BRIEF REPORT

Blood glucose level after infusing an activated charcoal suspension for acute drug poisoninga

Montserrat Amigó-Tadín[1], Adriana Pané-Vila[2], Santiago Nogué-Xarau[1]

Objective. Activated charcoal in suspension contains 600 mg/mL of sucrose. We aimed to assess the impact of an activated charcoal suspension on blood glucose levels in patients with acute medication poisoning.

Methods. We identified drug patients whose blood glucose levels were measured before and after administration of activated charcoal to treat poisoning. The impact on blood glucose level was compared to changes after breakfast in a control group not receiving treatment for poisoning.

Results. Fifty-five poisoned patients were included. Eighty-two percent had higher blood glucose levels after activated charcoal administration. The mean glucose levels before and 1 hour after treatment were 98.2 mg/dL and 124.2 mg/dL, respectively (*P*<.001). The increase did not translate to adverse clinical events. Glucose levels increased in 82.6% of the 23 patients in the control group. Mean glucose levels before breakfast and 1 hour later were 117.1 mg/dL and 152.0 mg/dL (*P*<.001).

Conclusion. Activated charcoal induces an increase in blood glucose level that is statistically but not clinically significant. The increase is comparable to the increase after breakfast.

Keywords: Activated charcoal. Sucrose. Blood glucose. Poisoning. Emergency department.

Evaluación del impacto glucémico de una formulación líquida de carbón activado en pacientes con intoxicación medicamentosa aguda

Objetivo. La suspensión líquida de carbón activado (CA) contiene como excipiente 600 mg/mL de sacarosa. Se evalúa el impacto glucémico de la administración de CA en pacientes con intoxicación medicamentosa aguda (IMA).

Método. Se identificaron pacientes con IMA y determinación de la glucemia antes y después de haber recibido CA. Se compararon estos cambios de glucemia con los generados por el desayuno en un grupo control de no intoxicados.

Resultados. Se incluyeron 55 IMA. En el 82% de los casos la glucemia aumentó tras administrar CA. La media de las glucemias previas al carbón fue de 98,2 mg/dL y a la hora posterior de 124,2 mg/dL (p < 0,001). El cambio glucémico no condicionó eventos clínicos adversos. En el grupo control (n = 23) la glucemia aumentó en el 82,6% de los casos. La media de las glucemias antes del desayuno fue de 117,1 mg/dL y la posterior de 152,0 mg/dL (p < 0,001).

Conclusión. La administración de CA induce un aumento estadísticamente significativo de la glucemia, pero sin relevancia clínica y equiparable al producido por un desayuno.

Palabras clave: Carbón activado. Sacarosa. Glucemia. Intoxicación. Urgencias.

Author affiliation:
[1]Emergency Department, Hospital Clínic, Barcelona, Spain. Research Group "Emergencies: Processes and Pathologies", IDIBAPS, Barcelona, Spain.
[2]Endocrinology and Nutrition Department, Hospital Clínic, Barcelona, Spain.

Contribution of the authors:
All authors have confirmed their authorship in the document of responsibilities of the author, agreement of publication and cession of the rights to EMERGENCIAS.

Corresponding author:
Montserrat Amigó Tadín
Área de Urgencias
Hospital Clínic de Barcelona
C/ Villarroel, 170
08036 Barcelona, Spain.

E-mail:
mamigo@clinic.cat

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Introduction

Activated charcoal (AC) administered orally is the most widely applied and preferred method of decontamination for treating acute drug poisoning (ADP). AC helps to slow down the absorption of the toxin and reduce its effects on different organs and systems[1]. It is a drug with hardly any contraindications, nausea and vomiting being the most frequently observed side effects[2].

