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Glycated haemoglobin measurement at the biochemistry laboratory of the university Hospital - Joseph Ravoahangy Andrianavalona

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Abstract

Introduction: In Madagascar, the number of diabetic patients registered in the health system is constantly increasing. Access to glycated haemoglobin (HbA1c) testing remains limited. The objective of this study was to describe the prescription of HbA1c dosage seen in the biochemistry laboratory of the University Hospital Centre - Joseph Ravoahangy Andrianavalona (CHU-JRA).

Materials and methods: This is a retrospective, descriptive and analytical study conducted in the Biochemistry laboratory of CHU-JRA, carried out from March 1 to April 30, 2022 on the analysis request forms of patients who had an HbA1c dosage.

Results: A total of 327 HbA1c assays were selected. The mean age was 57 years with a sex ratio of 0.9. The age group 40-60 years was the most represented (44%). Covid-19 was the most common clinical information (35.5%) followed by warning signs and/or risk factors for diabetes (33.3%). HbA1c was in the normal range in 30.6% of cases. Approximately 51.7% of the HbA1c tests were associated with a fasting blood glucose test. Simultaneous elevation of blood glucose and HbA1c was observed in 26.6% of cases. On the other hand, 44.4% of the cases had an HbA1c level <6% associated with a normal blood glucose level.

Conclusion: The prescription of HbA1c remains low in the laboratory. The majority of results show poor glycaemic control. This study argues in favour of raising awareness among practitioners of the importance of HbA1c testing in the optimal management of diabetes.

Keywords: Biochemistry Laboratory; CHU JRA; Glycemia; HbA1c

1. Introduction

Diabetes is a global burden with multiple short- and especially long-term complications [1]. Worldwide, more than 425 million adults live with diabetes, making it a major public health problem. The World Health Organization (WHO) predicts 622 million diabetics by 2040 [2]. In Madagascar, in 2015, the number of diabetic patients registered in the health system was 31,149 [3]. Haemoglobin A1c (HbA1c) is the main form of glycated haemoglobin characterised by the non-enzymatic binding of glucose to the N-terminus of the β-chains of globin. Its measurement is now an essential component of diabetes management. HbA1c is the best indicator for monitoring glycaemic control in patients with

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diabetes, both type 1 and type 2. Its value is an objective and retrospective indicator of the quality of diabetic control in the four to six weeks preceding the test [4,5]. Thus, the role of HbA1c measurement in the management of diabetes is to provide a simple measure of mean blood glucose; to predict the risk of complications (macrovascular and especially microvascular); to assess therapeutic efficacy; and to set therapeutic goals [6, 7]. The objective of this study was to describe the prescription of HbA1c measurement seen in the Biochemistry laboratory of the CHU-JRA.

2. Materials and methods

This is a retrospective, descriptive and analytical study carried out in the Biochemistry laboratory of the CHU-JRA, from March 1 2022 to April 30, 2021. The study focused on all the analysis request forms of patients having included an HbA1c dosage with or without fasting blood glucose determination. Patients with incomplete or unclear clinical information on their HbA1c test requests were excluded. Sampling was done in a comprehensive manner. The variables studied were sociodemographic parameters, HbA1c level, and fasting blood glucose. HbA1c was measured on the Mindray BS 300® automated system using the immunoturbidimetric method. Data analysis was performed using Microsoft Office Excel 2010 and Epi Info 7.2.3.1 software.

3. Results

Table 1 Distribution of HbA1c levels according to clinical information

HbA1c level	Clinical information									
	Diabetes follow-up n=36		Diabetes warning signs n=109		Covid-19 n=116		surgery n=10		Other n=56	
	N	%	N	%	N	%	N	%	N	%
< 4%	3	0,9	47	14,4	33	10,1	5	1,5	22	6,7
4 – 6%	15	4,6	29	8,9	51	15,6	2	0,6	20	6,1
6 – 7%	5	1,5	5	1,5	3	0,9	1	0,3	1	0,3
7 – 8%	5	1,5	10	3,1	9	2,8	0	0	4	1,2
>8%	8	2,4	18	5,5	20	6,1	2	0,6	9	2,8

Table 2 Distribution of HbA1c according to associated fasting blood glucose value

