Majorensis 2017; **13**: 21-23 www.majorensis.es

Majorensis
ISSN 1697-5529

A possible case of chronic zinc intoxication: increased zinc concentration in gastric mucosa

Emilio González-Reimers[1]*, Loreto Martín-Navarro[1], Elisa Espelosín Ortega[2], Daniel Martínez-Martínez[1], Luis Galindo-Martín[3], Lucía Romero-Acevedo[1], Candelaria Martín-González[1].

[1]Servicio de Medicina Interna, Hospital Universitario de Canarias, Tenerife. Islas Canarias, España.
[2] Servicio de Laboratorio, Hospital Universitario de Canarias; Tenerife. Islas Canarias, España.
[3]Departamento de Química Analítica, Universidad de La Laguna, Tenerife. Islas Canarias, España.

*Corresponding authors: Emilio González-Reimers, egonrey@ull.es

Received: March 24, 2017; Revised: April 5, 2017; Accepted: April 07, 2017

Summary

A possible case of chronic zinc intoxication: increased zinc concentration in gastric mucosa

The aim of the present study is to provide data relative to zinc gastric mucosal content of a 77-year-old woman attended in our unit because of a severe gastritis with intestinal metaplasia in possible relation with chronic ingestion of at least 56-96 mg supplemental zinc/daily, in addition to dietary intake. The clinical picture, with a two-month history of nausea, occasional vomiting and severe abdominal cramp, was compatible with chronic zinc intoxication, an uncommon condition that poses difficulty in diagnosis, due to the lack of universally validated criteria. We measured, by atomic absorption spectrophotometry with a VARIAN SPECTRA A 220Z, GTA-110 graphite camera, zinc in a sample of gastric mucosa of this patient, yielding a value of 52.5 mg/kg (in dried sample), and in two control samples, yielding values of 5.12 and 9.95 mg/kg, i.e., 5 to 10-fold lower. By contrast serum zinc and copper levels were normal (Zn 69.0 µg/dL, Cu 77.0 µg/dL). The data relative to zinc content in gastric mucosa in this case of possible chronic intoxication adds to the very scarce data reported in the scientific literature regarding gastric mucosal zinc content.

Keywords: chronic zinc toxicity, chronic gastritis, gastric mucosal zinc content, zinc supplements; zinc.

Resumen

Un posible caso de intoxicación crónica por zinc: aumento de la concentración de zinc en la mucosa gástrica.

El objetivo del presente trabajo es aportar los datos obtenidos al analizar el contenido de zinc en mucosa gástrica en una paciente de 77 años ingresada por gastritis severa, con náusea, vómitos ocasionales y dolor abdominal de unos dos meses de evolución. la paciente consumía crónicamente, como mínimo, de 56 a 96 mg de zinc al día en forma de suplementos más el aporte dietético, por lo que el cuadro clínico era compatible con intoxicaión crónica por zinc. No existen criterios uniformemente validados para el diagnóstico de esta entidad. Por eso procedimos a determinar zinc en mucosa gástrica de la paciente y de dos controles mediante espectrofotometría de absorción atómica en cámara de grafito (VARIAN SPECTRA A 220Z, GTA-110). Obtuvimos una concentración de zinc de 52.5 mg/kg (peso seco) en la paciente y 5.12 y 9.95, respectivamente, en los dos controles. Sin embargo, las concentraciones plasmáticas eran normales (Zn 69.0 µg/dL, Cu 77.0 µg/dL). Los datos relativos al contenido de zinc en mucosa gástrica en este caso de probable intoxicación crónica por zinc se suman a los escasos datos existentes en la literatura científica relativos al contenido de zinc en mucosa estomacal.

Palabras clave: intoxicación crónica por zinc, gastritis crónica, zinc en mucosa gástrica, suplementos minerales; zinc.

