Survey on Hypothermia and Hyperthermia in Poisoned Patients in a Unique Referral Hospital, Tehran, Iran

Naser Mozafari,1 Haleh Talaie,2,3 Simin Dokht Shoaei,3 Morteza Hashemian,4 and Arezou Mahdavinejad2

1Plastic Surgery Department, 15 Khordad Hospital, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran
2Toxicological Research Center, Department of Clinical Toxicology, Loghman Hakim Hospital, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran
3Clinical Research and Development Center, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran
4Corresponding author: Haleh Talaie, Toxicological Research Center, Department of Clinical Toxicology, Loghman-Hakim Hospital, Shahid Beheshti University of Medical Sciences, Tehran, IR Iran. Tel: +98-9122394067, Fax: +98-2155418175, E-mail: talaeih@yahoo.com

Received 2015 December 16; Revised 2016 January 13; Accepted 2016 February 29.

1. Background

The hypothalamus is responsible for body temperature, which is a critical criterion of health. Average temperature in humans varies due to a variety of factors, including the patient’s condition and medical diagnosis and treatment. There is no consensus on the normal range of temperature. Normal values range from 37.5 to 38.3°C (99.5 to 100.9°F) (1, 2). However, some studies report 36.8°C (98.2°F) as the mean body temperature (oral) in healthy individuals, with a spectrum of 35.6°C (96°F) to 38.2°C (100.8°F) and trivial daily variation (3). However, the mean normal body temperature is defined 36.8°C ± 0.4 in a textbook of internal medicine (4).

The definition of a fever is, therefore, controversial. A body temperature above 37.2°C in the morning or above 37.7°C in the evening indicating that the hypothalamus has increased the core body temperature set point, or its threshold is defined as a fever (4). Fever commonly occurs in approximately one-half of the patients admitted to intensive care units. It may be attributed to either infectious or noninfectious causes such as adrenal insufficiency and drug fever. The development of a fever increases the risk of...
death in critically ill adults (4, 5).

Hyperthermia is defined as an uncontrolled rise of core body temperature above 37°C, at which temperature the human body is unable to lose heat (4). Exposure to warm or humid environments and some medications can cause hyperthermia or fever (5).

Millions of people suffer from poisoning by various illicit substances or medications annually. Mortality due to complications from poisoning has increased dramatically in recent years. In the United States, mortality rates from unintentional poisoning almost tripled from 1990 to 2002 (6).

Drugs and the type of poison and its toxicity can affect body temperature in poisoned patients. Some potential poisons, such as ethanol, phenothiazines, barbiturates, antidepressants and organophosphate, induce hypothermia, and some, such as amphetamines, methamphetamine, MDMA (“ecstasy”), cocaine, salicylates, lithium, anticholinergics and monoamine oxidase inhibitors, induce hyperthermia (4, 7, 8).

Other studies have reported different findings from ours. In our previous study, the body temperatures of patients poisoned with organophosphate (OP) were significantly different from those reported in most other studies. However, we did not detect any hypothermia in poisoned patients (7, 9, 10).

2. Objectives

The findings of our previous study led us to the goal of this study: obtaining the initial tympanic temperature in a number of poisoned patients.

3. Materials and Methods

3.1. Study Design and Population

All poisoned patients who were admitted directly from the toxicological emergency room to the toxicological intensive care unit in Loghman Hakim hospital poison center (LHHPC) from February 2014 to February 2015 were included in this cross-sectional descriptive study. We used census sampling in this survey. All patients (n = 11) with underlying diseases, immune deficiency, or a history of infectious diseases or antibiotic use were excluded.

The hospital is a unique care teaching and referral poison treatment center in Tehran that treats, on average, nearly 20,000 patients annually. This study was approved by the ethics committee of Shahid Beheshti University of Medical Sciences (research project No.: 167.24.12.1393).

Data were retrospectively collected from patient records by a trained nurse, who filled out questionnaires with information including patient gender, age, type of poisoning, the season, presence of seizures, respiratory rate, pulse rate, blood pressure, initial tympanic temperature (first four hours), leukocyte count (cells/mL), amount of creatinine phosphokinase (CPK), length of stay and patient outcome.

3.2. Definitions

We used tympanic thermometers to measure patient temperature. The thermometers were calibrated repeatedly to assure validity. In this study, a tympanic temperature (TT) between 35.4 and 37.8°C was considered normal (11).

