International Journal of Medical Science and Clinical Research
Online-ISSN: 2664-7761; Print ISSN: 2664-7753
Received: 10-10-2020; Accepted: 25-10-2020; Published: 19-11-2020
www.journalofmedical.com
Volume 2; Issue 4; 2020; Page No. 38-40

Evaluation of zinc spray test for the diagnosis of hypozincemia in hospitalized patients at the central hospital of the state of Chihuahua

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Abstract

Scope: Zinc is required for cell maturation and it is essential for an adequate immune response, its deficiency in hospitalized patients may lead to a bad clinical course, the longer length of hospital stay, higher mortality, and increased costs. The aim of this study was to evaluate the usefulness of the spray test for zinc deficiency diagnosis in a quick and inexpensive way.

Methods and results: A zinc sulfate solution was placed on the tongue of the patients and they were asked if perceived an unpleasant taste, the ones who didn't were classified as "with hypozincemia" and had a blood test to confirm the diagnosis. Of the total of patients, 28 (20.1%) had obesity, 36 (25.5%) had diabetes mellitus and 3 (2.2%) had liver disease; 51.7% were men and of this 65.2% obtained as a result a null flavor, 48.3% were women, of which 49.2% had the same result.

Conclusion: The zinc tongue test can be useful for the diagnosis of hypogeusia that is related to patients who are obese, diabetic, or have liver disease. It is recommended to carry out a comparison of blood zinc in these patients with hypogeusia to establish the diagnosis of hypozincemia and therefore malnutrition.

Keywords: diagnosis, hypogeusia, hypozincemia, malnutrition, tongue test

Introduction

Zinc is an essential trace element in the performance of vital functions for humans; it's involved in cell development and in the proper functioning of the immune system [1]. Its relationship with the nutrition is crucial for the management of hospitalized patients and the knowledge of its serum levels allows us to act in a timely manner to provide the patient with better medical care and reduction of the expenses generated by these [2]. The problem when analyzing it, is that the sample represents a small proportion of zinc in total serum **[3].** Other diagnostic methods have been proposed, however these are expensive, time-consuming and of little use in our setting [4]. The aim of this study is to implement a screening test that indicates zinc deficiency in a quick and inexpensive way, thus evaluating the usefulness of the zinc spray test for diagnosis.

Materials and Methods

The patients were selected from the population of hospitalized patients in the Central Hospital of the State, from 18 to 50 years old, the exclusion criteria were patients with some oncological pathology, who had undergone digestive tract resection surgery, patients with sepsis or hemodynamically unstable, with suspected or confirmed pregnancy and mental or cognitive disorders. We proceeded to explain the methodology and then sign the informed consent. The elimination criterion was the refusal to submit to the study. A general information form was completed with personal history data of the patient, admission day laboratories, and evaluation of the nutrition department. Next, 2 ml of 0.1% zinc sulfate solution was placed, in the form of a spray, on the tongue and the patients were asked to remain so for 60 seconds, followed by asking if they perceived an unpleasant taste, patients who perceived it were classified as "without zinc deficiency" and the ones who did not, as "with hypozincemia" and had a blood test. If the result showed zinc level less than 70 ug/dl then the presence of hypozincemia would be confirmed. A confidence level of 95% was estimated, with a power of the test of 80% and a ratio of the clinical test of zinc spray and 1:1 blood zinc test, with a relative risk of detecting of 1.5 per the above is calculated with the EPIDAT software a sample size of 150 patients. This was a univariate analysis. Student's t-test was used to compare variables when measured on a ratio scale. The chi-square test was used for variables measured on the nominal or ordinal scale on STATA 11.0 for Windows. A significant difference was taken ($p = <0.05$).

Results

A total of 150 patients were included in the study in a period from November 2019 to January 2020, of which 11 patients were eliminated, 4 of them for being minors, 2 for a positive

pregnancy test and 5 for presenting an oncological process under study, thus leaving a total of 139 patients. Of the 139 patients, 72 (51.7%) were men and 67 (48.3%) were women with a mean age of 45.2 years ± 2.98. Of the total of patients, 28 (20.1%) fell within the obesity classification, 36 (25.5%) had diabetes mellitus, 45 (32.4%) had systemic arterial hypertension and 3 (2.2%) had liver disease, 51.7% were men and of this 34.7% obtained as a result of the spray zinc test a metallic flavor and 65.2% a null flavor, 48.3% of the sample corresponds to women, of which 50.7% obtained as a result a metallic flavor, and 49.2% a null flavor. Based on these results, we can suggest that men tend to present zinc deficiency states more frequently (Table 1).

