The Interest Of Uric Acid Dosage In The Exploration Of Renal Function In Diabetic Patients

AÏKOU Nicolas[1*], COULIBALY Amadou Founzegue [2,] OLOUNLADE Pascal[3], GNANGLE Bidossessi Rosen[4], AÏKOU N.L.M. [4] , AÏKOU A.N. E [4] , KANGNI Aballo Louis Marie[5], AMOUSSOU Judicaël Théophile[6], ALKOARE I.[7]

***Corresponding author:**

Dr **AÏKOU Nicolas:** National University of Sciences, Engineering and Mathematics
Department of Human Biology
Laboratory of Clinical Biochemistry and Medical Microbiology
aikounicolas@yahoo.fr, nicolashoundjo@gmail.com,
04 BP 435
Tel : 00229 95059832

SUMMARY

Aim: The aim of this work is to show the interest of uric acid dosage in the exploration of renal function and that in the future, practitioners can take this into account when prescribing examinations in the context of renal check-ups, in any patient requiring it, particularly diabetics. It is therefore necessary to combine the three biochemical parameters: urea, creatinine and uric acid for a good renal exploration and a good interpretation of the activity of the patient's kidneys. Uric acid exerts a direct toxicity on the kidneys. In addition, several epidemiological studies show a direct association between uric acid levels and kidney dysfunction, an association that is independent of traditional cardiovascular risk factors, gender, ethnicity or dietary habits**.** Kidney damage is a serious condition, especially in pathologies such as diabetes.

Patients and method

Blood samples were taken from 140 diabetic patients in the diabetology unit of the Zou and Hills Departmental Hospital Centre for the purpose of exploring renal function.

Results: The results obtained allowed the observation of: 10.20% hyperuricemia, 31.28% hyperuricemia and 34.69% hypercreatininemia in diabetics with hyperglycemia. We also found in diabetics with normal blood sugar levels 31.82% hyperuricemia, 47.62% hypercreatininemia and 43.37% high uremia. This means that these patients are predisposed to renal failure. Also in this study population 36% have a clearance of less than 90 ml/min. In this group 5.14% of the patients have a high risk of developing renal failure while the remaining 30.86% are predisposed to renal failure.

Conclusion: The hyperuricemia observed in these diabetics allows us to say that the dosage of uric acid is of interest for this group of patients because it would intervene in nephropathies in general, but particularly in renal insufficiency and kidney stones. Diabetes therefore has serious consequences on kidney function.

Key words: Diabetes, renal function, urea, uric acid, creatinine, renal clearance, glomerular filtration rate, acute toxicity, chronic toxicity.

INTRODUCTION

Uric acid is a chemical compound, almost insoluble in water, resulting from the degradation and excretion of purines, mainly guanine and adenine in humans and higher primates that no longer have uricase [1,2]. An increase in its concentration in blood serum leads to gout, which is responsible for arthropathies and renal lithiasis through the formation of crystals in the kidneys called kidney stones. This can also be due to an increase in the protonated fraction of uric acid, by a decrease in the urinary pH. An increase in uric acid levels is the cause of certain pathologies that are widespread throughout the world. Hyperuricemia has been shown to play a role in hypertension. Several recent studies suggest that uric acid is one of the causes of type 2 diabetes. The level of uric acid is a good predictor of the onset of diabetes. It also predicts the development of obesity. Various studies have

shown that lowering uric acid levels can lower blood pressure, lead to weight loss and reduce the risk of cardiovascular disease. However, such reductions have yet to be confirmed by large-scale studies [3]. Uric acid is well known as a pathogen of gout and certain kidney stones. Its involvement in both acute and chronic models of kidney disease has been the subject of several recent developments [4]. Given the importance of the kidneys in human life, it is essential to ensure the survival and maintenance of this vital organ. It is within this framework that this research work was initiated to explore the renal function, but above all to add an important biochemical parameter, which is involved in the exploration of renal function, but often ignored or neglected by some practitioners. The objective of this study was to evaluate the incidence of one hundred and forty (140) diabetic patients in the diabetology unit of the Zou and collines departmental hospital centre. Blood sugar, uremia, uricemia and creatinine were measured on the sera and plasma of these patients. Creatinine clearance was also calculated. The results obtained, confirm that, not only should the uric acid dosage, in diabetic patients, be necessarily included in the exploration of renal function, but also that the renal function should be periodically explored in order to detect possible early renal abnormalities in time.

PATIENTS AND METHOD

Biological material

The biological material consists of 140 blood samples taken from dry tube and blood glucose tube in diabetic subjects.

Equipment and consumables

The equipment used during our handling is :

Rack, new haemolysis tubes, Needle, Centrifuge, BA 88 Spectrophotometer, automatic pipettes (Eppendorf type 1000 µl, 100µl and 10µL), new cones, water bath at 37°C, timer. For the reagents we have: urea reagent; creatinine reagent and uricemia reagent; all these reagents are of the brand CYPRESS DIAGNOSTIC.

METHOD

Type of study

This is a prospective cross-cutting study with an analytical focus over a six-month period from 12 April 2020 to 20 September 2020 inclusive.

Study population

The sampling was carried out at the diabetology unit of the Zou and Collines Departmental Hospital Centre. It included a total of **140** patients divided into two groups:

-the first group is that of cases represented by **98** diabetic patients with hyperglycaemia,

-the second group is represented by **42** diabetic subjects with normal blood sugar levels.

