Research Article

Toxicology and Applied Pharmacology Insights

Evaluatıon of Basal Metabolıc Panels in Drug Poısonıng Who Applıed Wıth Actıvated Charcoal

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Abstract

Introduction: *Poisoning is the hindering of the bodily functions of the organism after it encounters a toxic factor. Poisoning may be the result of suicide attempts, overdose, or adverse effects. Some of these patients require gastrointestinal decontamination. The most commonly used material for this is activated charcoal. Activated charcoal may cause side-effects in the human body.*

Purpose: *This study examines the effects of active charcoal on the basic metabolic panel when used on patients for any reason.*

Material and Method: *This is a retrospective, single-center, and observational study. The subjects of the study are patients that were admitted to the emergency room between 01.01.2012 and 30.07.2017 with various cases of poisoning, and who underwent activated charcoal treatment. The ingested drugs were classified according to their active substances. The patients were evaluated with regard to their age, gender, vital findings, chronic diseases, chronic medication, whether they were referred from external centres, and whether or not they received active charcoal.*

Results: *The changes in patients' levels of pCO2, Na, Ca, BUN, creatinine and blood glucose were found to be statistically significant. However, since all the obtained values were within reference ranges, the difference was not considered to be clinically significant. No significant change was observed in blood pH, K and Mg concentrations.*

Conclusion: *This study is a first in the literature to indicate that there is no clinically significant change in the basic metabolic panels of patients who received active charcoal treatment. This study has shown that active charcoal treatment can be applied to patients with chronic diseases.*

Introduction

Poisonings can be defined as the deviation of metabolic functions from normal functions after the living organism encounters a strange factor[1]. Lately, as a result of the developments in the pharmaceutical industry, many different medications have entered the market, and the increased consumption of drugs has increased the incidences of poisonings and overdose [2]. Poisonings can develop in the form of drug consumption for suicidal purposes, accidentally overdosing on medication or undesired side-effects. Some of the patients who apply to hospitals need to resume their treatment in intensive care units [3]. Emergency services are critical in the treatment of intoxications [4]. These patients should be evaluated systematically. It should be kept in mind that symptoms and findings can show great variation among poisoning patients, and can be unprecedented [5]. For patient management, the main principle is supportive treatment. Until this stage can be reached, the priority should be to decrease toxic absorption, to apply antidote if possible, and to increase the elimination of the toxins that are already in

the gastrointestinal tract [6]. Gastrointestinal decontamination is the removal of the toxin from the gastrointestinal (GI) system to decrease absorption [7].

There are bo controlled clinical studies that indicate that routine gastrointestinal decontamination decreases mortality and morbidity [8-10]. There are many accepted approaches used as decontamination methods including gastric lavage (induced vomiting), gastric binding (most commonly using single or multiple doses of activated charcoal) or quickly disposing from the GI tract to reduce the total duration of the absorption of toxins (complete bowel irrigation or cathartics) [7]. The most commonly used decontamination method is the application of active charcoal. Active charcoal is a powder produced by the pyrolysis of superheated organic material with a high surface area, and which has porous particles and a very high absorption capacity [7]. The first examination should include the evaluation of vital signs (such as arterial tension, pulse, respiratory rate) of the patient, and the patient's consciousness, the comparative sizes of the pupillae, skin temperature and skin wetness should be checked. Together with the fingertip oxygen saturation, there could be constant cardiac monitoring. In the first examination, the patients should be evaluated using electrocardiogram [5]. The patients who have either a known drug intoxication or who have a suspicious anamnesis should at least receive urine analysis and their serum electrolytes, blood urea nitrogen (BUN), creatinine and glucose should definitely be analyzed [5]. The patients' basic metabolic panel can be used for this purpose in the primary evaluation. The basic metabolic panel (BMP) is a panel of 8 tests that provides information regarding the patient's metabolism such as renal function, blood sugar level, serum electrolytes and acid/base equilibrium [11].

