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Impact of Initial Hyperglycaemia on Mortality in Reanimation

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Abstract: *Objective*: to assess the impact of initial hyperglycaemia on the mortality of intensive care patients. *Methods*: This is a cross-sectional study involving 217 patients. The data was collected from patient files, then collected and stored on pre-established survey sheets. Data were entered into the computer using Epi Info software and analyzed using the Statistical Package for Social Science (SPSS) version 21.0 program. The chi-square test (Fisher exact) associated with the risk calculation allowed us to compare the groups of hyperglycemic (HG) and normo-glycemic (NG) patients and also the previously known diabetic hyperglycemics and the non-diabetics. The value of $p < 0.05$ was considered as the threshold of statistical significance. *Results*: initial hyperglycaemia is common in intensive care regardless of diabetic status. The mean age of the patients was 44.4 years; the male sex was predominant with a sex ratio of 1.2 (M/F). Diabetics accounted for 14.7%. Polytrauma was the most encountered pathology, followed by surgical pathologies, cerebrovascular accidents (CVA), sepsis and others. The hyperglycemics had presented more deaths than the normo-glycemics, with a significant difference. The long stay was observed more in normoglycemics than in hyperglycemics, with a significant difference. Hyperglycemia in the group of non-diabetic patients was accompanied by higher mortality than that in the group of diabetic patients. *Conclusion*: Mortality was high in the group of non-diabetic hyperglycemic patients, 88.9% vs 11.1% of hyperglycemic diabetic patients.

Keywords: Initial Hyperglycemia, Mortality, Resuscitation

1. Introduction

Hyperglycaemia is defined as an increase in blood sugar above 6.1 mmol/l (i.e. 110mg/dl) on an empty stomach and between 7.8 and 11.1mmol/l (140 and 200mg/dl) at 120th minute of a test of hyperglycemia otherwise called carbohydrate intolerance [1]. Hyperglycaemia is considered to be one of the determining factors of morbidity and mortality in intensive care [2].

Severe patients admitted to intensive care, following a septic complication, trauma, major surgery, or presenting multi-visceral failure caused by primary septic shock, have a very high risk of mortality and suffer from high morbidity. The hyper metabolic stress response that normally follows every major trauma or acute illness is associated with hyperglycemia and insulin resistance; whether the patient has prior diabetes or not. This situation is frequently referred to as “stress diabetes” or “damage diabetes” [3-8].

Moderate hyperglycaemia has long been thought to be beneficial in severe patients, as it provides glucose as an

energy source to organs that do not depend on insulin for absorption (e.g. brain and immune system). On the other hand, it seems increasingly clear that there is a link between the degree of hyperglycaemia on admission, its duration, and a poor prognosis [7].

A retrospective review of a heterogeneous group of severe patients indicated that even a modest degree of hyperglycaemia on admission was sufficient to significantly increase the risk of death during hospitalization [9]. The first evidence against the concept of "hyperglycemic tolerance" in severe disease comes from two large randomized controlled trials, which demonstrate that tight blood sugar control with insulin significantly improves morbidity and mortality in patients surgical [10], and in severe medical patients [11].

Umpierrez *et al.,* in 2002, in a study of 2030 patients showed that hyperglycaemia was a factor of poor prognosis [7]. Krinsley *et al.,* in 2004 evaluated, in a non-randomized study, with a cohort of control patients, the outcome of 800 consecutive patients before and after the implementation of tight glycemic control; Aiming for blood glucose values below 7.8mmol/l (140mg/dl). They had obtained a reduction in mortality which went from 20.9% to 14.8%, with a reduction in the incidence of organ failure; a reduction in the number of transfusions and the length of stay in intensive care [12].

In the Democratic Republic of Congo, Lepira et al. in 2010; in a retrospective study investigating the frequency and determinants of short-term stroke-related mortality observed that deceased patients had elevated blood glucose values ranging between 7.2 ± 2.5 vs 6.1 ±1.7 mmol/l (130 ± 45 vs. 109 ± 30 mg/dl); (p=0.001) [13].

Within the Department of Anesthesia Resuscitation (DAR) of the University Clinics of Kinshasa (CUK); some studies have been conducted on perioperative morbidity and mortality [14, 15], however none have focused on the impact of initial hyperglycaemia in intensive care patients. This is why it seemed appropriate to us to conduct this study, the main objective of which is to assess the impact of initial hyperglycaemia on the outcome of patients admitted to intensive care in order to suggest an integrated strategy for their management.

