

A Study of Non Protein Nitrogenous Substances in Renal Diseases

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Abstract

Kidneys are vital organs responsible for maintenance of body fluid, salts and electrolyte concentration. Non protein nitrogen substances have an important role in renal diseases that are serious concern to human health. The present research was carried out during 2006 at SVS Medical College and Hospital, Mahabubnagar, Hyderabad, India with the objective of examining patients with renal diseases with reference to NPN parameters. Blood samples from 30 patients were subjected to analysis of Blood Urea, Serum Creatinine, Serum Uric Acid, Serum Electrolytes, Sodium, Potassium and Chloride. The statistical analysis of the above data showed that there was significant elevation of urea and creatinine levels in the cases of renal failure. The uric acid levels were also elevated when compared to the normal, the difference is not statistically significant. All cases were advised for dialysis. Urea and Creatinine levels are considered to be reliable parameters in assessment of early renal diseases.

Keywords: Acute renal failure (ARF), Chronic Renal Failure (CRF), dialysis, NPN, electrolytes.

1. Introduction

Diseases affecting the kidneys can often be detected, even in asymptomatic patients from clues derived from routine clinical and laboratory examination. Kidneys are responsible for producing urine which is used to flush away the toxins. The kidneys also maintain a healthy balance of fluids and electrolytes or salt compounds in the body.^[13] Renal failure is a serious medical condition affecting the kidney. When a person suffers from renal failure, their kidneys are not functioning properly or no longer work at all. Renal failure can be progressive diseases or a temporary one depending on cause and available treatment options. In renal failure kidneys undergo cellular death and are unable to filter waste^[5]. This dysfunction causes a buildup of toxins in the body which can affect the blood, brain and heart as well as other complications also results. Main purpose of kidneys is to filter the blood and remove waste products and excess water. They also selectively reabsorb compounds that have been filtered thus conserving essential nutrients, electrolytes, amino acids and other biomolecules^[9]. Approximately one-quarter of the cardiac output i.e. 1200 ml of blood per minute is received by the kidneys^[8].

There are two types of Renal Failure:

1.1 Acute renal failure: This occurs suddenly and is usually initiated by underlying causes for example dehydration, infection, serious injury to the kidney or the chronic use of over dose of pain medications like Tylenol (Acetaminophen) or Advil (Ibuprofen). Acute renal failure is often reversible with no lasting damage^[7].

1.2 Chronic renal failure: This is more serious than acute renal failure because symptoms may not appear until the kidney is extremely damaged. Chronic renal failure can be caused by other long term diseases, such as Diabetes and high blood pressure. The symptoms of renal failure include edema which is an accumulation of fluid characterized by swelling and decrease in urination other symptoms may include a general ill feeling exhaustion and headache^[7].

A person with kidney failure can live a relatively normal life depending on the severity of kidney failure; renal function may be restored by treating the primary disease that is responsible for the damage or by treating the kidney with medication. In severe cases of renal failure, a person might require dialysis and a kidney transplant^[7]. The present study is taken up to assess the severity of the disease by using biochemical parameters such as NPN substances and electrolytes which are all estimated by standard procedures^[10].

The aim of this study is to analyze the Biochemical profile in renal diseases in adults. Early possible detection of any abnormal biochemical parameter will help in diagnosis of renal diseases which will help in prevention of complication and permanent damage of kidney. The kidneys excrete the waste products and fluid by using the mechanism of glomerular filtration and tubular re-absorption.

There are numerous potential causes for the damage of kidneys^[7].

- Decreased blood flow.
- This may occur in extremely low blood pressure caused by trauma, complicated surgery, septic shock, hemorrhage, burns or other several complicated illnesses.
- Acute tubular Necrosis.

This occurs when the tissues aren't getting enough Oxygen or when the renal artery is blocked or narrowed.

- Over exposure to heavy metals, solvents radiographic contrast materials, certain antibiotics and other medication.
- Infections such as acute pyelonephritis or septicemia.
- Urinary track obstruction- Such as narrowing of the urinary tract, tumors, kidney stones, nephrocalcinosis or enlarged prostate.
- Severe acute nephrotic syndrome.
- Disorders of the blood such as idiopathic thrombocytopenic purpura (ITP), transfusion reaction, or other hemolytic disorders. Autoimmune disorder such as scleroderma can cause acute renal failure.

2. Materials and method

The present study is carried out in Department of Biochemistry, S.V.S Medical College. The relevant data is gathered from the Department of medicine, S.V.S medical college and hospital during the year 2006. The present study included 20 cases of renal disease and 10 normal individuals who serve as control group. They are all above 40 years. The 20 cases were selected on the basis of the vital signs like.

- Edema
- Head ache
- Vomiting
- Loss of appetite
- Swelling of face and lower limbs
- Swelling of abdomen
- Decreased urine output

2.1 Collection of sample

2.1.1 Blood: - About 5ml of blood is collected from cubital vein by vein puncture into a sterile bottle and allowed to clot. The serum is separated and used for estimation of urea, creatinine, uric acid, sodium potassium and chloride^[1].

