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(RESEARCH ARTICLE)

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Epidemiological and Hemato-biochemical urinary profile of diabetic patients received in consultation at anastasis health center in Nongo (Conakry), Republic of Guinea

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Abstract

Introduction: Diabetes is a group of metabolic diseases characterized by chronic hyperglycemia resulting from a defect in insulin secretion or insulin action or both associated abnormalities.

Objective: Our study aims to contribute in improving of health care of diabetic patients in the Municipality of Ratoma, Conakry, and Republic of Guinea.

Methods: This study is a prospective and descriptive cross-sectional study lasting of 4 months, from February 16 to June 16, 2021.

Results: The study involved 300 patients whose blood and urine were examined, 17% of the patients were positive, therefore diabetic. Glycosuria was positive on an empty stomach in 87%. Abnormal parameters were found as followed: Urobilinogen with 97%, Blood with 97%, Optical Density with 90%, Nitrite with 84%, pH with 83%, Ketone Bodies with 76%, Bilirubin with 73%, presence of Proteins in 75%, and Leukocytes in 71%. The evolution of diabetes in 20 patients with the HbA1c test, i.e. 32% and the majority of the 20 diabetic patients had HbA1c levels between 4 to 5.60% with 7 patients, i.e. 35% followed by those with rate between < 4% and 6.80% to 7.20% with 5 patients each, i.e. 25% (cumulative 50% of patients); 3 diabetic patients whose hemoglobin were severely affected by glucose had high HbA1c levels between 8.80 and 9.60%, i.e. 10%, and 1 patient with an HbA1c level of 11.40%, i.e. 5%. THBs were low in 20 patients, about 32%. This study found respectively: hyperleukocytosis (10%), hyperneutrophilia (10%), hypermonocytosis (16%), hyperlymphocytosis (13%) among the diabetic patients and alongside, 32 diabetic patients suffered from hypoleukocytosis (19%), hyponeutrophilia (8%), hypolymphocytosis (8%) and 35% from hypomonocytosis. Frustrated anemia were found in 75%, moderate anemia in 20% and severe anemia in 5%, while 25% of diabetic patients suffered from Microcytic anemia and 75% from Normocytic anemia and 15% of diabetic patients suffered also from Hypochromic anemia and 85% of diabetic patients suffered from Normochromic anemia. Female sex was the most represented with 59% against 41% for male sex. All age groups were affected by diabetes, however, age group of 61 to 80 years were the most affected with a prevalence of 38% followed by those of 41 to 60 years and 21 to 40 with respectively 35% and 22%. The least represented age group were less than or equal to 20 years old with 5%. Housewives with 35% were the most affected followed by Commercial Agents, Pupils/Students and Administrative Agents with 22%, 10% and 8% respectively. The Married were the most with a prevalence of 83% against 14% among Singles and only 3% among Widowed. The majority of patients were from the commune of Ratoma, i.e. a prevalence of 81% followed by those from Matoto with 9%. Patients from elsewhere accounted for only 5%.

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Conclusion: This study revealed that in diabetic patients, hematological parameters must be monitored to ensure better patient care.

Keywords: Diabetes; Biochemistry; Glycated hemoglobin; Hematology; Commune of Ratoma (Conakry Republic of Guinea).

1. Introduction

Diabetes is a group of metabolic diseases characterized by chronic hyperglycemia resulting from a defect in insulin secretion or insulin action or both of these associated abnormalities. The consequences of diabetes can be serious for health, and it had reported to be an important risk factor for cardiovascular diseases (infarction, heart failure, arteritis, and stroke), neuropathy, or even micro-angiopathic disorders that can lead to blindness (retinopathy), chronic kidney failure (nephropathy). It has also been clearly defined as a major risk factor predisposing to periodontal disease (serious infections that damage the gums and can destroy the jawbones) [1]. Diabetes is a disease that aggravates disability, causes a reduction in life expectancy, and generates high medical costs [2]. Complications related to diabetic processes are mostly vascular and responsible for 77% of deaths in the world population [3]. Worldwide, the prevalence of diabetes is 8.5%, or 422 million people affected. The World Health Organization (WHO) predicts that by 2030, diabetes will be the seventh leading cause of death worldwide with many more people with diabetes [4, 5]. In the United States of America (USA), the magnitude of diabetes were found to be high with a rate of 9.1% in the population. In France, 8% of the population are affected by diabetes [6, 7]. In Africa, the prevalence is about 7.1% about 25 million people affected in 2016 (standardized by age). In Senegal, around 720,000 people are affected by diabetes, i.e. a prevalence rate of around 5.1%. In Mali, 5% of the population suffers from this condition [8–10]. In the Republic of Guinea, in 2016, according to WHO data, about 4.7% of the population suffered from diabetes. This situation makes diabetes a real public health problem and requires a depth study [11]. In order to improve the health care of diabetic patients in the commune of Ratoma, in the city of Conakry, we have chosen to study this subject on Hematological and urinary biochemical profile of diabetic patients received in consultation at the Center of Health Anastasis of Nongo (Commune of Ratoma, Republic of Guinea).