HbA1c level	Glycemia value					
	Hypoglycemia < 3,90mmol/l n=02		Normal Glycemia 3,90 – 6,99mmol/l n=77		Hyperglycemia >7,00mmol/l n=90	
	N	%	N	%	N	%
< 4%	1	0,6	46	27,2	19	11,2
4 – 6%	0	0	27	16,0	26	15,4
6 – 7%	0	0	0	0	8	4,7
7 – 8%	0	0	2	1,2	13	7,7
>8%	1	0,6	2	1,2	24	14,2

A total of 327 requests for HbA1c tests were registered during the study period, representing 3.9% of all biochemical tests. The sex ratio was 0.9. The mean age of the patients was 57 years with extremes of 9 and 91 years. The age range 40-60 years was the most represented (44%). Covid-19 was the most common clinical information found on test

requests (35.5%) followed by warning signs and/or risk factors for diabetes (33.3%). Of the 327 HbA1c tests, 30.6% came back abnormal with an HbA1c value higher than 6%, the majority of which concerned alarm signs and risk factors of diabetes. About 51.7% of the HbA1c tests were associated with a fasting blood glucose test. Simultaneous elevation of blood glucose and HbA1c was observed in 26.6% of cases, 44.4% had HbA1c <6% and normal blood glucose. Clinical information such as warning signs or risk factors for diabetes predominated for HbA1c>6% and hyperglycaemia >7.00 mmol/L in 53.3% of cases. (Table 1)

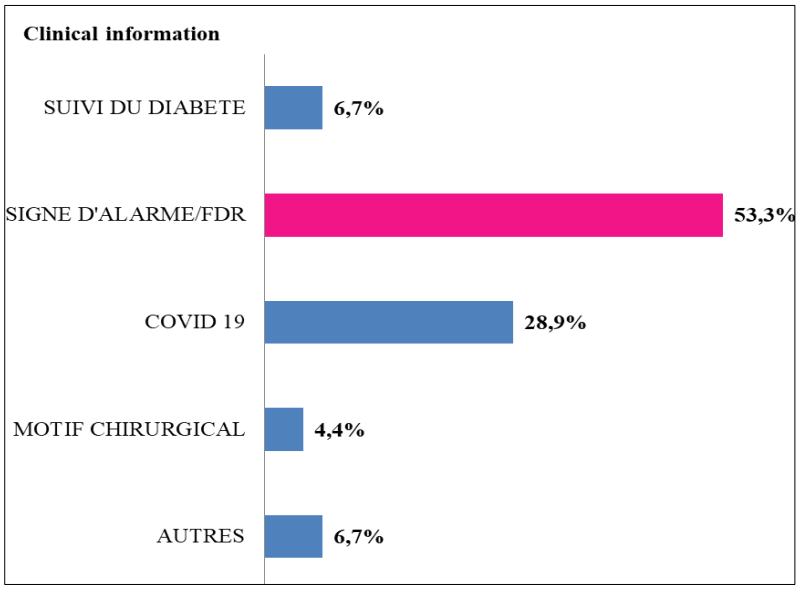

Figure 1 Distribution of HbA1c>6% and hyperglycaemia>7.00 mmol/L as per clinical information

Calculation of the correlation coefficient (r = 0.66) shows a positive correlation in patients with HbA1c values >6% and fasting hyperglycaemia. The linear regression equation is: HbA1c = 0.021 × (fasting blood glucose) + 7.794 (Fig 2)