Introduction

Zinc is an essential element, involved in many reactions related to nucleic acids metabolism, as well as antioxidant activity. The body of an average-70 kg weight adult individual contains 2-3 g zinc, and the daily needs are usually 2-3 mg of zinc element [11], something that can be fully achieved by the ingestion of a 10-15 mg zinc containing diet. Zinc intoxication is an uncommon situation in clinical practice. Acute exposure may be related to inhalation of compounds containing zinc vapours [2], or to accidental [8] or suicidal [4] intake of large amounts (usually, more than 300 mg) of zinc solutions, notably zinc chloride.

Majorensis
ISSN 1697-5529

In acute poisoning after oral intake, immediate burning sensation, nausea, vomiting, diarrhoea and cramping abdominal pain may be the presenting symptoms [13]. In those instances in which metal levels have been measured, very high values have been reported in blood [8,4], and also in gastric mucosa [4]. Chronic zinc intoxication may be associated to more subtle manifestations, including gastritis, abdominal pain, and sometimes pancreatitis. This constellation of symptoms has been reported in patients chronically consuming more than 4 mg/kg day, although gastritis, nausea, vomiting, abdominal cramping and even pancreatitis have been described with chronic consumption of only 50-60 mg zinc [5].

Material and methods

Summary of reported case

We recently reported the case of a 77 year old woman [7], usual consumer of herbal and/or homeopathic products, who was admitted to our unit complaining loss of weight and a several months history of abdominal cramping, sometimes, but not always, exacerbated by meals, and sometimes with mild diarrhoea. This patient consumed usually atleast between 56 and 96 mg zinc. At admission she was subjected to a throughout clinical evaluation. In addition to clinical signs of marasmus type malnutrition, main findings were the normal physical examination of the abdomen that was in contrast with the patient´s complains, and marked gas accumulation in the abdominal plain X-ray film. Endoscopy revealed signs of severe chronic gastritis with intestinal metaplasia. Inmunologic, histological and microbiological procedures ruled out Helicobacter pylori or Tropheryma whippleii infection, as well as celiac disease and Crohns´disease (by colonoscopy).

Biochemical determinations

As reported, we found normal zinc and copper plasma values (Zn 69.0 µg/dL, Cu 77.0 µg/dL), but we also determined, by atomic absorption spectrophotometry on a dry basis, zinc in gastric mucosa, both to the patient and also in two control samples (a 71 years old man and a 86 years old woman) belonging to autopsy cases dead by causes unrelated to zinc alterations. Briefly, gastric mucosal samples, weighing 0.7-7.2 mg, were rinsed in 5ml Acationox 0.1 % (Scientific Products, McGraw Park, Illinois), and allowed to dry during one night at 100º; once dried, samples were later digested in 0.5 ml HCl (Merck p.a.) and hydrogen peroxyde (Merck p.a.); solutions were quantitatively transferred to volumetric flasks and diluted to 10 ml with ultrapure water (Milli-Q OM-140 deionization system), and Zn was determined in these solutions, both by flame atomic absorption photometry, using a Varian Spectra spectrophotometer (Mulgrave, Victoria, Australia) and also by graphite camera (Varian Spectra A 220Z, GTA-110) (Mulgrave, Victoria, Australia) ; detection limit for zinc in the graphite camera are 0.00005 ng/g.

Results and discussion

We found significantly higher values (52.5 mg/kg Zn in the described patients, vs 9.95 and 5.12 in both controls).

Diagnosis of chronic zinc intoxication is a difficult task, because there are no fully validated criteria [1]. Plasma zinc or copper concentrations may be not useful for the diagnosis, since there is no correlation between plasma levels and tissue levels of this metal in this situation. Leukocyte zinc may help, although it has been also questioned [10]. Determination of zinc concentration in gastric mucosa is an uncommon procedure. There are some cases in which data are provided in acute intoxication, such as Kondo et al., [4] who found values as high as 7524 (probably, in mg/kg) in an acute lethal case, but the authors do not provide data relative to gastric mucosal zinc concentration in control cases (in contrast with control data reported for other organs). In cases of chronic gastritis, low zinc levels (around 0.50 mg/kg) are reported [6], but, following the methodology described, it seems that determinations were performed after digestion of the sample in nitric acid, not on a dry basis. Similarly, low concentrations of zinc in gastric mucosa have been reported by Sempértegui et al [12], in cases of Helicobacter pylori gastritis. Results are reported as ng /mg protein (from 35 to 400 ng/mg protein). As far as can be derived from the methodology exposed in that manuscript, methodology was similar to that used in this study, i.e, on a dry basis [12]. In an experimental model of gastric ulcer in rats, control animals showed gastric mucosa zinc values of about 14 ppm (mg/kg) [9]. Also in rats, Gawel et al report values of about 20 ppm in control animals [3].