Glucose - As the body requires a steady supply of glucose, the blood glucose levels should remain relatively stable.
Calcium - Required for the smooth operation of the muscular, skeletal and vascular systems. In addition, it is necessary for blood clotting and bone metabolism.
Sodium - Vital for normal body processes, şncluding nervous and muscular functions. Potassium - Vital for cellular metabolism and muscular functions.
CO2 (carbon dioxide, bicarbonate) - maintains the acid-base (pH) balance in the body.
Chloride - Maintains the body water and thus helps maintain acid-base balance.
BUN (blood urea nitrogen) - The conditions that affect the kidneys potentially affect the amount of urea in the blood.
Creatinine - Blood creatinine levels are an indicator of kidney function [11]. This study examines the effects of active charcoal on the patients with drug intoxication using the basic metabolic panel, and thus studies the effects of active charcoal on the basic metabolic panel.

Materials and Methods

Study design and setting

This is a retrospective, single-center, and observational study. The subjects of the study are patients of the Emergency Room in Ataturk University Hospital in Erzurum, Turkey.

Patients

The study was carried out between 01.01.2012 and 30.07.2017 by retrospectively reviewing the files of patients who applied to Atatürk University Hospital Emergency Room. The subjects of the study include patients who have applied to the emergency room between said dates with cases of poisoning related to various drugs, pesticides or fungi, and those who received active charcoal treatment and gastrointestinal decontamination. The patients who have made an application between said dates, but whose medical records were unavailable were left out of the study. While scanning the files, paracetamol, non-steroidal anti-inflammatory drugs, antibiotics, tricyclic antidepressants, selective serotonin reuptake inhibitors, pesticides and fungi were considered to be the main intoxication factors, and all the agents that were not mentioned above were categorized as "Other". The patients were evaluated with regard to their age, gender, vital findings, chronic diseases, chronic medication, whether they were referred from external centres, and whether or not they received active charcoal. Also, the reasons for intoxication (suicidal or accidental) were ruled out and all the patients who have received active charcoal treatment were included in the study.

The patients who have applied to the emergency room without the mentioned conditions were not included in the study.

Measurements

Using the Hospital Information Management System, the laboratory results of the patients who were planned to be included in the study were retrospectively examined, including the laboratory results from the time of admission to the hospital, at the 24th hour, at the 48th hour, and at the 72nd hour. Among the laboratory results, blood pH and magnesium (Mg) levels were analysed together with the basic metabolic panel, which includes sodium (Na), potassium (K), calcium (Ca), chloride (Cl), glucose, part,al carbon dioxide pressure (pCO2), creatinine, and blood urea nitrogen (BUN). Together with these results, the study also evaluates the vital findings (arterial tension, pulse, body temperature, respiratory rate, oxygen saturation), age, gender, the time between exposure to substance and admission to the hospital and chronic medication. The patients who match these criteria were included in the study.

Statistics

The statistical analysis of the study data was performed with the statistical software package SPSS v20.0 The data were expressed using mean and standard deviation. The suitability of the variables to the normal distribution was examined with the Kolmogorov - Smirnov and Shapiro – Wilk tests. When evaluating the change in values over time, repeated measures ANOVA was used for data which met all the criteria, and Friedman's Test (a non-parametric test) was used for data which didn't meet all the criteria. Statistical significance was accepted as $P<0.05$.

Results

The study included 483 patients whose data were accessed through files. 69.6% of the patients were women and the mean age was 27.18 ± 10.34 (min:18, max: 79). The vital signs of the patients were within normal range. The vital signs of the patients are shown in Table 1.