2. Methods

2.1. Study framework

Medical biology analysis laboratories of Anastasis Health Center in Nongo and the Department of the Biology at Gamal Abdel Nasser University (UGANC) were our study areas. This is a prospective cross-sectional and descriptive study that lasted 4 months, from February 16 to June 16, 2021. Our study focused on all patients seen in consultation at the Anastasis Health Center in Nongo during our period of investigation. Sampling was simple random and sample size was about 300 and it was calculated according to the prevalence of diabetes in Republic of Guinea (4.7%) through SCHWARTZ formula. Were included in our study, all the patients received at the laboratory with an examination report or notebook on which is requested the dosage of glycaemia, glycosuria and NFS.

2.2. Variables under study

- Biological variables taken into account: Blood sugar; HbA1c; Dipstick; THB; NFS; VGM and CCMH.
- Epidemiological variables: Age; Sex; Occupation; Marital Status and Residence.
- Bio material: Blood and Urine of patients.

2.3. Collection, processing and analysis of data

The collection of data was made using a survey sheet developed according to the objectives and variables through collection of information and samples taken from patients followed by analysis of blood and urine samples from each patient. Finally, data collected was entered on the Word 2016 software, processed and analyzed by Excel software of 2007 office pack.

2.4. Consent

Before the carrying out our study, patients gave their consent to participate in the study, confidentiality was respected throughout the data collection procedure and the results were used for strictly scientific purposes.

2.5. Limits and difficulties

The non-cooperation of some patients, lack of sufficient financial means for realization of glycated hemoglobin for all patient samples, constituted our main limits and difficulties during this study.

3. Results

In this figure, we note that out of 300 patients received in consultation, 237 had a blood sugar level <0.80g/l, i.e. 79%, compared to a patient who had a balanced blood sugar level (<0.80-1.30g/l), i.e. 0 33%, 28 patients had unbalanced blood sugar (1.30-2 g/l), i.e. 9.33% and 34 patients had very unbalanced blood sugar (>2 g/l), i.e. 11.33%. The presence of very unbalanced blood sugar in the 11% could be explained by the lack of regular physical exercise, no respecting rules related to their diets and sedentary lifestyle.

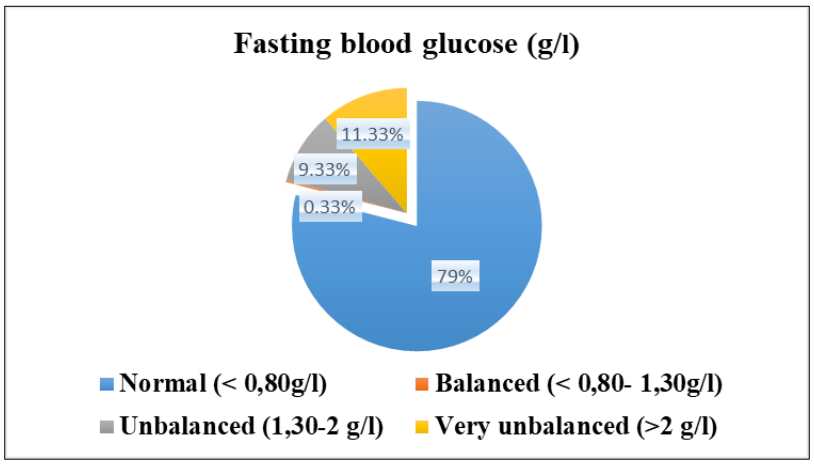

Figure 1 Blood glucose determination in patients

In this figure, we found out that an overall prevalence of diabetes was 63 cases, or 21% of diabetic patients out of 300 patients. This prevalence, which remains high compared to the national one, could be justified by the combination of several factors, in particular overweight, unbalanced diet and lack of physical activity in patients. Our results are superior to those of Mbaye N. et al., in 2010, in Senegal, who reported a rate of 10.4% and Diaby M. in 2018, at the Regional Hospital of Mamou who found 16% on 507 patients consulted [121;122].