In Spain, AC is available in the form of a powder and a liquid suspension. The latter has advantages over the more traditional powder, as it avoids having to resort to a liquid for its preparation and dispensing. In addition, this liquid form allows the carbon to be suspended in only 125 mL as opposed to the 200 mL that were needed in the powdered form. Therefore, less volume means more comfort for the patient, less time to prepare and administer it and, perhaps, better palatability and digestive tolerance[3]. However, this liquid presentation means that 600 mg/mL of sucrose has been added as an excipient, which implies the intake of 75 g of this disaccharide for every 25 g of carbon[4]. Although this fact could produce hyperglycaemia with a negative clinical impact, until now this hypothesis has not been evaluated in the field of clinical toxicology. Therefore, the objective of this study was to analyze the glycemic impact of this liquid AC suspension in patients with ADP.

Method

Patients with ADP attended for 12 months in the emergency department, who were prescribed liquid AC as part of their standard treatment and with information on blood glucose before and after administration of the charcoal, were prospectively included. The blood glucose could have been determined in capillary blood by the emergency medical services, in hospital triage or in the emergency consultation/boxes. In the latter case, venous blood glucose is also accepted. Patients diagnosed with type 1 or 2 diabetes or who had been poisoned by oral antidiabetics were excluded. The dose of AC administered was always 25 g in a 125 mL suspension.

A control group of non-poisoned patients without known diabetes who had had breakfast in the emergency department was also assessed, measuring capillary blood glucose before and after breakfast. Breakfast could consist of: a) a glass of full fat milk (200 mL) with 4-5 biscuits or b) a glass of full fat milk (200 mL) with 2 pieces of toast (15 g) and a small piece of fruit. The estimated carbohydrate intake in both options was comparable (3 servings). The presence of clinical signs or symptoms, analytical data and the need to administer insulin to patients were considered as negative clinical impacts. The inclusion of cases was based on the availability of the head researcher.

Epidemiological (age, sex), clinical (level of consciousness, vital signs), toxicological (drug ingested, dose) and evolutionary (adverse effects, discharge) variables of the patients were also collected.

The statistical analyses were performed with IBM SPSS Statistics 23.0 (SPSS Inc.; Chicago, IL, USA) for Windows. Results were expressed as absolute numbers (percent) and means (standard deviation). Inter (independent samples) and intragroup comparisons (paired samples) were made using parametric tests. A value of $p < 0.05$ was considered significant. The project was approved by the Ethics and Drug Research Committee of the Hospital Clínic de Barcelona.

Results

Fifty-five patients with ADP were included, 74.5% of whom were women. Their mean age was 37.9 (17) years. Poisoning was voluntary in 96.4% of cases and produced by diverse drugs, highlighting the presence of benzodiazepines (49.1%), neuroleptics (29.1%), selective serotonin reuptake inhibitors (18.2%) and paracetamol (12.7%). Most had been intoxicated with only one type of drug (average intake of 19 pills), but 27.3% associated the consumption of alcoholic beverages. Antidotes were administered in 27% of patients, and flumazenil was the most frequently used (14.5%). The time interval of intake-CA was 2.2 (1.2) hours, and was less than 2 hours in 62% of cases. AC was administered orally to 92.7% of those poisoned with a Glasgow Coma Scale score of 14-15. Three patients (5.5%) had their airway protected so that the charcoal could be administered safely.

A total of 9.4% of the intoxicated persons vomited as an adverse reaction to the administration of AC, and one presented a bronchial aspiration. The average stay in the emergency department was 16.7 (12) hours and 78.2% of patients were discharged home, 7.3% were admitted for the organic repercussions of their intoxication and 14.5% were admitted to psychiatry for suicidal ideation. There were no deaths.

With regard to the impact on blood glucose after the administration of liquid AC, in 81.8% of cases there was an increase in blood glucose (D of 26.4%). The mean basal glycaemia was 98.2 (20) mg/dL and approximately one hour [1.29 (0.9) hour] after AC treatment was 124.2 (31) mg/dL ($p < 0.001$). The maximum recorded blood glucose was 195 mg/dL. No patients required insulin administration to correct hyperglycemia.

