Successful Treatment of Acute Lethal Dose of Acrylamide Poisoning

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ABSTRACT

Background: Acrylamide (C3H5NO) is a vinyl monomer. This water-soluble crystalline solid is a colorless, odorless agent which is used in scientific laboratories and some industries. Acrylamide has cellular oxidative effects. Acute or chronic poisoning with this agent happens as a result of skin, respiratory, or oral contacts. Clinical manifestations depend on the dose, duration, and frequency of contact. Management of these patients consists of conservative and palliative therapies to reduce the oxidative effects.

Case: The case was a 29-year-old girl with a Master of Sciences degree in genetics who worked in a university research center with previous history of depression. She had ingested 100cc of 30% Acrylamide solution for intentional suicide attempt. The patient was successfully managed using N-acetyl cysteine, vitamin C, and melatonin.

Conclusion: Early diagnosis and appropriate treatment with recommended agents together with supportive therapies can save the life of patients exposed to potentially lethal doses of acrylamide, although intentional or accidental.

Keywords: Acrylamide, Acute Poisoning, Lethal Dose, Treatment.

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INTRODUCTION

Acrylamide (C3H5NO) is a vinyl monomer. This water soluble crystalline solid is a colorless, odorless agent with the molecular weight of 71.08 g/mol [1-3]. It is used for production of polyacrylamide which is used in paper manufacturing and wastewater treatment and as the grouting factor for seam upping of tunnels and barriers. Acrylamide is a complementary material in hygienic and cosmetic products and in scientific and industrial laboratories. Acrylamide is also used for electrophoresis or in chromatography gels [1-4].

It is also produced during cooking of aminoacid and glucose containing foods at very high temperature [1, 3-6]. According to WHO reports, there is daily contact of people with dietary Acrylamide with doses near to 0.3-2 micg /kg [1].

In human, Acrylamide has some mutagenic and carcinogenic effects. Hence, it is classified in class 2A of carcinogenic materials as an agent that increases the probability of endometrial, pulmonary, and pancreatic cancers [4-11].

Acute and chronic poisonings with Acrylamide are reported after skin, respiratory and oral contacts in human, mammals, and other animals [3, 7, 8, 12].

Most of the chronic poisoning cases with prominent neurologic manifestations are seen among workers in the mining industry and those who work in tunnels. Acute poisoning is reported rarely with life-threatening signs and symptoms [6, 13]. This study reports a case of acute intentional poisoning with high lethal dose of Acrylamide in a young woman who was successfully managed in our ward. This case report was approved by the Local Ethics Committee of Tabriz University of Medical Sciences.

CASE REPORT

The patient was a 29-year-old girl with a Master of Sciences degree in genetics who worked in a university research center. She had a bodyweight of 60 kg and previous history of

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depression. She had ingested 100cc of 30% Acrylamide solution during Acrylamide gel processing in an intentional suicide attempt. The patient prepared the solution (29g of acrylamide and 1g of Bis-acrylamide solved in 100^{CC} water) and drank all of it. An hour later, retractable vomiting appeared but she concealed her suicide attempt. Therefore, she was treated with diagnosis of gastroenteritis. About 15 hours thereafter, delusion, hallucination, gate disorders, and speaking difficulties became apparent and she was referred to a hospital. Emergency room physician found the truth during history taking and the patient was again referred to the Toxicology Center of Sina Hospital, Tabriz, Iran. The patient had slurred speech, ataxia, vertigo, midsize pupil reactive to light, resting tremor, and reduced muscle forces. In addition to initial symptoms and signs, her deep tendon reflexes were reduced. Her vital signs were BP= 80/50mmHg, PR= 78 beat/min, RR= 18/min, and T= 36.6°C. In upper gastrointestinal tract endoscopy, mild gastro-erosive lesion was reported. Supportive therapies were started along with the standard 21-hour IV NAC protocol followed by daily N-acetyl cysteine (NAC) (150mg/kg/daily), intravenous vitamin C 500mg/day for seven days and then 500mg/daily orally, intramuscular vitamin B complex (containing thiamine HCI 100 mg, pyridoxal HCI 100 mg and cyanocobalamin 1000 mcg) daily for three days and then one tablet (containing 5mg thiamine HCI, 2 mg riboflavin, 20 mg nicotinamide, and 2 mg pyridoxal HCI) daily and also melatonin (N-acetyl-5-methoxytryptamine) 3 mg/daily (one tablet). Gradually, the patient developed rigidity and increased DTR. Following three days of therapy with dantrolen (25 mg capsules twice daily), these complications disappeared. Brain MRI was normal. Eight days after the poisoning, hearing and visual hallucinations (killing of family and flashbacks of a horrible car accident) were reported by the patient. These hallucinations also disappeared on the 12th day of hospitalization. All lab data were normal, except for a mild reduction of serum cholinesterase level. Fourteen days after hospitalization, the patient was discharged with a good general condition and there were no complications in the later follow-ups.

DISCUSSION

Liver, kidneys, pancreas, and nervous (central and peripheral) system are affected in acrylamide poisoning [14-16]. Toxicity occurs because of binding to plasma proteins, conjugation by glutathione, epoxidation to glycidamide, oxidative stress, inhibition of energy production, and protein synthesis. Direct effects on the nervous system are also reported [1-4, 6, 11, 17]. Toxicity depends on the number and duration of contacts and dosage. Probable LD_{50} is less than 500 mg/kg [2, 16].