2. Methods

2.1. Type, Location and Study Population

This study is a cross-sectional study. It covered the period from November 1, 2012 to July 31, 2013, i.e. 9 months. It took place at the Resuscitation Service of the University Clinics of Kinshasa (CUK).

The population of this study was made up of all patients admitted to intensive care units at the CUK and the Ngaliema Clinic during the study period, i.e. from November 1, 2012 to July 31, 2013.

This study used exhaustive sampling with consecutive recruitment of all patients admitted to the intensive care unit during the study period and in whom blood glucose was measured during the first 24 hours.

2.2. Data Collection Technique

After selection, our sample was made up of 217 patients, including 108 cases of hyperglycemia, or 49.7%, and 109 cases of normoglycemia, or 50.3%. We divided the patients into two groups; a group of hyperglycemic patients (HG) and a group of normoglycemic patients (NG). From the group of hyperglycaemic patients, we divided the patients according to whether they were known to be diabetic beforehand or not.

Patients were enrolled in the order of arrival in intensive care. Blood glucose was measured on two samples 8 hours apart to exclude the possibility of postprandial hyperglycemia. The care of the latter met the usual therapeutic standards of the institution; the same was true for the treatment of comorbidities and other associated situations.

The data was collected from patient files, then collected and stored on pre-established survey sheets. Data quality control was ensured by the systematic examination of all the survey forms. The purpose of this review was to identify missing data.

The following variables were retained: socio-demographic data (age, sex, background, origin); clinical data (reason for admission to intensive care), paraclinical data (glycaemia level); evolving data (death and/or transferred to another department) and length of stay in intensive care.

Initial hyperglycemia was defined by a blood glucose level on admission greater than 7.8 mmol/l (> 140mg/dl) after two doses 8 hours apart.

2.3. Data Processing and Analysis

Data were entered into the computer using Epi Info software and analyzed using the Statistical Package for Social Science (SPSS) version 21.0 program. Qualitative variables were expressed in proportion or %, for Quantitative variables, means, medians and standard deviations were calculated. The results are presented in the form of figures and tables.

The Chi-square test (Fisher exact) associated with the risk calculation allowed us to compare the groups of hyperglycemic (HG) and normo-glycemic (NG) patients and also the previously known diabetic hyperglycemics and the non-diabetics. The value of $p < 0.05$ was considered as the threshold of statistical significance.

2.4. Ethical Considerations

The principles of anonymity and confidentiality were respected throughout the data collection process.

3. Results

3.1. General Patient Characteristics

The general characteristics relate to the age, sex, origin, reasons for admission, history and outcome of the patients.

Table 1. *Representation of the glycemic profile of patients according to age and gender.*

Variables	blood sugar				
	H.G.	NG	Total	P	GOLD
Age (years)					
>45	57 (59.4%) 26.3%	39 (40.6%) 18%	96 (100%) 44.2%	0.014	2006 [1.164-3.457]
≤45	51 (42.1%) 23.5%	70 (57.9%) 32.3%	121 (100%) 55.8%		
Sex					
F	50 (46.3%) 23%	48 (44%) 22.1%	98 45.2%	0.843	0.913 [0.535-1.536]
M	58 (53.7%) 26.7%	61 (56%) 28.1%	119 54.8%		
Total	108 (100%) 49.8 0 %	109 (100%) 50.2	217 100%		

Patients over 45 years old had more hyperglycaemia than patients aged less than or equal to 45 years old. The male sex is predominant, with a sex ratio of 1.2.

3.2. Origin of Patients

The majority of patients came from the emergency room (figure 1).

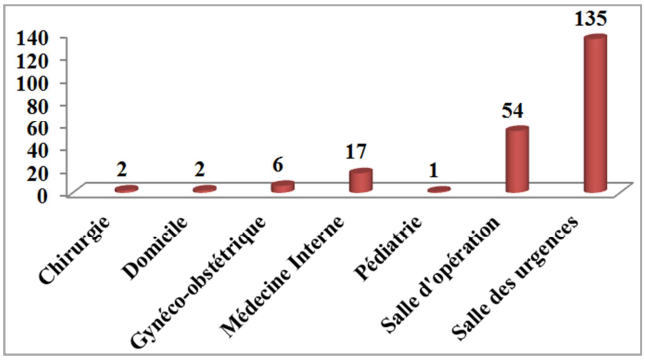

Figure 1. *Representation of patients by origin.*

3.3. Reasons for Admission

Polytrauma, surgical digestive pathologies, sepsis and stroke were more frequent.