A TT above 37.8°C was considered a fever (12, 13).

Rhabdomyolysis was diagnosed when CPK was measured at more than five times the normal amount (≥ 975 IU/L) (14).

3.3. Statistical Analysis

A descriptive statistical analysis was performed using the mean (SD) for continuous variables and the absolute and relative frequency (in percentages) for categorical variables. The median and interquartile range was reported for non-normal variables. The statistical analysis was performed using SPSS version 16 (SPSS Inc., Chicago, IL, USA).

4. Results

Three hundred and ten patients were enrolled in this retrospective study. The patients’ eligibility for the study was determined from a review of their medical records. The mean age of the patients was 32.65 (SD ± 14.40). Of these, 183 (59%) were male and 127 (41%) were female.

Table 1 shows the baseline characteristics of the patients. Intentional poisoning in a suicide attempt was recorded in 253 (81.6%) patients, and 57 (18.4%) were cases of accidental toxicity. Aluminum phosphate (ALP) (58 patients), opium (31 patients) and methadone (31 patients) were the types of poisons most frequently found in patients in this study (Table 2). Overall, the mean TT was 37.71°C (SD ± 0.62), with a range of 36 - 41.3°C. Seventy percent of the patients (n = 217) were classified as having a fever or hyperthermia. Surprisingly, hypothermia was not reported in this study, although the study included cases of alcohol and phenobarbital poisoning. A temperature ≥ 40°C was detected in just three cases of patients with amphetamine (n = 2) or phenobarbital (n = 1) poisoning. The maximum mean temperature was 38.2°C in cases of amphetamine poisoning, 38.1°C in cases of organophosphate poisoning and 38°C in cases of tramadol poisoning (Table 2).
Table 1. Baseline Characteristics of the Poisoned Patients (n = 310)

| Variables                   | Valuesa |
|-----------------------------|---------|
| Age                         | 32.65 ± 14.40 |
| Min-Max                     | 4 - 78 |
| Sex                         | Male 183 (59) Female 127 (41) |
| Cause of poisoning          | Suicide 253 (81.6) Accidental 57 (18.4) |
| Season                      | Spring 89 (35.2) Summer 104 (44.8) Autumn 27 (10.7) Winter 66 (23.3) |
| Intubation                  | Yes 262 (84.5) No 48 (15.5) |
| Seizure                     | Yes 23 (7.4) No 287 (92.6) |
| Hypertension                | Yes 47 (15.2) No 263 (84.8) |
| Pulse Rate                  | Yes 95.42 ± 23.31 Min-Max 39 - 178 |
| Respiratory Rate            | No 8844 ± 384 Min-Max 12 - 26 |
| Creatinine                  | Yes 1.29 ± 0.9 Min-Max 0.5 - 14.9 |
| Creatinine phosphokinaseb   | No 150 ± 340 Min-Max 20 - 1278 |
| White blood cellsb          | Yes 10400 ± 6700 Min-Max 7010 - 36,600 |
| Hemoglobin                  | No 13.72 ± 1.96 Min-Max 7.1 - 18.9 |
| Creatinine phosphokinase    | Yes 469 (97.3) CPK < 975 19 (62.4) CPK ≥ 10,000 2 (0.6) |
| White blood cells           | No 4 (1.3) WBC ≤ 4000 4 (1.3) WBC > 10,000 127 (41) |
| Hemoglobin                  | Yes 50 (16.1) Cure 260 (83.9) |

a Values are expressed as No. (%) or mean ± SD. 
b Median (Interquartile range).

The two amphetamine poisoning cases had a leukocyte count of 8,800 and 17,000; the respective CPK measurements of those cases were 3675 and 150. The leukocyte count of the phenobarbital case was 15200, and the CPK count was 4340 (Table 3). A CPK greater than 975 IU/L was recorded in 13.2% (n = 41) of cases (Table 3). A CPK over
10,000 was reported in just two patients: those poisoned by methadone and phenytoin.

5. Discussion

Since there have been a variety of findings in the literature on the relationship between body temperature and poisoning, we decided to investigate this issue in great detail. It seems that ours is the first study investigating body temperature in cases of poisoning by different kinds of poisoning.