The present case was poisoned with 500mg/kg Acrylamide (30gr). Clinical manifestations may be similar to a severe sepsis with acute nervous, cardiac, pulmonary, renal, and hepatic effects [2, 6, 11, 13, 16]. After a few hours [2], nausea, vomiting, hypotension, hallucinations, cardiovascular collapse, cough, ARDS, disorientation, tremor, dysarthria, muscle weakness, and numbness may be detected [2, 3, 12, 18, 19]. In the present case, most of these symptoms and signs were detected.

Some changes in lab data, like mild increases in Cr, BUN, ALT, AST, LDH, and ALKP levels as well as reductions in albumin, total protein, globulin, cholinesterase, Ig M, Ig G, noradrenalin, dopamine, and serotonin, were reported [4, 14, 20, 21].

In the present case, none of these changes except for mild reduction in serum cholinesterase level were seen. This may be due to early diagnosis and treatment.

In addition to conservative therapies, antioxidants, vitamin B6, vitamin C, green tea, NAC, melatonin, and some other drugs are recommended [3, 4, 11, 14, 20, 22]. NAC, vitamin C, melatonin, and vitamin B Complex were used. Eventually, the patient was discharged in a good general condition after 14 days. No other cmplications were detected in the follow-up, up to 12 months later. It seems that high dose therapy with NAC, vitamin C, melatonin, and vitamin B complex is effective in prevention and treatment of neurologic, hepatic, cardiovascular, pulmonary, and renal side effects.

CONCLUSION

Early diagnosis and appropriate treatment with recommended agents together with supportive therapies can save the life of patients

exposed to potentially lethal doses of acrylamide (intentional or accidental).

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REFERENCES

1. Besaratinia A, Pfeifer GP. A review of mechanisms of acrylamide carcinogenicity. Carcinogenesis. 2007;28(3):519-28.
2. Garland T, Patterson M. Six cases of acrylamide poisoning. BMJ. 1967;4(5572):134-8.
3. Pennisi M, Malaguarnera G, Puglisi V, Vinciguerra L, Vacante M, Malaguarnera M. Neurotoxicity of acrylamide in exposed workers. International journal of environmental research and public health. 2013;10(9):3843-54.
4. El-Kholy TA, Khalifa NA, Alghamidi A, Badereldin AM. A Trail of Using Green Tea for Competing Toxicity of Acrylamide on Liver Function. Journal of American Science 2011; 7 (12): 815-21.
5. Wilson KM, Mucci LA, Rosner BA, Willett WC. A prospective study of dietary acrylamide intake and the risk of breast, endometrial, and ovarian cancers. Cancer Epidemiology Biomarkers & Prevention. 2010;19(10): 2503-15.
6. LoPachin RM, Gavin T. Molecular mechanism of acrylamide neurotoxicity: lessons learned from organic chemistry. Environmental health perspectives. 2012;120(2):1650-7.
7. Busk L. Acrylamide–A case study on risk analysis. Food Control. 2010;21(12):1677-82.
8. Rudén C. Acrylamide and cancer risk-expert risk assessments and the public debate. Food and Chemical Toxicology. 2004;42(3):335-49.
9. Pelucchi C, Galeone C, Talamini R, Negri E, Polesel J, Serraino D, et al. Dietary acrylamide and pancreatic cancer risk in an Italian case–control study. Annals of oncology. 2011;22(8): 1910-15.
10. Rice JM. The carcinogenicity of acrylamide. Mutation Research/Genetic Toxicology and Environmental Mutagenesis. 2005;580(1):3-20.
11. Friedmann M. Chemistry, biochemistry, and safety of acrylamide. J Agric Food Chem. 2003;51:4504-26.
12. Paulsson B, Larsen K-O, Törnqvist M. Hemoglobin adducts in the assessment of potential occupational exposure to acrylamides—three case studies. Scandinavian journal of work, environment & health. 2006:154-9.
13. Mehrhof F, Joerres A, Dietz R, Oppert M. A message in a bottle: a case report. Critical Care. 2008;12(1):411-2.
14. Soliman GZ. Protective effect of Solanum nigrum, vitamin C or melatonin on the toxic effect of acrylamide on rats. J Pharm Biol Sci. 2013;5:47-54.
15. Stellwagen NC. Electrophoresis of DNA in agarose gels, polyacrylamide gels and in free solution. Electrophoresis. 2009;30(S1):S188-S95.
16. Cotruvo J. Acrylamide in Drinking-water. WHO Press: Geneva, 2011.
17. Fennell TR, Sumner SC, Snyder RW, Burgess J, Spicer R, Bridson WE, et al. Metabolism and hemoglobin adduct formation of acrylamide in humans. Toxicological Sciences. 2005;85(1):447-59.
18. Kjuus H, Goffeng LO, Heier MS, Øvrebø S, Skaug V, Ryberg D, et al. Examination of nervous system effects and other health effects in tunnel workers exposed to acrylamide and N-methylolacrylamide in Romeriksporten, Norway. 2002.
19. Hagmar L, Törnqvist M, Nordander C, Rosén I, Bruze M, Kautiainen A, et al. Health effects of occupational exposure to acrylamide using hemoglobin adducts as biomarkers of internal dose. Scandinavian journal of work, environment & health. 2001:219-26.
20. AlturfanL EI, Beceren A, Şehirli AÖ, Demiralp ZE, Şener G, Omurtag GZ. Protective effect of N-acetyl-L-cysteine against acrylamide-induced oxidative stress in rats. Turkish Journal of Veterinary and Animal Sciences. 2012;36(4):438-45.
21. Tilson H. The neurotoxicity of acrylamide: an overview. Neurobehavioral toxicology and teratology. 1980;3(4):445-61.
22. EL-Tantawi HGM. The protective role of ginger (zingiber officinale) against acrylamide induced nedrotoxicity in mice. The egyptian journal of histology 2007; 30(2): 325-36.