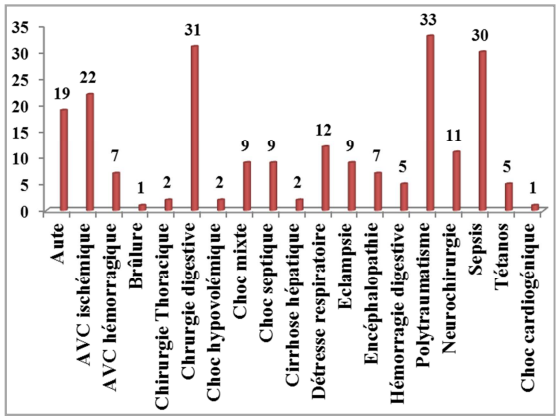

Figure 2. *Representation of patients according to reasons for admission.*

3.4. History of Diabetes

Non-diabetics were preponderant.

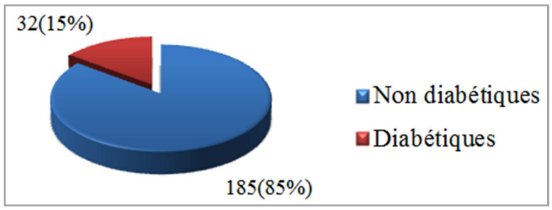

Figure 3. *Representation of patients according to history.*

4. Impact of Hyperglycaemia on Mortality and Length of Stays

Table 2. *Representation of patients according to Blood Glucose and Outcome.*

blood sugar	Issue			p*	GOLD
	deceased	Living	Total		
	Effective (%)	Effective (%)	Effective (%)		
H.G.	63 (58.3%) 29%	45 (41.7%) 20.7%	108 (100%) 49.8%	0.000	8,137 [4,231-15,650]
NG	16 (14.7%) 7.4%	93 (85%) 42.9%	109 (100%) 50.2%		
Total	79 (36.4%) 36.4%	138 (63.6%) 63.6%	217 (100%) 100%		

The hyperglycemics had presented more deaths than the normo-glycemics, with a significant difference.

Table 3. *Representation of patient stay according to glycaemia.*

blood sugar	Stay (day)		Total	p*	GOLD
	>5	≤5			
H.G.	26 (37.1%) 12%	82 (55.8) 37.80%	108 49.80%	0.013	0.468 [0.261-0.840]
NG	44 (62.9%) 20.30%	65 (44.2%) 30%	109 50.20%		
Total	70 (100%) 32.30%	147 (100%) 67.70%	217 100%		

The long stay was observed more in normoglycemics than in hyperglycemics, with a significant difference.

Table 4. *Representation of patient outcomes according to their stay.*

Stay (day)	Issue		Total	p*	GOLD
	deceased	Living			
>5	15 (19%) 6.9%	55 (39.9%) 25.3%	70 32.3	0.000	0.354 [0.183-0.683]
<5	64 (81%) 29.5%	83 (60.1%) 38.2%	147		
Total	79 (100%) 36.4%	138 (100%) 63.6%	217 100%		

There were more deaths in the stay of less than 5 days, with a significant difference.

Table 5. *Representation of the outcome of hyperglycemic patients according to the history.*

Hyperglycemia	Issue		Total	p*	GOLD
	deceased	Living			
Non-diabetics	56 (88.9%°) 51.90%	25 (55.6) 23.10%	81 75%	0.000	6.4 [2,399-17,076]
diabetics	7 (11.1%) 6.50%	20 (44.4%) 18.50%	27 25%		
Total	63 (100%) 58.30%	45 (100%) 41.70%	108 100%		

Hyperglycemia in the group of non-diabetic patients was accompanied by higher mortality than that in the group of diabetic patients.

5. Discussion

This survey, which had the general objective of evaluating the impact of initial hyperglycaemia on the outcome of patients admitted to intensive care in order to suggest an integrated strategy for their management, essentially shows that initial hyperglycaemia was frequent in intensive care. The mean patient age was 44.4; a median of 42, a standard deviation of 19.8 with a minimum of 3 years and a maximum of 95 years.