Conclusion

Therefore, our results in controls are in the range of those reported, but as said, to our knowledge, data regarding gastric mucosal zinc concentration in cases of chronic zinc toxicity are lacking. The data provided here may help in the diagnosis of this uncommon entity, which prevalence, however, may increase in the near future, given the increasingly common over-the-counter consumption of zinc supplements and other multi-mineral compounds, based on the recommendations derived from its antioxidant properties.

Bibliography

1. Barceloux D.G. Zinc. Clinical Toxicology, 1999; 37: 279-292.

Majorensis
ISSN 1697-5529

2. Cooper RG. Zinc toxicology following particulate inhalation. Indian J Occup Environ Med. 2008;12:10-3.
3. Gaweł M, Lipkowska A, Małgorzata H , Golasik M, Piekoszewski W, Gomolka E, Schlegel-Zawadzka M, Opoka W, Nowak G, Librowski T. Chronic treatment with zinc hydroaspartate induces anti-inflammatory and anti-ulcerogenic activity in rats Pharmacol Rep 2014; 66:862-866.
4. Kondo T, Takahashi M, Watanabe S, Ebina M, Mizu D, Ariyoshi K, Asano M, Nagasaki Y, Ueno Y. An autopsy case of zinc chloride poisoning. Leg Med (Tokyo). 2016 ;21:11-4.
5. Maret W, Sandstead HH.Zinc requirement and the risk and benefits of zinc supplementation. Journal of Trace Elements in Medicine and Biology 2006; 20: 3-18.
6. Marjanović K, Dovhanj J, Kljaić K, Sakić K, Kondza G, Tadzić R, Vcev A.Role of zinc in chronic gastritis. Coll Antropol. 2010 ;34:599-603
7. Martín-Navarro L, Falcón-Roca R, Hernández-García M, Reyes-Suárez P, Jiménez-Cabrera I, Martínez-Martínez D, Martín-González C, Romero-Acevedo L, González-Reimers E. Intoxicación por zinc. Majorensis 2016; 12:36-40.
8. McKinney PE, Brent J, Kulig K. Acute zinc chloride ingestion in a child: local and systemic effects. Ann Emerg Med. 1994;23:1383-7.
9. Opoka W, Adamek D, Plonka M, Reczynski W, Bas B, Drozdowicz D, Jagielski P, Sliwowski Z, Adamski P, Brzozowski T. Importance of luminal and mucosal zinc in the mechanism of experimental gastric ulcer healing. J Physiol Pharmacol. 2010;61 :581-91
10. Salgueiro MJ, Zubillaga M, Lysionek A, Sarabia MI, Caro R, De Paoli T, Hager A, Will R, Boccio J. Zinc as an essential micronutrient: a review. Nutrition Research 2000; 20:737-755.
11. Sandstead HH. Requierements and toxicity of essential trace elements, illustrated by zinc and copper. American Journal of Clinical Nutrition; 1995; 61(suppl):621S-624S.
12. Sempértegui F, Díaz M, Mejía R, Rodríguez-Mora OG, Rentería E, Guarderas C, Estrella B, Recalde R, Hamer DH, Reeves PG. Low concentrations of zinc in gastric mucosa are associated with increased severity of Helicobacter pylori-induced inflammation. Helicobacter. 2007;12:43-8.
13. Yamataka BA, Pringle KC, Wyeth J. A case of zinc chloride ingestion. J Pediatr Surg 1998; 33: 660-662.