According to the worldwide database, ethanol, phenothiazines, barbiturate and antidepressants are considered to be toxicological risk factors for hypothermia (4). Hypothermia has been identified as an early symptom of phenobarbital and methanol or ethanol poisoning, but this finding was not supported by the present study. Most of the patients in our study presented with hyperthermia rather than hypothermia. Rhabdomyolysis may be a cause of fever in cases of phenobarbital poisoning. Also, in this study, hypothermia was not diagnosed in every type of poisoning. As mentioned previously, the patient poisoned with organophosphate did not experience hypothermia (15). A study by Moffatt et al. reported early hypothermia (body temperature < 35°C) in half of the patients poisoned by OP and vice versa (16). It seems that the lack of hypothermia in this study is due to atropinization prior to hospitalization and to the tropical climate in which the study was carried out (15).

Both hyperthermia and fever cause an increase in core body temperature; however, their underlying mechanisms and treatments are different (4, 15). Excessive use of drugs and natural compounds that affect the thermoregulatory system may induce or contribute to hyperthermia. Hyperthermia associated with drug overdose is dangerous and potentially lethal.

It is notable that more than two-thirds of the patients in this study were diagnosed and classified with a fever or hyperthermia, but body temperatures above 40°C were reported just in 3 (1%) cases. Patients poisoned with amphetamine, organophosphates and tramadol had the highest mean body temperature. Of these toxins, only amphetamine could reasonably be assumed to cause drug-induced hyperthermia, although the other toxins also demonstrated a tendency to increase body temperature (4, 8). Our observations strongly emphasized the difference in body temperature changes between Iranian patients and those from other countries (4, 15).

The location of the patients in the hospital, the room’s temperature, specialized mattresses, hot lights, air conditioning and dialysis may have also influenced patient body temperatures (15, 17). Most of the poisoning cases in this study occurred in spring and summer. Furthermore, the cases in the study occurred in tropical regions: south Asia, the middle east and Africa (16). Ambient temperatures could explain the high body temperatures in our hospitalized patients.

On the other hand, in the current study, 57.7% of the pa-

| Type of Toxicity     | Number | Mean ± SD | Max  | Min  |
|----------------------|--------|-----------|------|------|
| Total                | 310    | 37.71 ± 0.62 | 41.3 | 36   |
| Aluminum phosphate   | 58     | 37.45 ± 0.42 | 38.1 | 36.7 |
| Co                   | 5      | 37.76 ± 0.56 | 38.7 | 37.2 |
| Phenytoin            | 10     | 37.94 ± 0.75 | 39.2 | 36.7 |
| Methadon             | 31     | 37.71 ± 0.49 | 39  | 36.7 |
| Organophosphate      | 18     | 38.06 ± 0.53 | 39.2 | 37.2 |
| Carbamazepin         | 15     | 37.84 ± 0.71 | 39.3 | 36.7 |
| Tricyclic antidepressants | 13   | 37.87 ± 0.54 | 38.7 | 36.9 |
| Phenobarbital        | 16     | 37.81 ± 0.71 | 40  | 36.7 |
| Benzodiazepine       | 30     | 37.49 ± 0.49 | 38.7 | 36   |
| Opium                | 31     | 37.54 ± 0.48 | 39.2 | 36.7 |
| Amphetamine          | 20     | 38.25 ± 1.15 | 41.3 | 36.7 |
| Acetaminophen        | 28     | 37.67 ± 0.47 | 38.7 | 36.7 |
| Methanol             | 17     | 37.55 ± 0.58 | 38.5 | 36.7 |
| Tramadol             | 18     | 38.03 ± 0.64 | 39.2 | 36.7 |
| Type of Toxicity/LAB Findings | ALP | Phenytoin | Organophosphate (n = 18) | Tricyclic antidepressants (n = 83) | Methanol (n = 17) | Amphetamine (n = 20)$^a$ | Tramadol (n = 18) |
|-----------------------------|-----|-----------|-------------------------|---------------------------------|-----------------|----------------------|-----------------|
|                             | CPK $< 975$ | $< 975$ | $< 975$ | $< 975$ | $< 975$ | $< 975$ | $< 975$ |
|                             | 35.4 | 2.19 (20) | 2.19 (20) | 3 (39.7) | 3 (39.7) | 3 (39.7) | 3 (39.7) |
|                             | $975 \leq$ | $975 \leq$ | $975 \leq$ | $975 \leq$ | $975 \leq$ | $975 \leq$ | $975 \leq$ |
|                             | CPK $< 10,000$ | CPK $< 10,000$ | CPK $< 10,000$ | CPK $< 10,000$ | CPK $< 10,000$ | CPK $< 10,000$ | CPK $< 10,000$ |
|                             | 34 (58.6) | 34 (58.6) | 34 (58.6) | 34 (58.6) | 34 (58.6) | 34 (58.6) | 34 (58.6) |
|                             | WBC $\leq$ | WBC $\leq$ | WBC $\leq$ | WBC $\leq$ | WBC $\leq$ | WBC $\leq$ | WBC $\leq$ |
|                             | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 | 4000 |
|                             | $4000 <$ WBC $> 10,000$ | $4000 <$ WBC $> 10,000$ | $4000 <$ WBC $> 10,000$ | $4000 <$ WBC $> 10,000$ | $4000 <$ WBC $> 10,000$ | $4000 <$ WBC $> 10,000$ | $4000 <$ WBC $> 10,000$ |
|                             | 8 (15.5) | 1 (10) | 1 (10) | 1 (10) | 1 (10) | 1 (10) | 1 (10) |
|                             | WBC $\geq$ | WBC $\geq$ | WBC $\geq$ | WBC $\geq$ | WBC $\geq$ | WBC $\geq$ | WBC $\geq$ |
|                             | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 | 10,000 |
|                             | 14 (24.1) | 3 (30) | 3 (30) | 3 (30) | 3 (30) | 3 (30) | 3 (30) |
|                             |                  |                  |                  |                  |                  |                  |                  |
|                             |                  |                  |                  |                  |                  |                  |                  |
|                             |                  |                  |                  |                  |                  |                  |                  |
|                             |                  |                  |                  |                  |                  |                  |                  |
|                             |                  |                  |                  |                  |                  |                  |                  |
|                             |                  |                  |                  |                  |                  |                  |                  |
|                             |                  |                  |                  |                  |                  |                  |                  |