Data collection

We subjected the diabetic subjects to a questionnaire to collect identifying data. These data included age, family history of diabetes, overweight, history of arterial hypertension, and treatment history. Pregnant women were excluded from this study to avoid bias from gestational diabetes.

Dosage procedure

For each identified patient, we have :

- Measured blood sugar levels for control,
- Determines the amount of urea, creatinine and uric acid.
- Calculated the glomerular filtration rate (GFR) for each patient entering the study. All dosages were performed with the spectrophotometer in kinetics and end point.

RESULTS

Characteristics of the population

Distribution of the 140 diabetic patients in the study according to age.

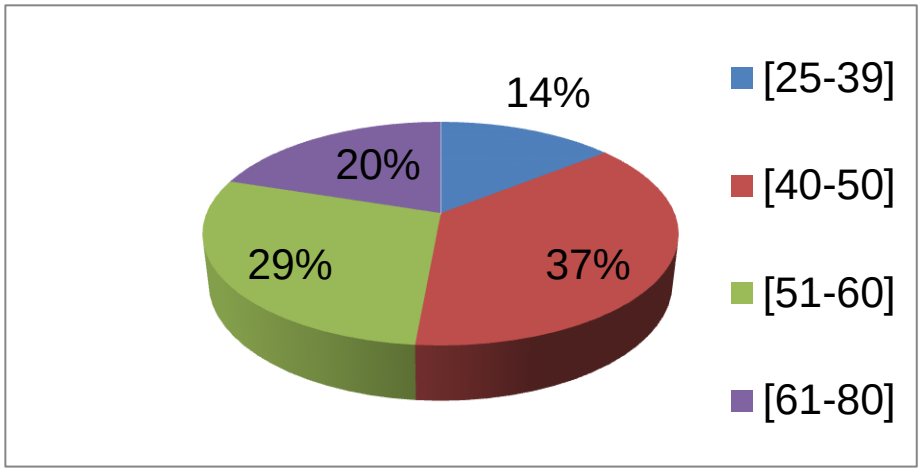

Figure 1: Age distribution of the study population.

This figure shows that 52 patients out of 140 of the study population belong to the 40 to 50 age group, i.e. a percentage of 37%.

Distribution of the study population by gender :

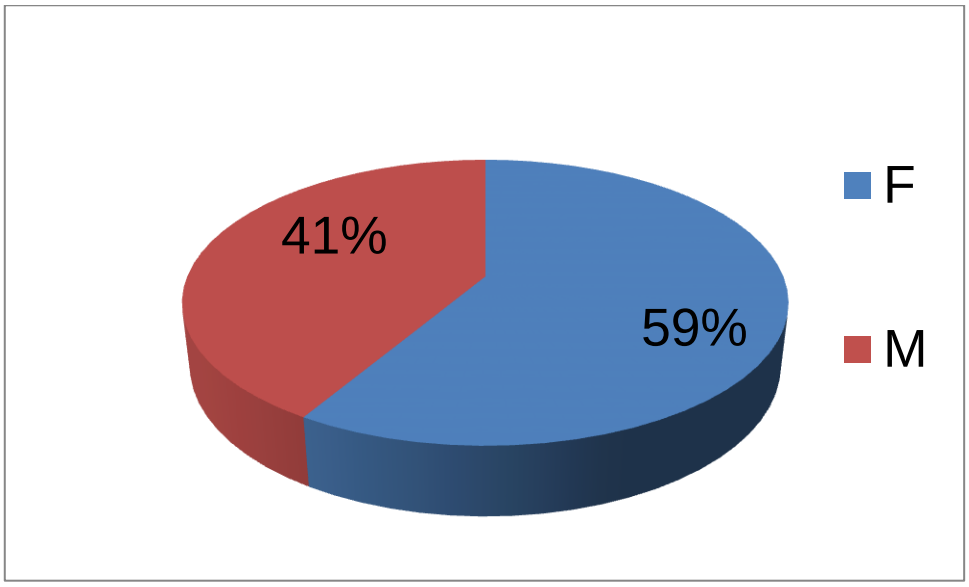

Figure 2: Distribution of the study population according to the sex of the subjects

This figure shows that out of 140 patients in the study population, 83 patients are female, i.e. 59%, and 57 patients are male, i.e. 41%.

Distribution of the population according to the two categories

The study was carried out on a population of 140 diabetic subjects divided into two categories, the category of hyperglycaemic subjects (98) and the category of subjects with normal blood sugar levels (42).

