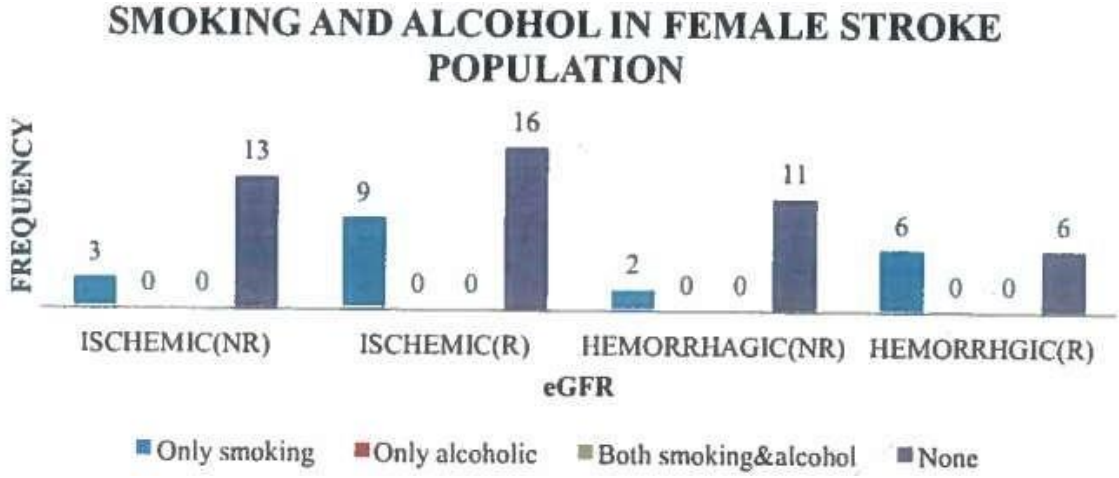
Figure: 5.2 **-Renal impairment - smoking and alcohol in female stroke population**



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	NON-RENAL	RENAL	z	P-Value
MEAN AGE{M)	57.27	62.36	29.251*	0
MEAN AGE(F)	55.62	67.35	3.984*	0
MEAN Wt(M}	62.75	61.24	2.56	0.37
MEAN Wt(F)	57.86	53.64	2.035*	0
Sr.Cr(M)	0.9	1.55	6.405*	0
Sr.Cr(F}	0.7	1.3	-6.730*	0
UREA(M)	30.07	51.8	5.102*	0
UREA(F)	34.1	52.3	8.117*	0
HB(M)	13.41	12.15	3.703*	0.4
HB(F)	11.72	11.3	-46.538*	0.6
ESR(M)	24.86	23.12	-0.069	0.473
ESR(F)	24	24.29	-1.366	0.8
TOTALC(M)	12,040	11,421	1.396	0.081
TOTALC(F)	9,617	10,897	1.443	0.075
SGOT(M)	42	57.5	-7.869*	0
SGOT(F)	40	39.5	14.53	0.8
SGPT(M)	27	31.7	-0.677	0.249
SGPT(F)	27	25.7	-4.86	0.4
TC(M)	178	176.6	8.34	0.3
TC(F)	188	203.8	33.6	0.02
TG(M)	96	107.1	25.9	0.04
TG(F)	118	116.3	20.8	0.6

TABLE: 6 - Various risk factors and lab parameters that associate with renal impairment

Values are given as Mean ± SEM.
**P≤0.05 as compared to non-renal subjects
*P≤0.001as compared to renal subjects

The table 6 shows a significant difference in mean age. mean weight(F). serum creatinine, urea, hemoglobin (HB). SGOT(M) and has no significant difference in mean weight(m). ESR. total count. SGOT(F), SGPT, total cholesterol and triglycerides.

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DISCUSSIONS

Renal failure is a primary cause of death in patients following stroke; however. impaired renal function is a significant predictor of both the types of strokes. The oxford community of stroke project reported that stroke survivals tend to die 2.3 times more than the matched general population[3]. By using the eGFR we identified a significant prevalence of renal dysfunction, in patients presenting early to the hospital with acute stroke (<24h). In our study, the high frequency of renal dysfunction might be explained in part by the higher coexistence of hypertension that was increased in the lower eGFR values. To assess the true prevalence of CKD and its role on long term mortality and occurrence of cardiovascular events, we identified patients with AKI and excluded them from the stud/. After excluding patients with a history of renal disease, nephrotoxic drugs or septicemia. transient renal impairment was found in 70 out of 136 patients (51.47%). We have shown that even a moderate reduction in renal function appeared to be independent and clinically relevant risk factor not only for the overall mortality but also for the composite fatal and nonfatal cardiovascular events.