$^a$Values are expressed as No. (%).
$^b$There was not any hypothermia.
$^c$There were three reports of temperature $> 40°C$ in the patients poisoned with amphetamine (n = 2) or phenobarbital (n = 1), which are not shown in this table.

Patients had a leukocyte count over 10000 when admitted, and 72.6% of them were febrile. Fever in these patients may be explained by infection, but mild leukocytosis is a normal symptom in poisoned patients. More than 50% of the patients poisoned with opioid or methadone had leukocytosis. In poisoned addicts, fever and hyperthermia may be caused by infection or by impurities in the substance or drug (18, 19).
In this study, 13.2% of cases met the criteria for rhabdomyolysis (CPK more than five times the normal amount, that is, ≥ 975 IU/L) on the day of their admission to the hospital. In our previous study, 79% of patients suspected to have rhabdomyolysis had a CPK count of more than 975 IU/L, and 65% of them had a fever. In the present study, a fever was reported in 73.2% of patients with rhabdomyolysis and 70.6% of patients without it (20). Therefore, rhab-
DOMYOLYSIS should be considered as a possible cause of fever in these patients. In the current study, around 50% of poisoned patients with rhabdomyolysis had been poisoned with opioid or methadone. This finding is compatible with our previous study, in which we found that the most common cause (23.3%) of rhabdomyolysis was opium. We measured CPK in the first four hours after admission, so the lower finding in this study is not surprising, since in poisoning cases, an increase in CPK occurs in the first 24 hours after exposure to the toxin. This is a limitation of this study.

Of the poisons examined in this study, aluminum phosphate was the most common cause of mortality, and most of the patients who died had a low-grade fever or a normal temperature. This indicates that mortality in patients poisoned with ALP was not related to their high body temperature and that the ALP poisoning was the main cause of mortality. The high prevalence of ALP toxicity in this study is notable. In our previous studies, pesticide toxicity, such as ALP, was reported in just 6.66% of the patients. However, pesticide poisoning was the most common cause of death (24.84%) from 2006 to 2011. In this study, ALP mortality was 8.7%, and more than half of the patients with ALP poisoning died (6, 21).