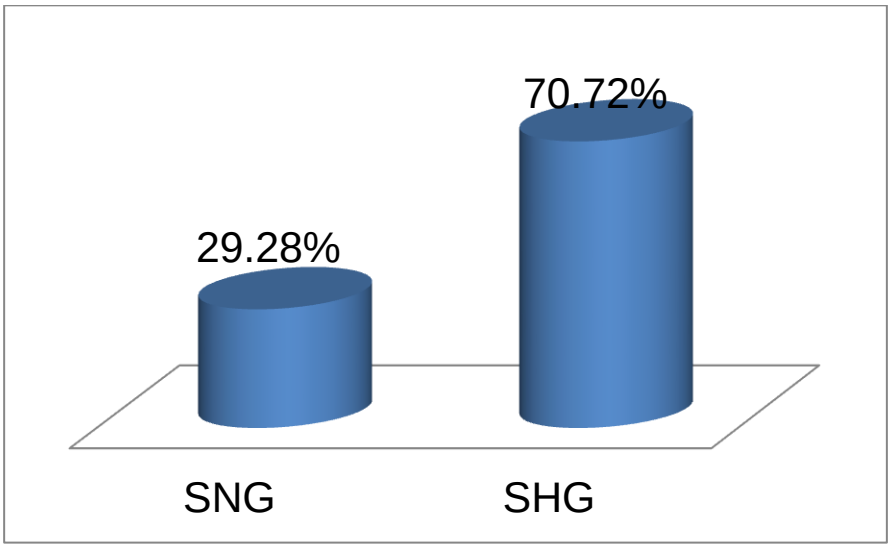

Figure 3: Distribution of the population according to the two categories

- **Hyperglycemic subjects**

Distribution of the population according to uremia

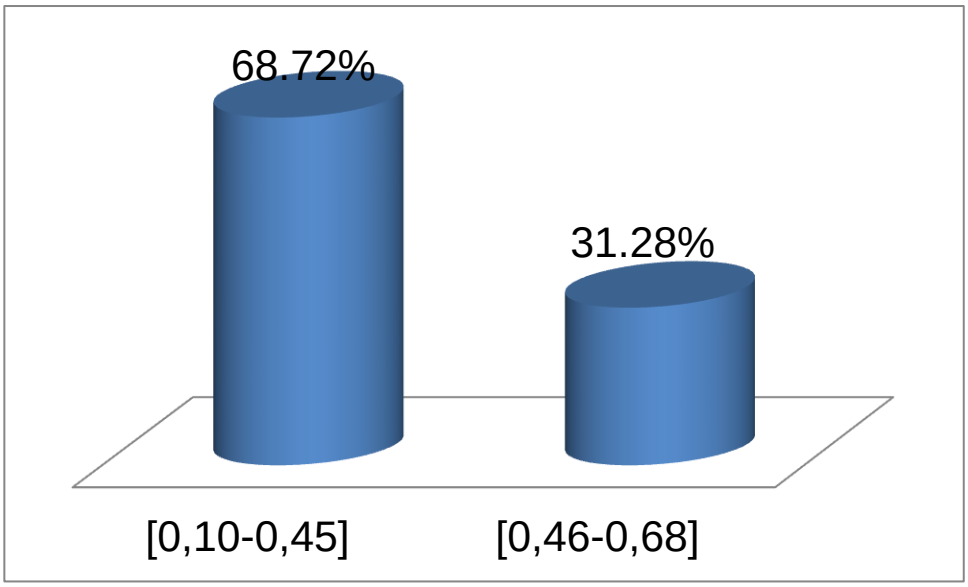

Figure 4: Distribution of hyperglycaemic subjects according to urea levels

The average uraemia in the study population is 0.34 g/litre. The majority of hyperglycemic subjects in the study population have normal uremia in the range of 0.10-0.45g/l, i.e. 68.72%; similarly 31.28% have above-normal uremia in the range of 0.46-0.68g/l.

Distribution of the population according to creatinine levels

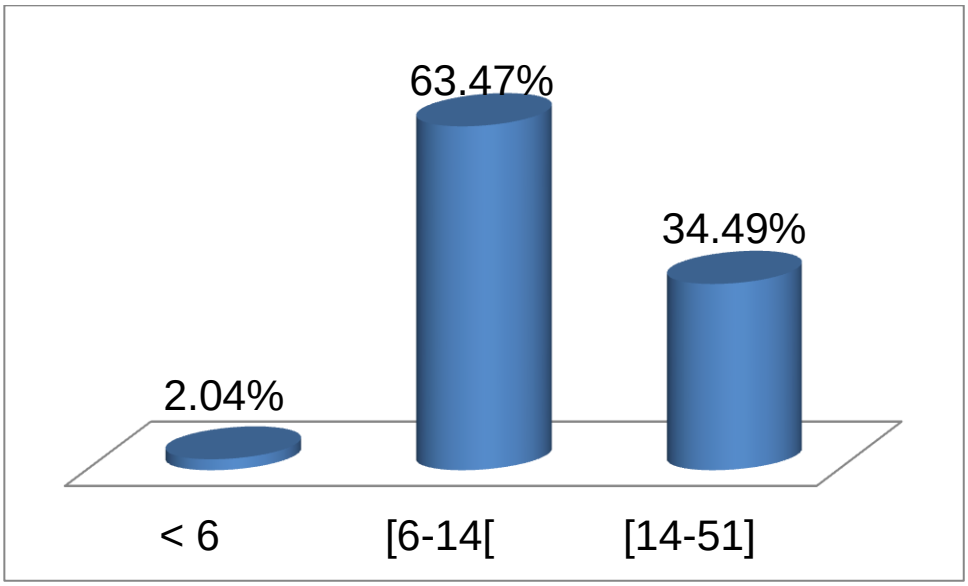

Figure 5: Distribution of hyperglycaemic subjects according to creatinine levels

The average creatinine level in the study population is 12.91 mg/l. It can be seen that the majority of hyperglycemic subjects in this study population have a normal creatinine level in the range of 6-14 mg/l, i.e. 63.47%; similarly 34.49% have an above-normal creatinine level in the range of 14-51g/l and 2.04% have a creatinine level of less than 6 mg/l.