Table 1: Cross-tabulation between gender and taste

		Taste		Total
		Metallic	None	
Gender	Male	25	47	72
	Female	34	33	67
Total		59	80	139

It was found that 63 patients who reported alcoholism, of which 42 (30.2%) did not report a taste of zinc administration and 21 (15.1%) reported a metallic taste (finding a statistically significant relationship between patients with positive alcoholism and the perception of no taste using the test for the detection of hypozincemia chi-square = 3,917, p <0.05, Cramer's V 0.168). This could indicate that consuming alcohol could alter the taste perception of the zinc test and be related to a zinc deficiency state. It was found that 100% (3) of the patients who presented liver disease perceived no taste before the hypozincemia test, with no statistically significant relationship $p = 0.133$, however it could indicate that patients with liver disease who present hypogeusia could present a state zinc deficiency, so it would be important to carry out a subsequent study with only a sample of patients with liver disease. Regarding the relationship between the total days of hospital stay and the taste perception of the zinc spray test, we found that 57% of the patients obtained a null taste of the test, from these patients a DOHS *(days of hospital stay)* average of 7.4 days. 42.4% obtained a metallic taste result with an average of 7.7 DOHS, not having a statistically significant relationship. We can see that of the total sample of 139 patients, only 32.3% are at an adequate weight for their height and age, and 67.6% are overweight or obese. By relating the result of the zinc spray test with the weight of the patients, we can observe that the overweight patients (67.6%) tend to have a zero taste test result, which would indicate a lack of zinc and therefore so much leads us to malnutrition. Of the total of patients, 39 (28.1%) were classified as pre-diabetic, of which 11 obtained a metallic taste to the test and 28 a null taste and 32 (23.1%) were classified as diabetics according to their glucose levels, of these 13 they obtained a metallic taste to the zinc test and 19 a null taste (Table 2).

Table 2: Relationship of blood glucose levels and taste

		Taste		Total
		Metallic	None	
Glucose	Less than 70	6	2	8
	71 to 100 mg/dL	29	31	60
	100 to 126 mg/dL	11	28	39
	Greater than 126.1 mg/dL	13	19	32
Total		59	80	139

We can observe with these results that with increasing blood glucose levels, the results of null taste to the zinc test are more prevalent.

Discussion

The nutritional status of hospitalized patients is an important factor to take into account for their recovery [5]. The prevalence of malnutrition reported in hospitalized patients varies from 20% to 50% in Latin America [6]. Although there are several diagnostic methods for malnutrition such as Nutritional Risk Screening 2002 and the European Society for Clinical Nutrition and Metabolism there is still no exact method or gold standard for this [7]. A hospitalized patient with malnutrition has a worse prognosis than if her nutritional status were optimal, in addition to increasing days of hospital stay also generates a higher cost during stay and subsequent recovery [8]. Zinc is the second most prevalent micronutrient in the human body and so adequate intake through the diet is needed to maintain desirable levels in the body [9]. It has important antioxidant, anti-inflammatory and antiapoptotic effects, it is a cofactor in many metabolic processes and it is essential for an adequate immune response [10, 11]. In this study, we sought to relate the perception of zinc taste in the tongue with zinc levels in hospitalized patients, taking as patients with hypozincemia to the ones that did not perceive any flavor. In 2016 Courtney A. Hill *et al*. showed that taste perception is negatively affected by overweight and obesity [12]. In our study we could observe something similar, since 67.6% of the total sample was classified in the overweight or obesity group and of this, 63.8% obtained a result of null taste to the zinc test. On the other hand, we found that patients with higher blood glucose levels are more likely to present a taste-free result. Muhammad F (2019) published an article in which he states that zinc is a trace element that acts as a cofactor for the synthesis and secretion of insulin by the pancreas [13]. The predominant effect of diabetes on zinc homeostasis is hypozincemia, which may be the result of hyperzincuria or decreased intestinal absorption of zinc or both [13, 14]. We can say that there is a relationship between liver disease and hypogeusia presented to the zinc test since in this study we found that 100% of patients with liver disease also have a taste-free result, so they were classified as patients with zinc deficiency. Supporting our results we find that Sabrina A *et al*. published an article in which liver cirrhosis is related to a

malnutrition status and ensures that one of the most frequent complications is protein-calorie malnutrition, which occurs in 40-60% of patients with cirrhosis [15].

Conclusions

The zinc tongue test can be useful for the diagnosis of hypogeusia that is related to patients who are overweight or obese, those who have poor glycemic control as well as those with liver disease. Although the zinc tongue test does not confirm a state of malnutrition, it is recommended to carry out a comparison of blood zinc in these studies with these hypogeusia patients in order to establish the diagnosis of hypozincemia and therefore malnutrition.

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