

Comparison of Activated Charcoal and Industrial Charcoal in Prevention of GI Absorption of Diazepam

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ARTICLE INFO

Article Type:
Original Article

Article History:
Received: 7 July 2012
Revised: 30 July 2012
Accepted: 4 Aug 2012

Keywords:
Activated Charcoal
Antidote
Animal Model
Poisoning
Therapy

ABSTRACT

Background: GI decontamination is required frequently in management of intoxicated patients. Activated charcoal is used for this purpose normally. Is it possible that powdered industrial charcoal is used as a substitute? Present study was conducted to determine efficiency of industrial charcoal in prevention of absorption of diazepam, compared to activated charcoal.

Method: 30 Sprague–dawley rats were randomly divided into 3 equal groups. 20 mg/kg diazepam was given orally to all 3 groups. No GI decontamination was performed for the control group. Activated and industrial charcoal (1 g/kg dissolved in 10 ml of water) was administered for other two groups. The urinary concentration of diazepam was used for evaluation of level of the drug absorption in the animals.

Results: The mean urine concentration of diazepam was considerably lower in groups taking charcoal, compared control group. However the concentration in the group taking activated charcoal was lower than the concentration in the group taking industrial charcoal.

Conclusion: Results of present study suggest that industrial charcoal can be used as a substitute for activated charcoal, though with a little lower efficacy for absorption of drugs and toxins.

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► *Implication for health policy/practice/research/medical education:*
Activated Charcoal and Industrial Charcoal

► *Please cite this paper as:* Norouzi A, Rajabi R, Rajabalipour F, Solhi H, Alimoradian A. Comparison of Activated Charcoal and Industrial Charcoal in Prevention of GI Absorption of Diazepam. *International Journal of Medical Toxicology and Forensic Medicine*. 2012; 2(4):124-127.

1. Introduction:

Frequency of self-inflicted behaviors includes suicidal attempts and ideation is increasing. Drug poisoning is common method for suicide. Easy access and availability of drugs may is cause for this

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(1). It is reported that 9.4 per 100,000 Iranian populations have attempt suicide, mostly by means of drug ingestion. Benzodiazepines place in the top list of the drugs used for suicidal drug intoxication (2). Numerous studies performed in various cities of Iran include Shahroud, Sari, Kerman, and Babol have confirmed that benzodiazepines poisoning,

particularly with diazepam is the most common drug intoxication in Iran (1, 3-5). Diazepam is well-known member of benzodiazepines family. It is used as sedative-hypnotic, anxiolytic, anti-convulsant, and muscle relaxant. Depression, disturbance in memory, sexual and behavioral difficulties, tremor, palpitation, bradycardia, cardiovascular collapse, respiratory depression, and syncope may occur in its overdose or intoxication (6).

Decontamination is the mainstay of clinical management in poisonings. Most of poisonings take place after ingestion, so GI decontamination is required frequently in management of poisoned patients. Activated charcoal is used for this purpose routinely. It is produced through heating wood paste at 900°C, its rinsing with tap water, and making it active by strong acids. Each gram of the material embraces approximately 1000 m² surface area which can sop up numerous drugs and poisons and prevent their absorption into systemic circulation. If it was administered within 1 hour after poison ingestion, it would effectively prevent the poison absorption. Constipation is the most notable side effect of activated charcoal (7).

It is claimed that activated charcoal reduces urinary excretion of diazepam i.e. its systemic absorption up to 27% (8). Activated charcoal attracts the poison in the lumen of GI; before it is entered into systemic circulation (9).

But what we can achieve, if activated charcoal is not available or too expensive? Is it possible that powdered industrial charcoal be used as a substitute? Industrial charcoal is produced by unhurried combustion of wood and contains Carbon (87%), Hydrogen (2.1%), Oxygen (9.1%), Nitrogen (0.43%), and Sulphur (0.03%) (10).

Present study was conducted to determine efficiency of industrial charcoal in absorption of diazepam (as prototype and common drug used for suicidal poisonings) in the lumen of GI, compared to activated charcoal.

2. Materials and Methods:

30 Sprague-dawley rats with mean weight 250-300 grams were randomly divided into 3 equal groups. The animals were given 2 weeks acclimation period, during which they were fed a standard rat pellet diet and water ad libitum, with alternated 12-h dark/light cycle; and the ambient temperature, was held constant between 21 and 25°C.

All groups were given 20 mg/kg diazepam orally by gavages. No GI decontamination was performed for the control group (group A). Activated and industrial charcoal 1 g/kg dissolved in water 10 ml were administered for groups B and C respectively by oral gavages.

Urinary concentration of diazepam was used for evaluation of extent of the drug absorption in the animals. 48 hour urine sample was collected from each animal. The samples were sent to the laboratory immediately. Urinary concentration of diazepam was determined with HPLC method using UV spectrum at 254 nm, after extraction of the samples by standard methods. The measurements were performed by laboratory of Iranian Legal Medicine Organization.