Correlation of uricemia with hyperglycaemia

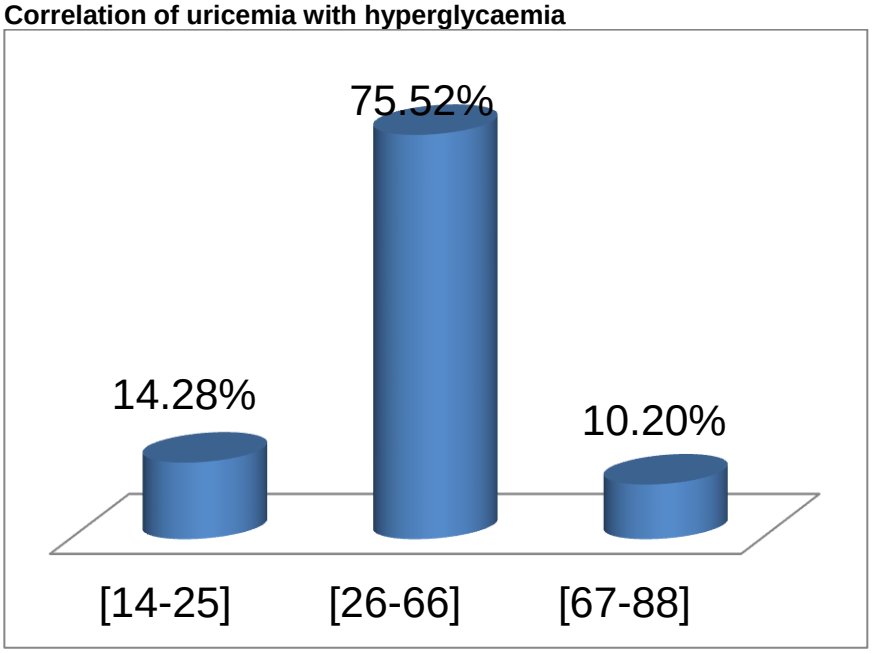

Figure 6: Figure showing the distribution of diabetic subjects with hyperglycaemia according to uricemia.

The average uricemia in the study population is 48.92**.** It can be seen that the majority of hyperglycemic subjects in the study population have normal below-normal uricemia in the range 14-25 g/l and 10.20% have high uricemia in the range 67-88mg/l.

- **Subjects with normal blood sugar levels**

Distribution of the population according to uremia

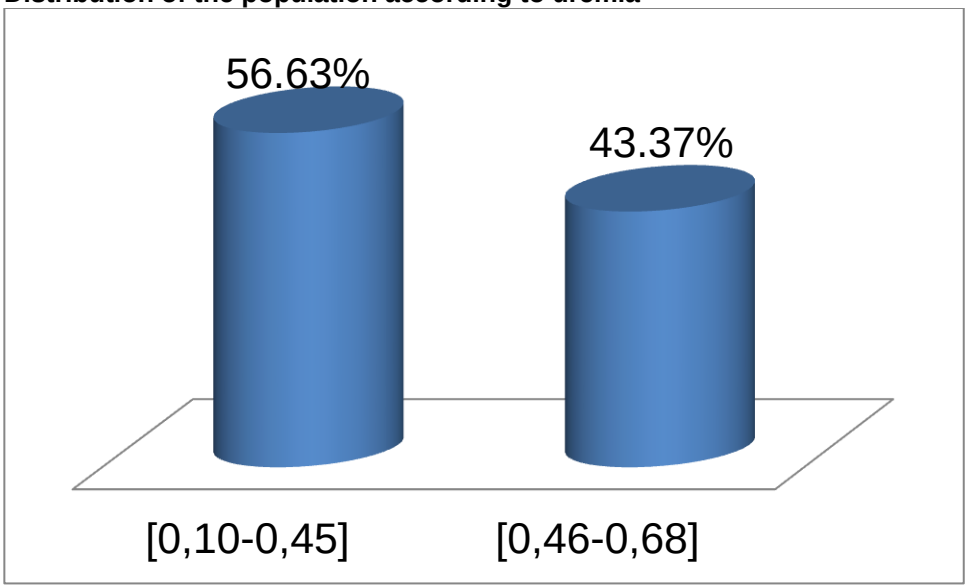

Figure 7: Distribution of subjects with normal blood sugar levels according to uremia.

The majority of these subjects with normal blood sugar levels have a normal uremia in the range of 0.10-0.45 g/l, i.e. a rate of 56.63%. In addition, 43.37% have above-normal uremia in the range of 0.46-0.68g/l.