Table 1: The vital findings of the patients

	Minimum	Maximum	Mean	Std. Deviation
SBP* (mmHg)	76	195	124,28	16,740
DBP** (mmHg)	35	120	74,55	12,443
Heart rate (beats per minute)	43	160	85,45	16,831
Body Temperature (°C)	35,0	39,0	36,540	,4148
sO2***	82	100	95,24	2,836
Respiratory rate (per minute)	10	38	16,82	3,164

*Systolic Blood Pressure (mmHg)
**Diastolic Blood Pressure (mmHg)
*** Oxygen Saturation

Only 3.3% of the patients included in the study (n = 16) had chronic diseases, and only 0.4% of the subjects were regularly using medication (n =2).

When categorized according to the reason of activated charcoal application, it was determined that the reason was overdose of paracetamol for 15.3% (n = 74), NSAIDs for 20.5% (n = 99), antibiotics for 11.6% (n=56), TCA for 2.3% (n=11), SSRIs for 11.4% (n=55) and other medication for 65.2% (n = 315). Also, for 9 patients (1.9%) activated charcoal was applied for the consumption of toxic fungi, and for 25 patients (9.2%) for consumption of pesticides for suicidal reasons.

69,2% of the patients (n = 334) have first applied to the hospital where the study is conducted, whereas 30.8% of the patients (n = 149) have been transferred from external health centers. It was determined that 56.3% of the patients (n = 272) have applied to the emergency room one hour after the consumption of poisonous material.

Table 2: Admission of the patients to the emergency room, 24. The biochemical values ar 24 hours, 48 hours and 72 hours.

	First admission mean±SD	**24. hours** mean±SD	**48. hours** mean±SD	**72. hours** mean±SD	**P value**
ph	7,39±0,53	7,38±0,36	7,39±0,33	7,38±0,37	0,357
pCO2	36,67±6,85	38,31±5,33	38,06±4,64	39,83±5,43	0,02
Sodium	136,87±2,25	137,93±2,62	137,61±3,074	137,96±3,041	0,005
Potassium	3,87±0,46	3,95±0,42	3,87±0,32	3,91±0,34	0,37
Calcium	9,12±0,64	8,64±0,59	8,72±0,55	8,77±0,58	<0,001
Chloride	107,07±3,21	109,26±3,38	108,86±2,96	108,89±3,18	<0,001
Magnesium	1,87±0,19	1,83±0,21	1,82±0,18	1,82±0,19	0,126
BUN	11,92±4,32	9,97±4,63	9,04±3,74	9,42±3,07	<0,001
Creatinine	0,73±0,23	0,67±0,20	0,68±0,20	0,68±0,20	0,01
Blood glucose	113,30±27,96	102,39±18,91	105,37±30,83	101,65±23,53	0,007

The patients' blood pH, partial carbon dioxide pressure (pCO2), sodium (Na), potassium (K), calcium (Ca), chloride (Cl), magnesium (Mg), blood urea nitrogen (BUN), creatinine and blood sugar, admission to emergency room, 24 hours, 48 hours, 72 hours. Changes were examined in terms of per hour.

The changes in patients' levels of pCO2, Na, Ca, BUN, creatinine and blood glucose were found to be statistically significant. However, these values were found to be in the reference range, thus were not clinically significant. There were no changes in blood pH, K and Mg levels.

Discussion

Drug-induced problem is defined as an event or situation that potentially or practically prevents the patient to obtain the best results from their medical treatment [12]. This definition includes adverse drug reactions, drug interactions, improper drug selection, supra-therapeutic dosage, dissonance and drug usage without doctor's recommendation [13]. According to research conducted regarding cases of hospitalization, it is determined that 5-10% of these are caused by drug-related problems and that 50% of these cases are preventable [14]. American Academy of Clinical and The European Association of Poisons Centres and Clinical Toxicologists (EAPCCT) do not recommend that gastric decontamination to be used as a routine procedure, but that it should be preferred only for select cases [15]. Active charcoal can absorb significant amounts of toxins due to its large surface area. If the patient is intoxicated with a substance that can be absorbed by active charcoal, activated charcoal treatment can be considered for up to one hour [8]. When categorized according to the reason of activated charcoal application, it was determined that the reason was overdose of paracetamol for 15.3% (n = 74), NSAIDs for 20.5% (n = 99), antibiotics for 11.6% (n=56), TCA for 2.3% (n=11), SSRIs for 11.4% (n=55) and other medication for 65.2% (n = 315). Also, for 9 patients (1.9%) activated charcoal was applied for the consumption of toxic fungi, and for 25 patients (9.2%) for consumption of pesticides for suicidal reasons. The links between drug intoxications and the metabolic panel will be evaluated.