As for the control group, their average age was 65.6 (21) years and 73.9% were women. An increase in glycaemia was observed in 82.6% of the cases (D of 29.9%). In this group, basal glycaemia was 117.1 (42) mg/dL and at breakfast 152.0 (31) mg/dL ($p < 0.001$).

Although the pre-intake blood glucose was higher ($p < 0.05$) in the control group vs. ADP, this difference was not clinically relevant. The same situation was repeated in the post-set comparison ($p < 0.001$), but likewise lacked clinical significance.

Discussion

In our study, a significant increase in blood glucose was observed after AC administration. However, in no case did this increase imply a negative clinical impact or the need for insulin administration. Furthermore, the glycaemic change was comparable to that observed after a standard breakfast.

Liquid AC suspension has proved to be more convenient, easier and faster to prepare than its classic powder formulation, as it only requires intense agitation prior to administration, and is particularly useful in pre-hospital emergency care services as it favours immediate use, which is basic to guarantee its effectiveness[5]. With regard to improving palatability to avoid refusals to take it, although it has a sweet taste and is not as unpleasant as the powdered preparation, the patient has the sensation of drinking a sandy solution and its consistency is thick and cloying due to its excipients[6]. Therefore, it is suggested that about 20 mL of water be added to the suspension to reduce its concentration, especially if administered by nasogastric tube[7].

Sucrose is one of the excipients used in this liquid formulation, as it does not reduce the adsorptive capacity of carbon and would improve its palatability due to its sweet taste[8]. It should be noted that sucrose is poorly adsorbed by AC and therefore passes into the bloodstream as reported in this series. Paradoxically, most intoxicated patients arrive at the emergency department fasting for several hours, with low glycemia (65.4%

with glycemia < 100 mg/dL) and some having consumed alcohol.

Although in our sample the pre-intake blood glucose was higher in the control group than in the ADP group, this difference could be explained by the age divergence between groups (younger in the ADP group). This same situation was reproduced in the comparison made later: a statistically significant difference was observed between groups, but without any clinical impact or need for insulin.

Therefore, the administration of a sugary solution would not be a problem based on the usual epidemiological characteristics of the population with ADP. Moreover, although the carbohydrate content of AC is almost double of that of a standard breakfast in the ED (75 g vs 30 g), its glycemic impact would be comparable. However, in patients with diabetes or other comorbidities, as well as those affected by medication that compromise glycemic metabolism (glucocorticoids, immunosuppressants), sucrose contained in the AC should be considered because of the potential risk of hyperglycemia and ketosis. In these cases it would be advisable to control blood glucose levels after using the AC, as stated in its technical data sheet[4].

With regard to the characteristics of the ADPs included in this study, there is little epidemiological variability in relation to other studies carried out in our setting[9], except for an increase in paracetamol poisoning. It should also be noted that the maximum interval of 2 hours between ADP and administration of AC was mostly followed, since, although there are exceptions to this narrow margin of time such as the intake of slow absorption drugs, the most frequently ingested drugs in our setting are absorbed in less than 2 hours[10,11].

The use of AC involves a risk of adverse events. Nausea and vomiting are the most common[12] and may be accompanied by serious complications[13,14]. It is therefore important to respect the indications for this drug, use the appropriate dose and protect the airway if necessary[15]. In our case, the patient who bronchospired (AC output from the endotracheal tube) was due to a progressive deterioration of his level of consciousness, probably conditioned by the high dose of psychotropic medication ingested.

In conclusion, the administration of a liquid formulation of AC induces a statistically significant increase in blood glucose, but without being clinically relevant or requiring specific treatment. This statement is only valid in the usual epidemiological context of ADPs, as there is a potential risk of hyperglycemia in susceptible populations.

Conflicting interests: The authors declare no conflict of interest in relation to this article.

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Ethical responsibilities: The Study was approved by the Ethics and Drug Research Committee of Hospital Clínic. All patients gave their written consent prior to participation in the study. All the authors have confirmed the maintenance of confidentiality and respect for patients' rights in the author's responsibilities document, publication agreement and assignment of rights to EMERGENCIAS.

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