About 59% of the subjects in this study were male. In other studies, such as those done in Turkey and western Iran, the majority of poisoned patients (71.3% to 59.2%) were female (22, 23). Since poisoning occurs more often in young populations, the mean patient age in our study of 32.65 ± 14.40 is completely predictable. This figure is supported by a study by Zohre E et al. which mentioned that the majority of poisoning victims were younger (22).

Hyperthermia may induce life-threatening complications and is one contributing factor to the development of more severe clinical symptoms mentioned in some literature (24, 25). This study also shows that CNS stimulants, such as amphetamines, can lead to fever, hyperthermia and life-threatening complications.

This study was the first to measure and compare the temperatures of patients poisoned by a variety of toxins, so it provides groundwork for future similar comparative studies. One weakness of the study is that we measured CPK in the first four hours, but CPK increases in poisoning cases over the first 24 hours. Therefore, this study may not accurately or adequately compare CPK levels; however, since CPK rises in poisoned patients, this could also be a strength of the study.

In human poisoning cases, changes in body temperature should be approached with special attention and care. We did not find any controversy over hyperthermia in the literature. We did find some patterns of fever and hyperthermia in different types of poisoning. If there are no limits to diagnose fever and hyperthermia, increased body temperature in any case with a poor prognosis that does not respond to treatment could be dismissed as drug-induced hyperthermia. Therefore, a different approach is needed for poisoned patients.

Acknowledgments

We are grateful to Dr. Gachkar, Dr. Akbarpour (epidemiologist) and Mrs. Barari (head nurse of TICU).

Footnotes

Authors’ Contribution: Haleh Talaie and Simin Dokht Shoaai had the idea and revised the manuscript for intellectual content and collected data, Morteza Hashemian analyzed the data, Arezou Mahdvinejad prepared the bibliography and drafted the article, and Nasir Mozafari completed, edited and revised the article. All authors read and approved the final manuscript.

Funding/Support: This research was supported by a grant from the toxicological research center, Loghman-Hakim hospital, Shahid Beheshti University of Medical Sciences.

References

1. Laupland KB. Fever in the critically ill medical patient. Crit Care Med. 2009;37(Suppl):S273-8. doi: 10.1097/CCM.0b013e3181a6017. [PubMed: 19535958].
2. Axelrod YK, Diringer MN. Temperature management in acute neurologic disorders. Neurol Clin. 2008;26(2):585-603. doi: 10.1016/j.ncl.2008.02.005. [PubMed: 18514428].
3. Mackowiak PA, Wasserman SS, Levine MM. A critical appraisal of the normal body temperature, and other legacies of Carl Reinhold August Wunderlich. JAMA. 1992;268(12):1578-80. [PubMed: 1302471].
4. Dinarello CA, Porat R. Alteration in body temperature. In: Harrison’s principles of internal medicine. Longo DL, editor. McGraw Hill; 2012. pp. 443-423. Alteration in body temperature.
5. Musselman ME, Saely S. Diagnosis and treatment of drug-induced hyperthermia. Am J Health System Pharm. 2012;70(1):34-42. doi: 10.2146/ajhp110543.
6. Hashemian M, Kamalbeik S, Haji Seyed Razi P, Barari B, Salimi A, Talaie H, et al. VAP or poisoning; which one has more effect on patients' outcomes in toxicological ICU?. Acta Biomed. 2015;86(1):58-63. doi: 10.1016/j.actbio.2014.09.005. [PubMed: 25948030].
7. Gordon CJ. Thermoregulation in laboratory mammals and humans exposed to anticholinesterase agents. Neurotoxicol Teratol. 1994;16(5):427-51. [PubMed: 7845226].
8. Eyer F, Zilker T. Bench-to-bedside review: mechanisms and management of hyperthermia due to toxicity. Crit Care. 2007;11(6):236. doi: 10.1186/cc6177. [PubMed: 18096088].
9. Gordon CJ, Grantham TA, Yang Y. Hyperthermia and delayed fever in the male and female rat exposed to chlorpyrifos. Toxicology. 1997;118(2-3):149-58. [PubMed: 9129669].
10. Gordon CJ, Fogelson L, Richards J, Highfill J. Relationship between cholinesterase inhibition and thermoregulation following exposure to diisopropyl fluorophosphate in the rat. *Toxicol Lett.* 1991;59(1-3):161-8. [PubMed: 17550222].