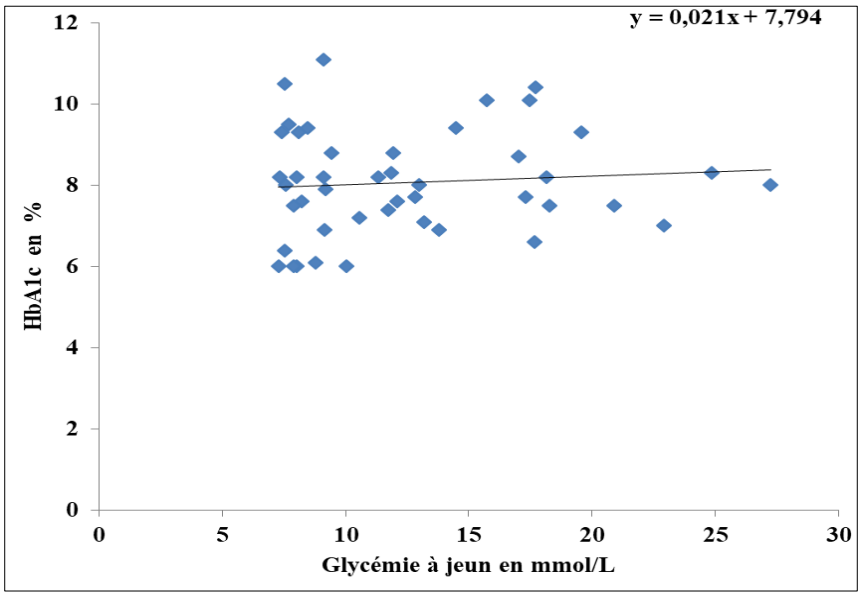

Figure 2 Curve representing the correlation between HbA1c >6% and fasting blood glucose >7.00mmol/l)

4. Discussion

The prescription of HbA1c testing remains low in the laboratory according to our results, but there has been a clear increase in recent years. Moreover, international expert committees in diabetology recommend HbA1c as a better

diagnostic tool for diabetes with a threshold of 6.5% [8]. Furthermore, in the pre-analytical phase, HbA1c is not influenced by immediate food intake, which facilitates sampling and analysis [8, 9].

The precision and accuracy of HbA1c are currently being demonstrated to make it an equally accurate test for defining the degree of hyperglycaemia at which complications arise [10]. However, the HbA1c assay has limitations as its value is conditional on normal red blood cell life (120 days) and normal haemoglobin synthesis (97-99% HbA). The low HbA1c prescription rate observed could be explained by the fact that our study site is a surgical hospital. This prescription rate is slightly increased compared to a study conducted by Rahajamanana V in 2011 with a rate of 1.9% [11]. A slight female predominance was found. Most diabetes studies have also found this to be the case, such as those conducted in Madagascar. Similarly in Australia in 2007, 54.3% of the population at risk of diabetes were women [12]. However, other studies found a male predominance [13]. All age groups were concerned by the prescription of HbA1c with an average age of 57 years. This prescription remains low for those under 40 years of age, whether for screening or for monitoring diabetes. Then a net increase in demand was noted from the age of 40. The covid-19 treatment centre (CTC) was the main prescriber of HbA1c tests (42.7%). This could be explained by the entry of the SARS Cov2 virus in Madagascar since March 2020. Indeed, hyperglycaemia was often encountered on admission of Covid19 patients to these treatment centres associated with an elevated HbA1c, leading to the diagnosis of previously unknown diabetes.

Moreover, the demand for HbA1c in the context of monitoring diabetics is only 11%. This parameter is not yet part of the systematic requests of doctors taking care of diabetic patients, and capillary blood glucose measurements on glucometers are often used. Prescribers should be made aware of the importance of monitoring blood glucose control by measuring HbA1c in order to avoid micro and macro vascular complications.

Approximately 3.1% of HbA1c requests were prescribed as part of preoperative assessments. Diabetes is an important risk factor for surgical complications, so preoperative HbA1c testing can be used to assess the risk of postoperative complications, including the risk of surgical site infection [15, 16]. Apart from the prescription of HbA1c alone, our study revealed 169 requests for blood glucose testing coupled with HbA1c, i.e. 51.7%. Among the patients with hyperglycaemia, 50% had an HbA1c level >6%. According to the WHO, in 2006, fasting blood glucose alone was able to make the diagnosis in only 30% of previously undiagnosed diabetics. A better sensitivity in diagnosing a diabetic state is found when HbA1c and fasting blood glucose are combined, especially in individuals at high risk of early diabetes [14,15,16].

5. Conclusion

The HbA1c assay is an essential tool for monitoring glycaemic control in diabetics. However, this biochemical parameter is rarely prescribed by practitioners who manage diabetic patients. Our results show a significant proportion of patients with poor biochemical control. Thus, to ensure effective management of patients, it is essential that practitioners be made aware of the advantages of HbA1c testing compared to conventional blood glucose testing, the recommended frequency of testing, the target value and the action to be taken according to the values found.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors declare no conflict of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study

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