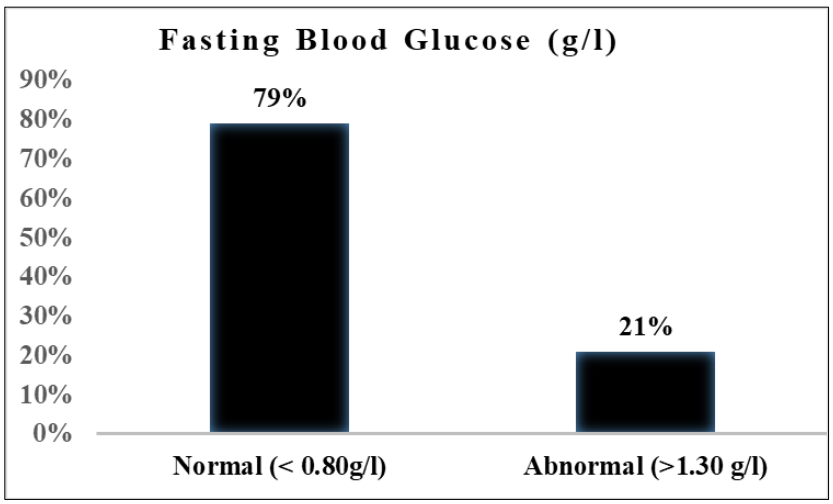

Figure 2 Global prevalence of diabetes according to blood glucose

In this Figure, our study found out that out of 63 diabetic patients, only 20 were able to perform HbA1c test, i.e. 32%. However, the majority of the 20 diabetic patients had normal HbA1c levels (< 7%) for 17 patients, i.e. 85% followed by those with unbalanced levels (7-9%) with 2 patients, i.e. 10% and only one patient very affected by glucose which has a very unbalanced HbA1c level (>9%), i.e. 5%. When the results of the HbA1c tests are too high, it is likely that the diabetic patient is unable to balance his diabetes, that an additional incident has disturbed him (flu, stress, etc.) or that the treatment does not work is not suitable [49].

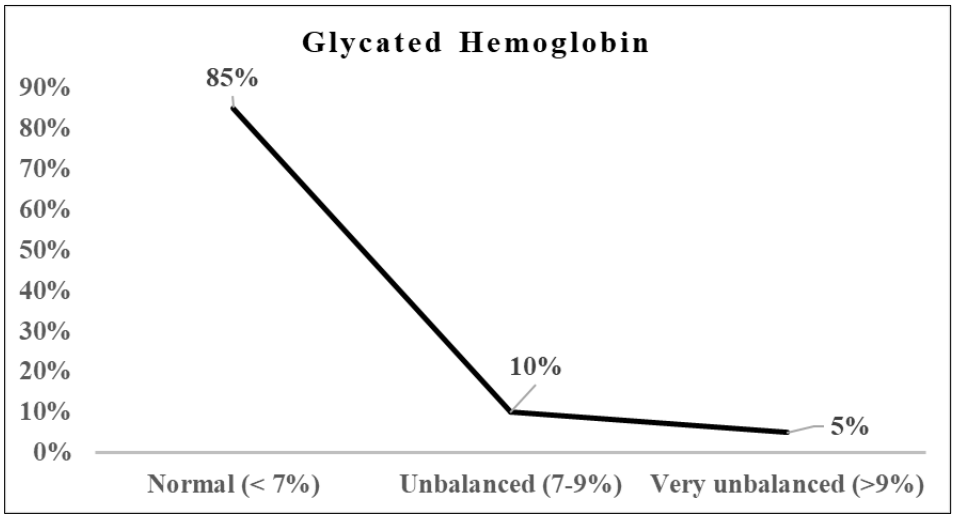

Figure 3 Distribution of diabetic patients according to glycated haemoglobin

In view of this this figure, for glycosuria to be positive on an empty stomach in a diabetic, a blood sugar level must be greater than or equal to 1.86 g/l. Furthermore, taking this statement above into account, we notice that out of the 63 patients with a positive glycaemia, 55 (87%) patients have positive glycosuria. Our results are superior to those found by Bah A., in 2015, at the University Hospital of Conakry, who reported 21% of patients with positive glycosuria and those found by Diaby M., in 2018, at the Regional Hospital of Mamou, which recorded 75% of patients with positive glycosuria [122; 123].