Distribution according to creatinine levels

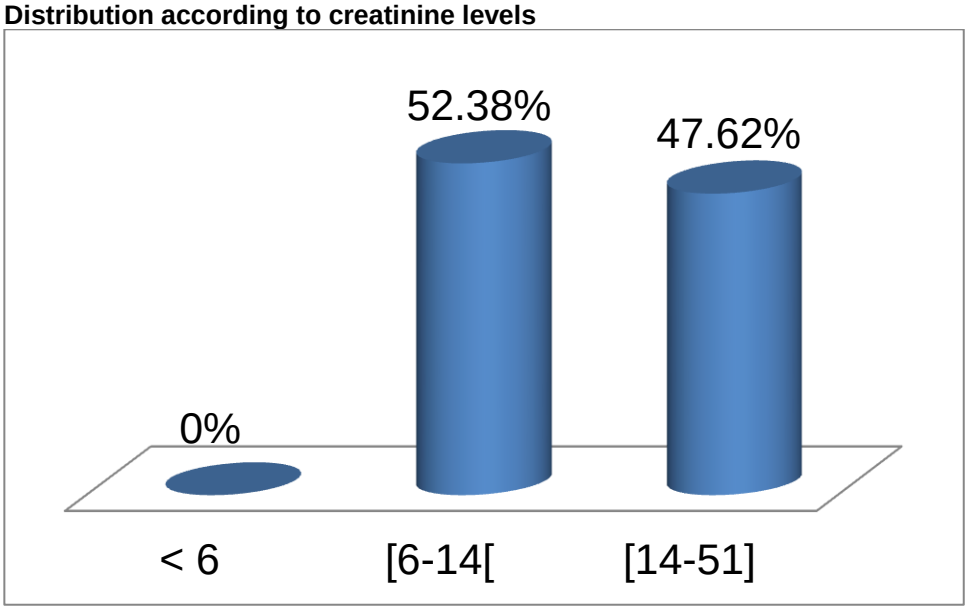

Figure 8: Distribution of diabetic subjects with normal blood glucose levels according to creatinine levels. The majority of the subjects in the study population had normal creatinine levels in the range of 6-14 mg/l, i.e. 52.38%; in addition, 47.62% had high creatinine levels in the range of 14-51 mg/l.

Breakdown by uricemia

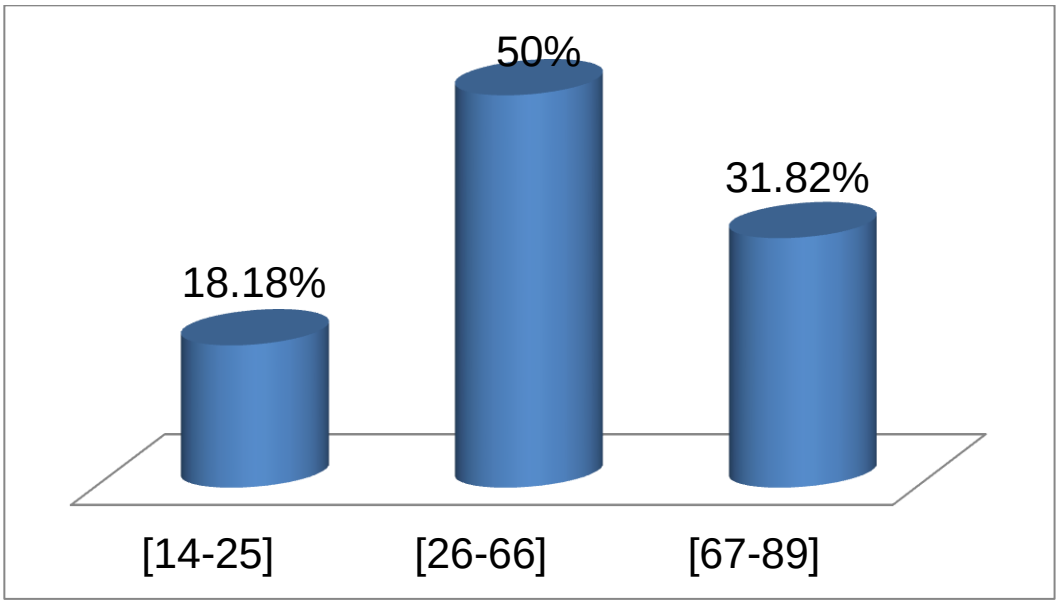

Figure 9: Figure showing the distribution of diabetic subjects with normal blood sugar levels according to uricemia.

The majority of normoglycemic subjects in the study population had normal uricemia in the range of 26-67 g/l, i.e. a percentage of 50%.
18.18% have hypouricemia in the range of 14-25 g/l. 31.82% have high uricemia in the range 67-89g/l

Calculation of clearance in the diabetic subjects studied.

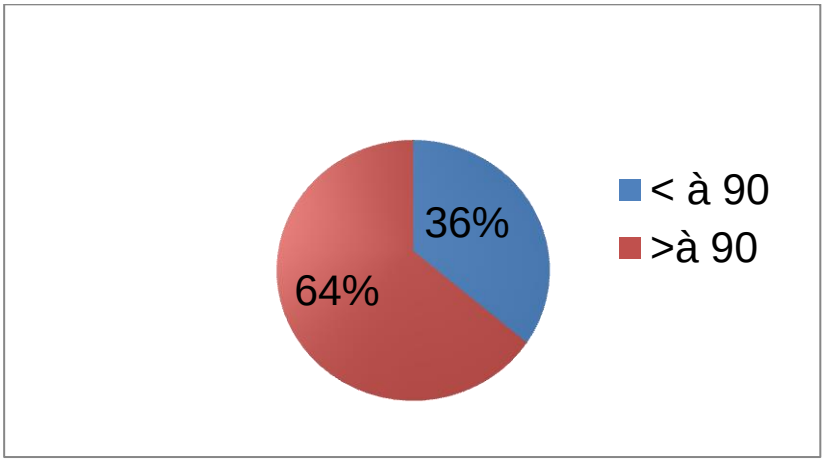

Figure 10: The percentage of clearance in the study population.

This figure shows that 64% of the study population have normal clearance and 36% have less than normal clearance.