The majority of patients came from the emergency room and the operating room. Polytrauma, digestive surgical pathologies, sepsis and stroke were the most frequent reasons for admission. Diabetics accounted for 14.7%. The study recorded 79 deaths or 36.4%, including 29% for the hyperglycemic group and 7.4% for the normoglycemic group. The average patient stay was 5.1; the median of 4; the standard deviation of 4.2; the minimum at 1 and maximum at 26 days.

As part of this study, we took the option of determining the frequency of initial hyperglycaemia, its impact on mortality and its influence on the length of stay in intensive care. Ideally, this study would have been based on previous data; a process that was not easy for us due to certain difficulties, especially in collecting the necessary information. Finally, patients of different ages and sexes were included in the present study.

Despite all these methodological and material limitations, at the end of this study, we had obtained results allowing us the present discussion. These are the general characteristics, the impact of hyperglycaemia on mortality and length of stay in intensive care.

5.1. Main Features

The population of our study was mixed, both sexes were represented with a male predominance without statistical significance. Almost all ages were interested.

5.2. Impact of Hyperglycaemia on Mortality and Length of Stay in Intensive Care

In this study we considered two groups of patients: the group of hyperglycemic patients and the group of normoglycemic patients. We found 49.8% of hyperglycemic patients and 50.2% of normoglycemic patients. Our results are similar to those of Umpierrez G., Cely CM et al. [7, 8] who confirmed that hyperglycaemia is frequent in intensive care, whether the patients are diabetic or not.

We found that mortality was high in the group of

hyperglycemic patients, ie 29% against 7.4% in the group of normoglycemic patients. The risk of death for a hyperglycemic patient was high compared to the normoglycemic patient, p=0.000; OR= 8.137 [4.231-15.650]. Our results are similar to those of:

Krinsley JS [9] who, in a retrospective review of a heterogeneous group of severe patients, indicated that even a modest degree of hyperglycaemia on admission to intensive care was sufficient to significantly increase the risk of death during hospitalization.

Lepira *et al.* [13] who had shown in a retrospective study in patients admitted for stroke, that deceased patients had high blood sugar levels varying between 7.2 ± 2.5 vs 6.1 ±1.7 mmol/l (130 ± 45 vs 109 ± 30mg/dl); (p=0.001).

Wahab *et al.* [16] who had shown that a hyperglycaemia greater than 11 mmol/l on admission was associated with an increase in intra-hospital mortality in patients with myocardial infarction.

Goldberg RJ et al. [17] who had evaluated the impact of hyperglycemia on the mortality and morbidity of 3601 non-diabetic patients presenting with myocardial infarction, showed that patients with a hyperglycemia of 8.6 mmol/l had intra-hospital mortality higher than that of subjects with normoglycaemia. Although we did not distinguish coronary and non-coronary patients, we observed like them that hyperglycaemia is accompanied by excess mortality.

Leonidou L et al. [18] in a recent study had confirmed that stress hyperglycaemia greater than 11.1 mmol/l was associated with a higher mortality rate than diabetic septic patients or without stress hyperglycaemia.

A length of stay in intensive care greater than five days was observed in patients normoglycemic than in those who presented with hyperglycemia. Our results differ from those of Van Den Berghe G, Krinsley *et al* [10, 12] who observed a reduction in the length of stay in intensive care for hyperglycemic patients controlled with strict insulin therapy. This could be explained by the fact that the patients with hyperglycaemia died before five days and not that they were cured.

Hyperglycemia in non-diabetic patients was accompanied by higher mortality than observed in hyperglycemic diabetic patients. The difference is significant, p=0.000; OR=6.4[2.399-17.076]. Our results are similar to those of Wang *et al.* [19] who had retrospectively evaluated the impact of first 24-hour hyperglycemia and diabetes in 416 stroke patients, they had shown that only hyperglycemia in non-diabetic patients was a predictive factor for intra-hospital mortality.. OR=3[1.1-8.3]; p=0.035.

There were more deaths before five days; 81% against 19% in the stay of more than five days, with a significant difference; p=0.000; OR=0.354[0.183-0.683].

6. Conclusion

This survey shows the negative impact of hyperglycaemia on the outcome of serious patients admitted to intensive care; it therefore justifies the mandatory implementation of this measure, the adequate management of which could influence the morbidity and mortality of patients. Directives should be formulated in this direction in any doctor of Resuscitation.

Conflict of Interest

All the authors do not have any possible conflicts of interest.

Authors' Contribution

All authors have read and approved the final version of the article.

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