The study had been approved by local ethical committee of Arak University of medical sciences.

The collected data were analyzed using SPSS statistical software version 16.0.

3. Results:

The mean urinary concentration of diazepam was 7.97 ± 6.54 ng/ml in the studied rats. Details of the measurements were demonstrated in table 1.

As it can be seen, mean urine concentration of diazepam was considerably lower in group B and C, compared to group A (control group). Though the concentration in group B (taking activated charcoal) was lower than the concentration in group C (taking industrial charcoal). One-way ANOVA test confirmed that differences between groups are statistically significant. Turkey

Table 1: concentration of diazepam in 48-hours urine samples of the studied rats.

Group	Mean± SD	Range
Group A (control)	17.28±1.07	15.20-18.60
Group B (activated charcoal)	0.28±2.13	1.7-2.6
Group C (industrial charcoal)	5.44±0.48	4.8-6.2

post HOC test showed that urine concentration of diazepam in group A differs significantly from the concentrations in group B and C. Urine concentration of diazepam in group B also differs significantly from group C (p-value less than 0.001 in all cases).

4. Discussion:

Present study confirmed that both activated and industrial charcoal can attract diazepam in the GI tract, and prevent its systemic absorption; however the former act more effectively than the later. Nevertheless if the former is not accessible, the later can be used with sensible degree of achievement.

The outer surface of charcoal is crucial for its function in absorption of drugs and toxins. Lapatto *et al* have reported that activated charcoal can decrease urine concentration of diazepam up to 37% (8). It is consistent with results of present study. There are also various articles that believe super-activated charcoal act 1.7-4 folds more efficiently compared to standard activated charcoal (9).

Activated charcoal had indisputable property for absorption of drugs and toxins and prevention of their systemic absorption. However its production is costly. It may not accessible in all emergency wards, particularly in distant areas (9, 11). Industrial charcoal can absorb drugs and toxins too. It is economical and easily primed (10). Results of present study suggested that it can be used as a substitute for activated charcoal, though with a little lower efficacy for

absorption of drugs and toxins. As the authors have searched there was no related published study with same subject in the more popular scientific databases.

In present study, we used 48 hours urine sample for assessment of systemic absorption of diazepam. Assessment of serum concentration of the drug few hours after its ingestion seems more feasible (11-12); however we could not achieve this because of technical and instruments limitations. Assessment of efficacy of higher doses of industrial charcoal and with measurement of serum concentration of the drugs or toxins is suggested in arrangement of future studies on the matter.

Acknowledgement:

Present study was performed with financial support of Arak University of Medical Sciences. The authors thank the superintendents for their contribution.

References

1. Moghadam M, Abdollahi M. Acute poisoning in Babol during 1994-1996. JBUMS. 1998;1(1):19-26.
2. Ghoreishi SA, Mousavinasab N. Systematic review of researches on suicide and suicide attempt in Iran. Iranian Journal of Psychiatry and Clinical Psychology. 2008;14:115-121.
3. Mousavi A, Khosravi A, Hasani MH, Jahani Z. The epidemiologic study of deliberate self-harm (poisoning) in Shahroud. Knowledge and health Journal. 2007;2(2):39-45.
4. Karami M, Ebrahimzadeh MA, Yousefi P, Khani K. Investigation of Drug poisoning

- effects in Boo-Ali and Nileh-Shaban Hospitals during 2000-2002. Razi journal of Medical sciences. 2005;11(42):629-636.
5. Yasemi MT, Saneie N, Malekpur Afshar R, Honarmand AR, Mirshekari R. Epidemiological evaluation of suicide in Kerman. *Andeesheh va Raftar*. 1998;3(12):15-27.
 6. Diazepam. PubChem. National Institute of Health: National Library of Medicine. 2006.
 7. Using charcoal efficiently". <http://www.fao.org/docrep/X5328E/x5328e0b.htm>. Retrieved 2010-02-01.
 8. Lapatto O, Kivisto K.T, Neavonen J. Effect of activated charcoal alone or given after gastric lavage in reducing the absorption of diazepam, ibuprofen and citalopram. 1999;48:148-153.
 9. Katona BG, Siegel EG, Cluxton RJ Jr. The new black magic: activated charcoal and new therapeutic uses. *J Emerg Med*. 1987;5(1):9-18.
 10. Barbeque – History of Barbecue". [Inventors.about.com](http://inventors.about.com). 2010-06-15.
 11. Isbister GK, Kumar VV. Indications for single-dose activated charcoal administration in acute overdose. *Curr Opin Crit Care*. 2011;17(4):351-7.
 12. Bond GR. The role of activated charcoal and gastric emptying in gastrointestinal decontamination: a state-of-the-art review. *Ann Emerg Med*. 2002;39(3):273-86.