Distribution according to Glomerular Filtration Rate (GFR) for clearance < 90 ml/min representing 36% of the study population.

- **Hyperglycemic subjects**

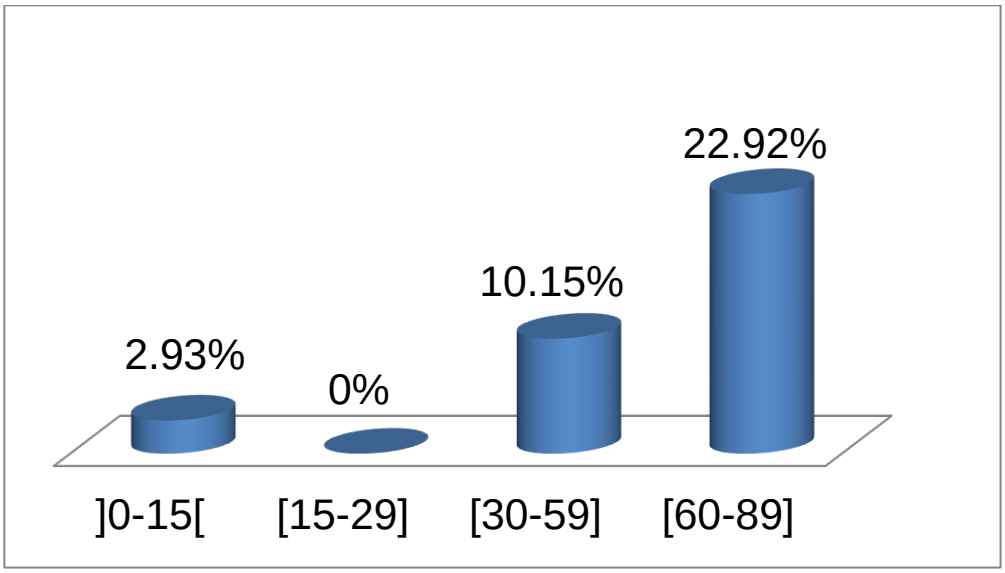

Figure 11: Distribution of hyperglycaemic subjects according to DFG.

This figure shows that the majority of the 36% of the study population has an early onset of renal failure with a GFR in the range 60-89 ml/min, i.e. a rate of 22.92%; in addition, 10.15% have moderate renal failure with a GFR in the range 30-59 ml/min. 2.93% have end-stage renal failure with a DFG of less than 15ml/min.

- **Diabetic subjects with normal blood sugar levels**

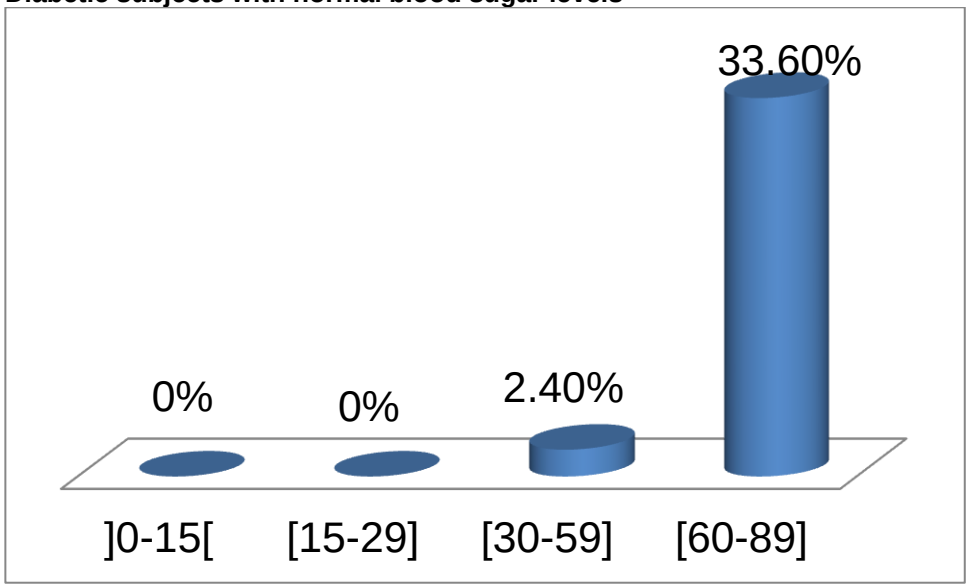

Figure12: Distribution of normoglycaemic subjects according to DFG.

This figure shows that the majority of the 36% of the study population has an early onset of renal failure with a DFG in the range 60-89 ml/min, i.e. a rate of 33.60%; in addition, 2.40% have moderate renal failure with a DFG in the range 30-59 ml/min.