Hypertension is attributed to a large share of patients progressing to end stage renal failure. In the present study 11 out of 21 patients with hemorrhagic stroke and 21 out of 33 patients with ischemic stroke had HTN are affected with renal impairment. Even the patients with normal blood pressure have renal impairment, i.e., 12 out of 27 ischemic and 11 out of 25 hemorrhagic non hypertension patients are having renal impairment 3. This may be due to the risk factors such as age. gender. DM, stress, smoking and alcohol. Age group of 51-70 years of ischemic stroke patients and 51-80 years of hemorrhagic stroke are more affected to renal impairment. The interaction of kidney function and CVD has been the subject of many recent analyses. There is ongoing evidence that CKD is an additional risk factor for CVD including stroke. This association is mainly explained by shared biological mechanisms predisposing to the development of clinical atherosclerosis in the renal. coronary and cerebral vasculature. Traditional cardiovascular risk factors, in particular hypertension and diabetes, could lead to a similar vascular injury in both kidney and brain and explain these associations. Autopsy data have shown that atherosclerotic renal artery stenosis is common in patients with stroke. especially in those with brain infarction. In addition, recent studies showed a close relationship between renal dysfunction and stroke due to small vessel diseases. The brain and kidney share a similar vascular structure with low-resistance exposure of the small vessels to highly pulsatile flow and pressure. As a result, microvascular damage to both organs can lead not only to renal impairment with reduced GFR but also to asymptomatic or symptomatic brain infarcts and white matter lesions[2]•

In our study. some degree of renal impairment was seen in 57.31% of patients with Ischemic stroke and 42.59% of patients in hemorrhagic stroke. The higher incidence of renal impairment seen in the ischemic stroke subgroup may be due to use of mannitol, nephrotoxic drugs. various antibiotics etc. This study is unable to explore this possibility in detail; however. as all these patients were managed in the same institution, over the same period. Our results suggest that estimated GFR may be useful tool to identify patients at high risk of death and nonfatal cardiovascular events in patients presenting with stroke.

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Based on grades of eGFR we classified stroke patients into renal, non-renal impairment condition. The average values of each patient's laboratory parameters are calculated and have observed the significance for each parameter. Age, weight, serum creatinine. Urea, SGOT had showed a significant difference. Our study has several limitations. First, the study is hospital based and not population based. Secondly, although the use of Cockcroft-Gaull equation is quite reliable means of estimating GFR. It tends to overestimate GFR in high levels of renal function and is inversely affected by age. Despite these limitations, our study reinforces the belief that renal function is an important and significant independent prognostic factor for mortality and cardiovascular events after stroke.

CONCLUSIONS

The study was conducted in 136 stroke patients in General Medicine In-patient ward of King George Hospital. Among which 82 are ischemic stroke and 54 are hemorrhagic stroke patients.

1. In this prospective observational study of patients with hemorrhagic and ischemic stroke, renal impairment was observed in more patients of ischemic subgroup (57.31%) compared to hemorrhagic subgroup (42.59%) based on estimated GFR.

2. Renal and non-renal conditions for each lab parameter were compared and have observed significant difference in age, weight, serum creatinine. urea and SGOT parameters.

3. No significant difference in mean weight(m). ESR. total count. SGOT(F). SGPT. total cholesterol and triglycerides

These findings suggest that estimated GFR should be added to the other known prognostic factors and emphasizes the importance of identification and management of unrecognized renal impairment in stroke therapy.

REFERENCES

References:

1. Park JH, Ovbiagele B. Kidney health and ischemic stroke: an overlooked association. J Stroke. 2017;19(2):143-151.

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2. Knežević M, Stašević Z, Stefanović B. Acute kidney injury following ischemic stroke: a single-center prospective study. Neurol Sci. 2020;41(8):2235-2243.

3. Liu J, Zhu Y, Wu Y, et al. Increased risk of chronic kidney disease in patients with ischemic stroke without comorbid atrial fibrillation: a retrospective cohort study. Int Urol Nephrol. 2021;53(3):579-586.

4. Xiong X, Wang X, Zhang Y, et al. Hemorrhagic transformation after cerebral infarction: current concepts and challenges. Ann Transl Med. 2014;2(8):81.

5. Inaba A, Di Tullio MR. Kidney-brain crosstalk in the acute and chronic setting. Nat Rev Nephrol. 2021;17(1):45-61.