11. Sund-Levander M, Forsberg C, Wahren I.K. Normal oral, rectal, tympanic and axillary body temperature in adult men and women: a systematic literature review. *Scand J Caring Sci.* 2002;16(2):222-8. [PubMed: 12006664].

12. Kouchek M, Aghari R, Mahdvinejad A, Salimi A, Barari B, Seyedi P, et al. Comparative Study between Teicoplanin and Vancomycin in Methicillin-Resistant Staphylococcus Aureus (MRSA) Infections of Toxicological Intensive Care Unit (TICU) Patients-Tehran Iran. *Life Sci J.* 2014;11(3s):83–90.

13. Salimi A, Talaei H, Hemami MR, Mahdvinejad A, Barari B, Razi P, et al. Suggested Teicoplanin as an anti-methicillin resistant staphylococcus aureus agent in infections of severely poisoned intensive care unit patients. *Acta Bio Medica Atenei Parmensis.* 2014;84(3):389-95.

14. Talaei H, Emami-Hadi M, Panahandeh R, Hassanian-Moghaddam H, Abdollahi M. On the mechanisms underlying poisoning-induced rhabdomyolysis and acute renal failure. *Toxicol Mech Methods.* 2008;18(7):585-8. doi: 10.1080/15376510802232167. [PubMed: 20020858].

15. Talaei H, Owliaey H, Pajoumand A, Gholaminejad M, Mehrpour O. Temperature changes among organophosphate poisoned patients, Tehran- Iran. Daru. 2012;20(1):52. doi: 10.1866/2008-2238-20-52. [PubMed: 23351847].

16. Moffatt A, Mohammed F, Eddleston M, Azher S, Eyer P, Buckley NA. Hypothermia and Fever after organophosphorus poisoning in humans—a prospective case series. *J Med Toxicol.* 2010;6(4):379-85. doi: 10.1007/s13188-010-0021-y. [PubMed: 20300985].

17. Arulrhaj S, Karunakaran K, Kannan A, Prakash SA. Fever In ICU. Medicine. 2011:407.

18. Eisenstein TK, Rahim RT, Feng P, Thingalaya NK, Meissler JJ. Effects of opioid tolerance and withdrawal on the immune system. *J Neuroimmun Pharmacol.* 2006;1(3):237-49. doi: 10.1007/s11481-006-9019-1. [PubMed: 18040801].

19. El-Sharif A, Ashour HM. Community-acquired methicillin-resistant Staphylococcus aureus (CA-MRSA) colonization and infection in intravenous and inhalational opiate drug abusers. *Exp Biol Med (Maywood).* 2008;233(7):874–80. doi: 10.3181/0711-RM-294. [PubMed: 18445771].

20. Talaei H, Pajouhmand A, Abdollahi M, Panahandeh R, Emami H, Hajinasrolah S, et al. Rhabdomyolysis among acute human poisoning cases. *Hum Exp Toxicol.* 2007;26(7):557-61. doi: 10.1177/0960327107078667. [PubMed: 17884958].

21. Hassanian-Moghaddam H, Zamani N, Rahimi M, Shadnia S, Pajoumand A, Sarjami S. Acute adult and adolescent poisoning in Tehran, Iran; the epidemiologic trend between 2006 and 2011. *Arch Iran Med.* 2014;17(8):534.

22. Zohre E, Ayrik C, Bozkurt S, Kose A, Narci H, Cevik I, et al. Retrospective analysis of poisoning cases admitted to the emergency medicine. *Arch Iran Med.* 2015;18(2):117-22. [PubMed: 25644881].

23. Najafi F, Beiki O, Ahmadijouybari T, Amini S, Moradinazar M, Hatemi M, et al. An assessment of suicide attempts by self-poisoning in the west of Iran. *J Forensic Leg Med.* 2014;27:1–5. [PubMed: 25287790].

24. Curry SC, Chang D, Connor D. Drug- and toxin-induced rhabdomyolysis. *Ann Emerg Med.* 1989;18(10):1068-84. [PubMed: 2679245].

25. Vanholder R, Sever MS, Erek E, Lamere N. Rhabdomyolysis. *J Am Soc Nephrol.* 2000;11(8):1553-61. [PubMed: 10906771].