- **Hyperuremic subjects**

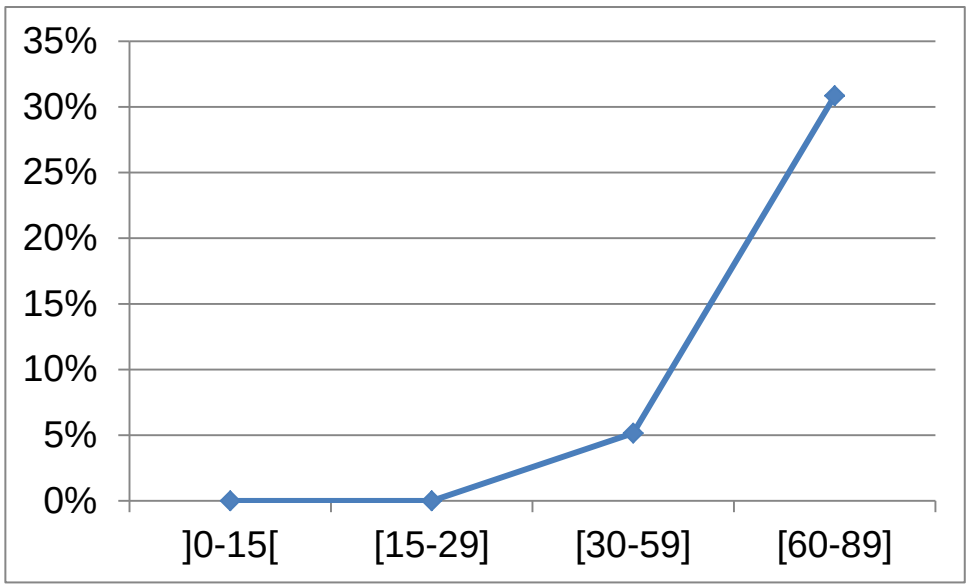

Figure 13: Distribution of hyperuremic subjects according to DFG.

This figure shows that the majority of the 36% of the population with hyperuremia have an early onset of renal failure with a GFR in the range 60-89 ml/min, a rate of 30.85%, and 5.15% have moderate renal failure with a GFR in the range 30-59 ml/min.

- **Hyperuricemic subjects**

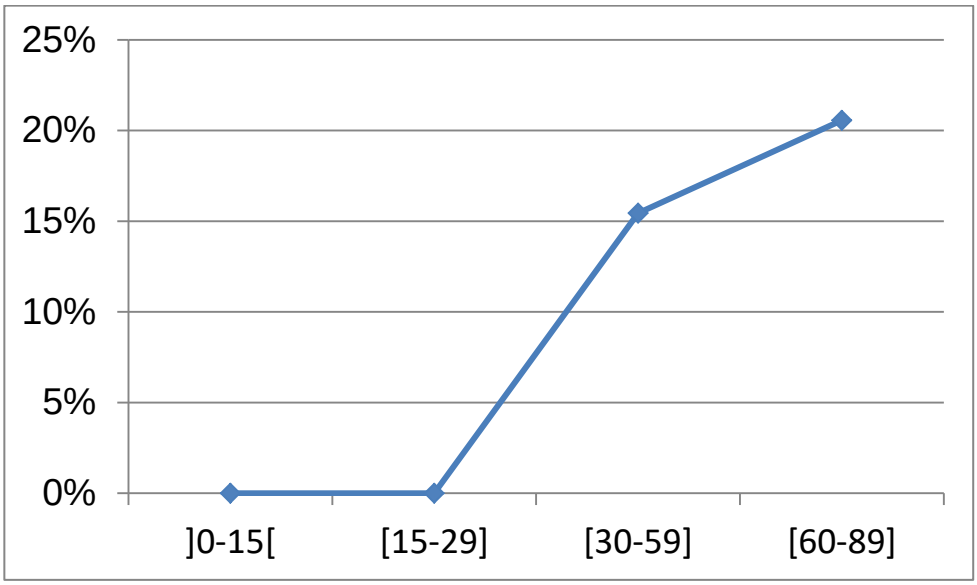

Figure 14: Distribution of hyperuricemic subjects according to DFG.

This figure shows that the majority of the 36% with hyperuricemia to early renal failure with a DFG in the range 60-89 ml/min, i.e. a rate of 20.56% and 15.44% also have moderate renal failure with a DFG in the range 30-59 ml/min.

Statistical analysis

In order to better interpret the results obtained, we have searched :

✓ **The average of** the different data series obtained. This makes it possible to determine the central tendency of each series of data. It is noted $\bar{X}$and is obtained by the following calculation:

$$\bar{X} = \frac{1}{N}\sum_{i=1}^{n} x_i$$

$\bar{X}glucose = 1{,}92$g/l

$\bar{X}urée = 0{,}34$ g/l

$$\bar{X}créatinine = 12{,}91\ mg/l$$
$$\bar{X}Acide\ urique = 48{,}64\ mg/l$$

Where N denotes the total number of employees in the series, x_i the different values taken by the variable x and n the number of observations.

- ✓ **The standard deviation (σ^2)** which is the square root of the arithmetic sum of the squares of the deviations from the mean. It is given by the formula :

σ^2 urea = 0,16
σ^2 creatinine = 3,49
σ^2 Uric acid = 14,61

$$\sigma^2 = \frac{1}{N}\sum_{i=1}^{n}(x_i - \bar{x})2$$

- ✓ **The coefficient of variation (CV),** which makes it possible to assess the relative dispersion of the results obtained in each set of data. It is obtained by the following calculation : **CV=** $\frac{\sigma}{\bar{X}}$ **× 100**