Glucose

Blood glucose level is a parameter that is known to increase under stressful conditions. The body raises the blood glucose level as a response to the stress that it is faced with. In this study, the blood glucose levels of the patients who received active charcoal treatment were found to be in the normal range. Our study has determined that active charcoal does affect blood glucose levels.

Sodium

It was determined that active charcoal application did not affect serum Na concentrations. In sodium level abnormalities, the main reasons are considered to be hypotension, low pH, dehydration and infections [16]. Our study has determined that active charcoal treatments do not lead to any dehydration in the body.

Calcium

Calcium in the blood is found in the form of bound or ionized fractions, or as complexes [17]. Clinical conditions, particularly in diseases that affect acid-base balance, can affect the bound and free calcium levels [17]. This study has determined that active charcoal applications do not affect serum calcium levels in patients.

Potassium

Potassium level abnormalities can be the result of excessive intake, reduced excretion or the passage of potassium ions out of the cells

to the extracellular fluid [18]. Sodium is the extracellular cation that determines the osmotic movement of water in and out of the cells. On the other hand, potassium is intracellular 99% of the time and mostly regulates the excitability of muscle and nerve cells [19]. Many drugs can cause significant changes in potassium levels [20,21]. Our study has determined that application of active charcoal has no significant effect on blood potassium levels.

Chloride

Chloride is the dominant extracellular anion. Other than the maintenance of the acid-base balance, it protects cellular integrity by regulating osmotic pressure and balance [22].

Chloride level abnormalities can be the result of many conditions including renal failure, dehydration, hyperparathyroidism and the use of certain medications [23]. Our study has determined that the application of active charcoal has no effect on blood chloride levels.

Carbon dioxide

There are many possible factors in the etiology of Blood CO2 level changes, including the use of several drugs, COLD and other diseases of the lung, central nervous and neuromuscular diseases [24,25]. The carbon dioxide level changes occur in minutes as the blood pH is being regulated. Our study has determined that active charcoal does not affect pCO2.

BUN

Blood urea nitrogen (BUN) is a part of the basic metabolic panel (BMP), which is a routine part of medical examinations. BMP is also evaluated for patients in emergency rooms because it can provide fast and critical clues for clinical cases, which may be the result of a chemical imbalance in the body [26]. This study indicates that there are no changes in blood BUN levels in the acute stage in patients who received active charcoal treatment.

Creatinine

Creatinine has a critical role in the evaluation of renal function [27]. Serum creatinine is a typical part of the basic metabolic panel [27]. This study indicates that there are no significant changes in blood BUN levels in patients who received active charcoal treatment.

This study has found that the changes in patients' levels of pCO2, Na, Ca, BUN, creatinine and blood glucose levels were statistically significant. However, these values were found to be in the reference range, thus were not clinically significant. There were no changes in blood pH, K and Mg levels.

Conclusion

Being exposed to a substance that can cause intoxication for any reason makes up an important portion of emergency service admissions. A significant percentage of these patients receive gastrointestinal decontamination treatment. Among the gastrointestinal decontamination methods, using active charcoal is a commonly preferred method. Our study is a first in the literature in that it has shown that the patients' basic metabolic panels are not affected by the application of active charcoal in a clinically significant manner. Our study has shown that active charcoal treatment can be easily applied to patients who have affected basic metabolic panels due to various chronic diseases.

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