The following bio-chemical parameters^[4] are estimated and compared with normal persons of the same age group (above 40 years).

- Blood Urea (Diacetyl Monoxime Method DAM)
- Serum Creatinine (Jaffe's Alkaline Picrate)
- Serum Uric Acid (Phosphotungstic acid Method)
- Serum Electrolytes (Roche 9180 electrolyte analyzer-(ISE) Ion-selective electrode)

- (a) Sodium.
- (b) Potassium.
- (c) Chloride.

3. Result and discussion

The term non-protein nitrogenous in blood includes the nitrogen present in all nitrogenous substances other than protein. The total plasma nitrogen concentration is about 250-400 mg/L. NPN of whole blood is approximately 75% greater than that of plasma because of the glutathione content of erythrocytes. Catabolism of proteins and nucleic acids results in formation of NPN compounds. The principle NPN substances are amino acids, ammonia, Urea, Uric acid and Creatinine. Urea is the major NPN constituent in plasma and constitutes 45% of total NPN substances. NPN which contributes to 69%, amino acid- 20%, creatine nitrogen- 1%, creatinine nitrogen 2% and uric acid nitrogen 8% of total plasma NPN. The amount of ammonia is negligible. Increasing concentration of these substances occur as a consequence of decreased renal function^[6]

Urea is the main end product of protein catabolism in humans. In a healthy adult the plasma urea concentration is about 20-40 mg/dl^[11]. Tubular re-absorption becomes significant at low urine flow rates. Creatine is synthesized in the kidney, liver and pancreas^[2]. Creatine is the most important substance as it plays an important role in muscular contraction. The concentration of creatinine in the blood will increase with decreased kidney function. The serum concentration of creatinine is 0.6-1.2mg/dl for males and 0.5-1.0mg/dl for females. Both serum creatinine and creatinine clearance value have been used as indices of renal function. Uric acid is the major end product of purine catabolism in humans. An average adult has total body content of about 1.2gms of uric acid which may be considered as miscible urate pool. Approximately 60% of this pool is replaced daily by formation and excretion^[13]. Mainly uric acid formation occurs in the liver. Nearly about 200-600mg of uric acid is produced and same is excreted in 24 hrs. Total body sodium is about 4000mEq and about 50% of it is in bones, 40% in extracellular fluid and 10% in soft tissues. Sodium is the major cation of extracellular fluid. Sodium pump operates in all the cells. Normal levels of Sodium in plasma is 136-145mEq/L and in cells, it is about 12mEq/L. Normal diet contains about 5-10gm of sodium as Sodium chloride. Some amount of sodium is daily excreted through urine. When urine is formed, original glomerular filtrate (175lt per day) contains 800mg/day sodium out of which 99% is reabsorbed. Out of this, 88% is reabsorbed in proximal convoluted tubules. This is an active process. Along with sodium, water is also reabsorbed. The total body potassium is about 3500mEq out of which 75% occurs in the skeletal muscle. Potassium is the major intracellular cation and maintains intracellular osmotic pressure. Potassium requirement is 3-4 g/day. Plasma potassium is 3.5-5mEq/L. The cells contain 100-120mEq/L^[3].

Total number of cases studied was thirty, out of which ten were normal persons. The remaining twenty were suffering from Renal Disease. The age group varied from 40-60 years. The study was done in patients who are admitted in Department of Medicine. The diagnosis of Renal Disease was done by the symptoms (edema, Hypertension, Seizures, Decreased urine output and prolonged diseases DM).

The following investigations were carried out: Blood Urea, Serum Creatinine, Serum Uric Acid, Serum Electrolytes, Sodium, Potassium, and Chloride.

The cases were discussed under two groups.

- a) Control subjects
- b) Abnormal group

The mean values were compared with mean values of control subjects. There is an increase in Blood Urea, Creatinine and Uric acid. The mean value of Blood urea and Creatinine are significantly raised compared with control subjects.

Table 1 and 3 show the estimated levels of Non Protein Nitrogenous substances in control group. The mean and SD values of Urea, Creatinine, Uric Acid and serum Electrolyte (Sodium, Potassium and Chloride) are within normal range. Table 2 and 3 show the values of NPN substances in renal disease patients. The mean and SD values of Blood Urea, Serum Creatinine, and Uric Acid are elevated. Serum Electrolytes are not altered and Not Significant (NS).