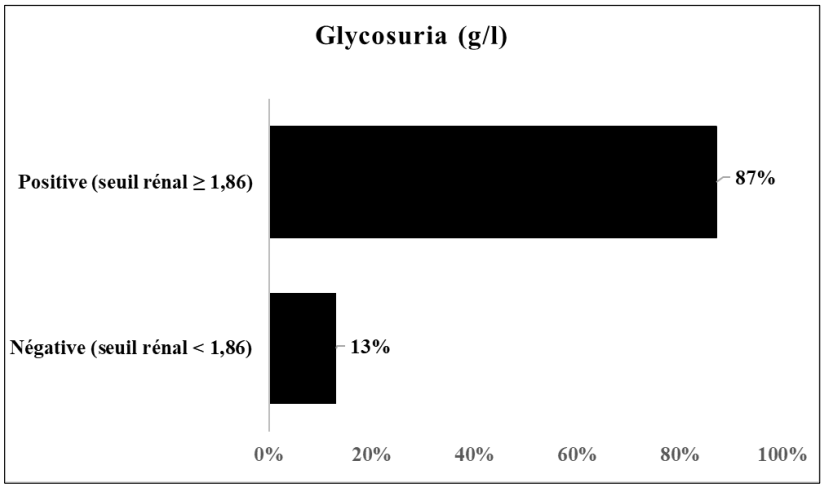

Figure 4 Distribution of diabetic patients according to glycosuria

Table 1 Distribution of diabetic patients according to biochemical parameters

Nº	Parameters	Values			
		Abnormal		Normals	
		Patients	%	Patients	%
1	Urobilinogen	61#	97#	2	3
2	Bilirubin	46#	73#	17	27
3	Ketone bodies	48#	76#	15	24
4	Proteins	47#	75#	16	25
5	Blood	61#	97#	2	3
6	pH	52#	83#	11	17
7	Leukocytes	45#	71#	18	29
8	Nitrites	53#	84#	10	16
9	Density	57#	90#	6	10

Abnormal biochemical parameters in diabetic patients.

In this table 1, we found out that in urine of all the 63 diabetic patients, all parameters are abnormal: Urobilinogen with 97%, Blood with 97%, Optical density with 90%, Nitrite with 84%, pH with 83%, Ketone Bodies with 76%, Bilirubin with 73%, the presence of Proteins with 75%, and Leukocytes with 71%. This abnormal situation of all the parameters explains the kidney damage due to diabetes which affects several organs at the same time.

Table 2 Determination of hematological parameters in diabetic patients

Parameters	Values					
	Low		Normals		High	
	Patients	%	Patients	%	Patients	%
Hemoglobin	20*	32*	35	56	5***	8***
WBC (Leukocytes)	8*	13*	49	78	6***	10***
Neutrophils	12*	19*	45	71	6***	10***
Eosinophil	-	-	63	100	-	-
Basophils	-	-	63	100	-	-
Lymphocytes	5*	8*	50	79	8***	13***
Monocytes	22*	35*	31	49	10***	16***

* Low hematological parameters in diabetic patients; *** High hematological parameters in diabetic patients.

In view of this table, we note a variation in the hematological parameters in the 63 diabetic patients: 20 patients had a low hemoglobin level, 32%. However, we note hyperleukocytosis in 10%, hyperneutrophilia in 10%, hypermonocytosis in 16%, and hyperlymphocytosis in 13% of diabetic patients. While 32 diabetic patients suffered from hypoleukocytosis, 19% from hyponeutrophilia, 8% from hypolymphocytosis and 35% from hypomonocytosis. This significant variation in hematological parameters justified their determination in all diabetic patients in order to improve their management for this chronic pathology.