CV urea =116,64%
CV creatinine = 14,47%
CV Uric Acid =7,81%

- ✓ **The correlation** between the variables by calculating the **correlation coefficient "r".**

r = $\frac{\sum_{i=1}^{n}(x_i-\bar{x})(y_i-\bar{y})}{\sigma_x \times \sigma_y}$

- **Let r be the correlation between blood glucose and uric acid**
  r = 25%

DISCUSSION

This study is of twofold interest, namely to highlight renal dysfunction in diabetics, particularly nephropathies; renal dysfunction is highlighted by the Glomerular Filtration Rate [2, 5, 6]. According to the results of creatinine blood tests. When the kidneys are damaged, they cannot purify the blood and rid it of waste products. The aim of this research was to investigate the kidney function in 140 diabetics in the diabetology unit of the ZOU and COLLINES Departmental Hospital Centre, in order to identify possible kidney damage by measuring urea, uric acid and creatinine and to calculate the creatinine clearance. We have carried out a prospective transversal study with an analytical aim. Each patient had a blood sample taken on an anticoagulant tube (of sodium oxalofluoride) and dry tube. We checked the blood sugar level in all the diabetic subjects included in our study. All subjects whose diabetic status was established by the doctor and who met our inclusion criteria were included, regardless of their blood sugar levels. The statistical analyses were performed using Excel 2010 software and the compilation of the blood glucose results in the two groups of subjects showed that the average blood glucose level was 1.92g/l, the average blood glucose level in hyperglycemic subjects was 2.32g/l. The average age of the patients in our study population is 50 years, which allows us to say that this is a relatively young population. The female sex (83 women) is more represented than the male sex (57 men). Urea was measured by the urease method, uric acid by the uricase method and creatinine by the Jaffé method. As for the clearance, it was calculated by the COCKROFT method. For normal renal function, uricemia is between 25mg/l and 66mg/l; [7,8], uricemia varies between 0.15g/l and 0.45g/l and creatinine is between 7mg/l and 14mg/l. Creatinine clearance is defined as the rate of purification or elimination of the given substance or the amount of creatinine purified in the kidneys per unit of time. Its value is a reliable indicator of good kidney function [9, 10, 11]. It is 120ml/min (100-140ml/min) in men and 95ml/min (75-115ml/min) in women. In the patients in our study, uricemia values ranged from 14mg/l to 89mg/l, uremia values varied from 0.10g/l to 0.68g/l, and creatinine values from 4mg/l to 51mg/l and clearance values from 35ml/min to 282ml/min). This is because uric acid is the by-product of purine [12]. The level of uric acid in the blood can worsen kidney function, deposits of uric acid in the kidneys can cause inflammation in the kidneys directly [13, 14, 15]. In addition, the accumulation of uric acid can affect the excretion of urine. In our study in hyperglycemic diabetics, 10.20% of the population had hyperuricemia, and in diabetics with normal blood sugar levels, hyperuricemia was 31.82%. Urea is produced in a variable way from one day to the next depending on the amount of degraded proteins, of food or endogenous origin. Nitrogen levels are increased in cases of hypercatabolism (treatment with corticoids, tetracyclines, infectious syndrome, trauma, digestive haemorrhage...), which alone cannot allow the kidney function to be explored. Creatininemia remains a fundamental biological parameter because it is one of the best markers of renal function exploration used in clinical practice. Thus within the diabetic populations studied,

those declared hyperglycemic have hyperuremia, i.e. 31.28% of the population, and hypercreatininemia, i.e. 34.69%. This means that within these patients, renal insufficiency may be suspected.

In patients declared to be diabetic with normal blood sugar levels, hyperuremia was found in 43.37% of the population and hypercreatininemia in 47.62% of the population. This indicates that in patients under treatment, renal insufficiency may be suspected. In the population studied, 36% have a clearance of less than 90ml/min, which confirms the risk of renal insufficiency for his patients. Our study has also detected that within this 36% of the population studied, 22.92% of the hyperglycemic patients had a Glomerular Filtration Rate between 60 and 89ml/min and 33.60% of the normal glycemic patients suffered from an early renal failure; In hyperglycaemic people 10.15% with a Glomerular Filtration Rate between 30 and 59 ml/min and 2.40% in diabetics with normal blood sugar levels run the risk of moderate renal insufficiency; finally 2.93% have a GFR of < 15 ml/min, which is equivalent to end-stage renal insufficiency.

However, all three parameters must be measured to diagnose kidney failure. Determining the serum level of parameters involved in renal function is a standard element in the management of diabetic patients. Secondly, particular emphasis should be placed on the biochemical parameters to be measured when exploring renal function. These are: urea, creatinine and uricemia.

In order to better explore kidney function, in contrast to what used to be done with urea and creatinine dosing.

CONCLUSION

Diabetes, when not properly monitored, can cause disruptions in many body functions such as kidney function. In our study, which included 140 diabetics from the diabetology unit of the ZOU and COLLINES Departmental Hospital Centre, the impact of diabetes on kidney function was demonstrated. We observed renal damage in 36% of the diabetic patients. This renal damage was highlighted by the discovery of abnormalities in uricemia, creatinine, uremia and clearance. We have also discovered that among the patients taken care of by the centre some develop end-stage renal failure. It is therefore necessary to institute an exploration of renal function in these patients. Likewise, any diabetic patient who arrives monthly in an emergency, must have a blood test for the following parameters before the start of any treatment, a renal exploration and the dosage of glycaemia. It is at this price that renal abnormalities can be discovered and treated early in order to avoid a fatal and unexplained outcome for the patient. The major risk is chronic and irreversible renal failure [16, 17, 18]. Recent developments tend to confirm the involvement of uric acid in certain forms of acute kidney disease, as well as in the development and progression of chronic kidney disease [19,20]. However, there is currently insufficient evidence to generalise the prescription of a hypouricemia treatment for this indication.

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