Table-1: Levels of different biochemical parameters in control subject

S.NO	AGE	SEX	Blood Urea	Serum Creatinine	Serum Uric Acid	Serum Sodium	Serum Potassium	Serum Chloride
1	65	Male	38	1.1	5.6	133	3.8	98
2	50	Male	30	0.9	6.2	136	4.2	102
3	55	Male	36	1.1	5.2	134	4.6	100
4	50	Female	18	0.7	4.8	137	3.9	97
5	45	Male	35	1.1	5.6	134	4.0	102
6	55	Female	46	1.0	6.2	136	5.2	99
7	50	Male	28	0.9	5.2	130	3.6	103
8	74	Male	29	0.9	6	136	4.2	97
9	45	Female	16	0.8	5.6	133	3.6	95
10	45	Female	16	0.5	6.2	138	3.4	96
MEAN =			29.0	0.9	5.66	134.7	4.05	98.9
SD ± =			10.08	0.21	1.4	2.35	0.57	2.7

Table-2: Levels of Different Biochemical Parameters in Abnormal Subjects

S.NO	AGE	SEX	Blood Urea	Serum Creatinine	Serum Uric Acid	Serum Sodium	Serum Potassium	Serum Chloride
1	57	Female	75	1.4	6.0	138	3.4	102
2	50	Female	153	8.2	7.0	128	2.8	96
3	60	Male	92	3	9.5	139	5.5	80
4	72	Male	54	1.4	6.8	138	3.0	95
5	70	Male	86	2.4	5.5	128	3.3	103
6	65	Female	130	4.7	4.8	128	2.9	98
7	38	Male	208	7.7	11.8	124	8.3	100
8	40	Male	65	2.3	10.6	131	3.4	102
9	70	Male	98	3.0	6.2	141	4.4	101
10	55	Female	74	2.6	6.1	135	3.8	96
11	40	Male	92	3.7	6.0	132	3.9	80
12	38	Male	119	2.4	7.2	136	5.3	101
13	65	Male	80	1.8	5.5	133	4.6	102
14	45	Male	223	6.0	4.9	127	4.2	101
15	20	Male	168	1.5	6.2	131	3.6	101
16	55	Male	138	2.6	6.8	122	4.8	93
17	26	Female	98	1.3	5.8	131	5.4	104
18	45	Male	58	3.0	7.0	134	2.8	103
19	85	Male	65	2.0	7.6	136	4.60	104
20	60	Female	100	1.8	6.4	135	4.4	94
MEAN=			108.8	3.14	6.88	132.35	4.22	97.8
SD ± =			47.9	2.0	1.8	32.04	1.4	6.9

Table-3: Summary of the Results

S.NO	Investigation	Values	Control	Abnormal
			Subjects	Subjects
1	Blood Urea	MEAN=	29	108.8
		SD \pm =	10.08	47.9
		SDE =	15.3	
		P =	< 0.01	
2	Serum Creatinine	MEAN=	0.9	3.14
		SD \pm =	0.21	2.0
		SDE =	0.6	
		P =	< 0.01	
3	Serum Uric Acid	MEAN=	5.66	6.88
		SD \pm =	1.4	1.8
		SDE =	0.65	
		P =	NS	
4	Serum Sodium	MEAN=	134.7	132.35
		SD \pm =	2.35	32.04
		SDE =	10.2	
		P =	NS	
5	Serum Potassium	MEAN=	4.05	4.22
		SD \pm =	0.57	1.4
		SDE =	0.46	
		P =	NS	
6	Serum Chloride	MEAN=	98.9	97.8
		SD \pm =	6.9	2.7
		SDE =	2.29	
		P =	NS	

In the present study, there are two groups namely control (Normal subjects) and Abnormal group (Subjects who are suffering with renal diseases). The age varies between 40–60 years in all the subjects of both groups. All the parameters like urea, creatinine, uric acid and serum electrolytes (Sodium, Potassium and Chloride) were estimated in both the groups. About 10 cases were studied in the control group who showed normal levels of all the parameters estimated, so they served good controls. 20 cases were studied under the Abnormal group out of which 6 cases suffered from Chronic Renal Failure (CRF) and the rest of them had Acute Renal Failure (ARF). Urea and Creatinine in this abnormal group showed significant elevation, uric acid showed elevated levels but the difference was not significant, Sodium, Potassium and Chloride levels were normal when compared with the control subjects. All the 20 cases (100%) showed increased levels of Urea there by showing much significance statistically when compared with the normal group. Out of 20 cases, 17 cases (85%) showed increased levels of creatinine which showed marked significance when compared with the normal group. Out of 20 cases, only 4 cases (20%) showed much increased levels of uric acid, but mean value shows insignificance when compared with the normal group. Serum Electrolytes (Sodium, Potassium and Chloride) didn't show any significance when compared

with the normal group. So estimation of Urea and Creatinine levels in serum are reliable indicators.

4. Conclusion

The statistical analysis of the above data showed that there was significant elevation of urea and creatinine levels in the cases of renal failure. Though the uric acid levels were also elevated when compared to the normal, the difference is not statistically significant. Serum levels of Sodium, Potassium and chloride levels showed no statistical significance when compared to the normal levels. All cases were advised for dialysis. Urea and Creatinine levels are reliable parameters in severity of renal diseases.

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