Table 3 Typology of anemia in diabetic patients

Total		**Anemias**					
		Frustrated		**Moderate**		**Severe**	
Patients	**%**	**Patients**	**%**	**Patients**	**%**	**Patienta**	**%**
20	100	15	75	4	20	1	5

According to this table 3, we discovered that of the 20 diabetic patients with a low hemoglobin level, the anemic typology shows: mild anemia in 75%, moderate anemia in 20% and severe anemia in 5%. This shows that in diabetic patients, the hemoglobin level must be monitored with the taking of anti-anemic products and a good rich and balanced diet for patients suffering from mild anemia and moderate anemia. Those with severe anemia, management should include blood transfusion.

Table 4 Pathophysiological variation of MCV in diabetic and anemic patients

Total		**VGM**					
		Microcytic		**Normocytic**		**Macrocytic**	
Patients	**%**	**Patients**	**%**	**Patients**	**%**	**Patients**	**%**
20	100	5	25	15	75	-	-

Analysis of this table shows that of the 20 diabetic patients, 5 suffered from Microcytic anemia, i.e. 25%, and 15 suffered from Normocytic anemia, i.e. 75%. Microcytic anemia is due to lack of vitamin B12 and iron. This situation could be corrected by a good rich and balanced diet.

Table 5 Pathophysiological variation of MCHC in diabetic and anemic patients

Total		**MCHC**					
		Hypochromic		**Normochromic**		**Hyperchromic**	
Patients	%	Patients	%	Patients	%	Patients	%
20	100	3	15	17	85	-	-

Analysis of this table shows that of the 20 diabetic patients, 3 suffered from Hypochromic anemia, i.e. 15%, and 17 suffered from Normochromic anemia, i.e. 85%.

Table 6 Distribution of diabetic patients according to gender

No	**Sex**	**Patients**	**Percentage**
1	Masculin	26	41
2	Féminin	37	59
Total		63	100

This table shows that of the 63 diabetic patients, the female sex is the most represented with 59% against 41% for the male sex. This difference in prevalence is random because sex is not a risk factor for diabetes because both sexes have the same probability of being affected.

Table 7 Distribution of diabetic patients according to age groups

Nº	**Age groups**	**Patients**	**Percentage**
1	≤ 20	3	5
2	21 – 40	14	22
3	41 – 60	22	35
4	61 – 80	24	38
5	81 et plus	-	-
Total		63	100

We see in this table 7 that all ages are affected by diabetes. However, the age group of 61 to 80 years is the most affected with a prevalence of 38% followed by those of 41 to 60 years and 21 to 40 with respectively 35% and 22%. The least represented age group is that less than or equal to 20 years old with 5%. The high prevalence in these age groups could be explained not only by the frequency of sexual relations but also by the fragility of the organs due to diabetes, which is a chronic pathology.

Table 8 Distribution of diabetic patients according to socio-professional categories

Nº	**Socio- professional categories**	**Patients**	**Percentage**
1	Administrative agents	5	8
2	Commercial agents	14	22
3	Drivers	2	3
4	Pupils/Students	6	10
5	Teachers	4	6
6	Housewives	22	35
7	Workers	6	10
8	peasants	4	6
Total		63	100

From the point of view of socio-professional categories, as shown in this table, of the 63 diabetic patients, Housewives with 35% are the most affected, followed by Commercial Agents, Pupils/Students and Administrative Agents with respectively 22%, 10 % and 8%. This high prevalence among Housewives could be justified by sexuality, physical inactivity, unbalanced diet and overweight in some patients. This difference could be related to the size of the sample and the frequentation of the different socio-professional strata during our different surveys.

Table 9 Distribution of Diabetic Patients by Marital Status

Nº	**Marital Status**	**Patients**	**Percentage**
1	Married	52	83
2	Singles	9	14
3	widowers	2	3
Total		63	100

In this table, we note that of the 63 diabetic patients, married people are more affected by this disease, i.e. a prevalence of 83% against 14% among single people and only 3% among widowers. The marital situation having no impact on the

occurrence of diabetes, this prevalence among Married people is therefore random, because all are exposed to the same risks (sedentary lifestyle, overweight, excessive consumption of sodas, etc.).

Table 10 Distribution of diabetic patients according to residence

No	Residence	Patients	Percentage
1	Dixinn	3	5
2	Kaloum	-	-
3	Matam	-	-
4	Matoto	6	9
5	Ratoma	51	81
6	Outside Conakry *	3	5
Total		63	100

* Outside Conakry: Patients from Coyah and Dubreka.

In view of this table, of the 63 diabetic patients, the majority of them come from the municipality of Ratoma, i.e. a prevalence of 81% followed by those of Matoto with 9%. Patients from elsewhere represent only 5%. The high prevalence of diabetic patients in the Municipality of Ratoma would be explained by the fact that it not only houses the Anastasis Health Center of Nongo, therefore receives more patients from it, but also it is one of the largest municipalities from the country.

4. Discussion

The different variations in levels of elements of hemogram in type 2 diabetics undoubtedly reveal hematological impact of type 2 diabetes form and function of red blood cells [3]. Hosseini et al. (2014) showed that hyperglycemia increases the level of sorbitol in red blood cells, which impairs Na+/K+-ATPase pump, and consequently an osmotic imbalance sets in and leads to cell death [13]. Indeed, both decrease and increase in levels of red blood cells were evident in our patients; we believe that these variations are due to fact that diabetes causes changes in small blood vessels that supply the kidneys. Thus, alterations in renal function are associated with lower hemoglobin levels and therefore with an increased prevalence and severity of anemia [15]. The low levels of both red blood cells and hemoglobin, accompanied by the observed hematocrit (Ht) levels, could also be explained by the fact that anemia is a frequent complication in patients with diabetes mellitus, particularly in those who have overt nephropathy [3]. Furthermore, research by Pretorius et al. (2015) showed in a comparative study between type 2 diabetics and controls, that the red blood cells of type 2 diabetics experienced a significantly greater stiffness of their membranes than those of controls; and that overall this could be alleviated by addition of iron chelators [4]. However, although anemia may be a sign of diabetic kidney disease, hemoglobin levels reduced or borderline, can identify increased risks of micro vascular complications in diabetic patients [13]. Variations in the levels of white blood cells, and therefore of the whole leukocyte formula, were evident in our patients. Indeed, we believe that the low level of white blood cells could mean that there has been a drop in the defense of the immune system, just as it could be due to the presence of foreign organisms [1, 16]. And in the leukocyte formula, the most abundant figured elements are neutrophils. Khan et al. (2014) reported that neutrophils plays a central role in defense of host against invading pathogens; they are an essential component of innate immune system with several effector and regulatory immune functions. Thus we estimate that the patients who had presented low levels of white blood cells were probably in a state of oxidative stress. Other studies have revealed that neutrophils from patients with iron deficiency have a reduced oxygen radical production capacity [1, 16]; and that functional neutrophil abnormalities occur in patients with renal failure. These abnormalities are at least partly responsible for the increased susceptibility to infections [9, 10]. Moreover, changes in observed lymphocyte levels corroborate the results of the studies by Neamtu et al. (2015); who subsequently showed that T lymphocytes are among the first cells to be infiltrated into the arterial intima during the initial stages of atherosclerosis. Changes in distribution of blood lymphocytes could be associated with stimulation of development of atherosclerotic plaque [15]. However, cases of lower monocytes that have been evident in our patients are of course indicative of some complications. Investigations by Persson et al. (1998) had shown that monocyte levels often decreased in type 2 diabetics with atherosclerosis [11]. Some cases of diabetics had presented an average globular volume lower than 80 femtoliter and others had a rate in normal range; these results corroborate with those of Hosseini et al. (2014) who found in their study that about a third of patients with type 2 diabetes had normocytic anemia and others had microcytic anemia.

Study limitations

This study had limitations. If the sample size (300 diabetics) allows for acceptable conclusions, however, not all diabetic patients could achieve glycated hemoglobin. Nevertheless, this work has conceptual merit and could serve as a reference for future studies. It demonstrated the impact of diabetes on variations in hematological parameters.

5. Conclusion

This study at the Anastasis Health Center in Nongo showed significant variations in hematological profile in 300 type 2 diabetic patients in the Commune of Ratoma. These changes in hematological parameters are the basis of chronicity of disease. This is why it is important to determine hematological profile of patients in order to improve their management.

Compliance with ethical standards

Acknowledgments

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Disclosure and conflicts of interest

The authors declare no conflict of interest.

Authors Contributions

All authors have contributed to this research and have read and approved the final version the manuscript.

Statement of ethical approval

Confidentiality was respected throughout data collection process and all results were used for strictly scientific purposes.

Statement of informed consent

Before the carrying out our study, patients gave their consent to participate in the study.

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