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Does Money Spent on Measuring Blood Levels of Acetaminophen Reduce the Cost of Treatment of Acetaminophen Poisoning?

ORIGINAL INVESTIGATION

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ABSTRACT

Objective: Acetaminophen has been used as a safe analgesic and antipyretic. Acute ingestion of 10 g or more than 200 mg/kg as a single ingestion is accepted as toxic for adults. To show that money spent on measuring blood levels of acetaminophen reduces the cost of treatment of acetaminophen poisoning.

Materials and Methods: The files of patients who were admitted to Kayseri Training and Research Hospital with pre-diagnosis of acetaminophen intoxication were examined over 6 months. One of the costs is based on the patients' own estimation of the toxic level of acetaminophen and the other is according to the measure of the toxic blood level of acetaminophen. The cost of the two groups was compared.

Results: A total of 558 patients were diagnosed to have drug overdose during 6 months. Of these patients, 55 patients were evaluated as having acetaminophen overdose. According to the claims of 19 patients, acetaminophen level was calculated as toxic. However, only five patients' blood acetaminophen level was measured as toxic.

Conclusion: Measuring blood acetaminophen level would be more accurate and advantageous in terms of both treatment planning and the cost of therapy in developing countries as in developed countries that have advanced healthcare system.

Keywords: Acetaminophen intoxication, N-Acetylcysteine therapy, cost efficiency, emergency department

INTRODUCTION

Acetaminophen is a safe and effective analgesic as well as an antipyretic (1, 2). It has been used commonly since the 1950 (3-5). Acetaminophen-containing medicines were distributed at more than 28 billion doses in 2005 (2). Although acetaminophen has an excellent safety profile when administered in adequate therapeutic doses, it is one of the most common agent for drug overdose that is reported to poison center (1, 2, 5-9). Its serious toxic effects can cause fulminant hepatitis as well as death (1-4). In 2009, 170 deaths depending on acetaminophen alone and 240 deaths depending on the combination of acetaminophen have been reported in the United States; acetaminophen poisoning occupied the fourth position as the cause of death owing to drug intoxication (10). Acetaminophen is rapidly absorbed after oral administration and reached the peak serum concentrations in 90 min. Presence of food in the stomach delays the absorption of the acetaminophen slightly. The half-life of acetaminophen is up to 2–2.5 h. There recommended daily maximum therapeutic dose for adults is 4 g. In acute single dose intake, 10 g or more than 200 mg/kg ingestion of acetaminophen is considered to be toxic for adults. The findings in the early period after the excessive intake of acetaminophen are nonspecific. Rumack–Matthew nomogram is an important tool to assess the risk of hepatotoxicity in the acute intake of acetaminophen (1). According to the Rumack–Matthew nomogram (11), N-acetylcysteine (NAC) treatment is recommended if the blood acetaminophen level is above the baseline (4-h post ingestion level of 150 µg/mL) (1, 12). NAC is an effective antidote for acetaminophen poisoning (1). Intravenous (IV) NAC therapy has been approved by the Food and Drug Association (FDA) and has been used since 2004 (13). According to this nomogram, the treatment with NAC was suggested within 8 h above the treatment line (post ingestion level of 150 µg/mL). NAC can be used either orally or intravenously (1). NAC has been the most commonly used antidote in 2012 (14). IV NAC treatment of 20 h is widely used worldwide (1). Knowing the time of ingestion and the amount of acetaminophen is important to start NAC treatment if needed (2). There are so many studies comparing IV therapy with oral therapy in terms of cost, effectiveness, or side-effects (7, 15-22).

Measuring blood acetaminophen level and NAC treatment are ideal in case of acetaminophen intoxication. There are no studies that compare between the two costs where one is based on the patients' own estimation of the toxic level of acetaminophen and the other is according to the measure of toxic blood level of acetaminophen. But in many developing countries, such as Turkey, blood levels of acetaminophen cannot be measured. The treatment (NAC) was made according to acetaminophen level that is calculated according to the declaration of patients.

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Blood levels of acetaminophen cannot be measured at the Kayseri Training and Research Hospital up to 9 months. In case of suspected acetaminophen intoxication, NAC treatment was scheduled in patients who ingest acute intake level estimated at 200 mg/kg according to their declaration. Because the measurement of blood acetaminophen level was started at our hospital, NAC is started to be administered in patients whose blood acetaminophen level was above the treatment line based on the nomogram. Patients with acetaminophen intoxication are hospitalized in intensive care unit and a 20-h IV NAC treatment is applied. We have seen a reduction in the number of patients treated with NAC because blood acetaminophen level was started to be measured. Although it may seem that measuring the level of acetaminophen may be an additional cost, when considering the total cost, measurement of acetaminophen level might be more profitable.

MATERIALS and METHODS

The study was allowed by the Kayseri Training and Research Hospital Education, Planning Board (date: 12.12.2013 and number: 2013/25). All patients voluntarily signed consent forms. The files of the patients who were admitted to the Kayseri Training and Research Hospital with a pre-diagnosis of acetaminophen intoxication and the hospital database were examined between 01 March, 2013 and 31 August, 2013. The files of the patients and hospital databases were studied according to patients' declaration with the calculation of the toxic level of acetaminophen and according to the measure of toxic blood level of acetaminophen. The cost of treatment of the two groups was calculated and compared. The costs spent on routine examination and procedures for patients with intoxication (such as intensive care unit fee, service charge, routine laboratory examination fee, and costs of IV NAC therapy and measurements of blood acetaminophen level) are also added. The remaining money spent on treatment owing to personal differences was not included in the total cost.

Statistical analysis

Data were recorded into the licensed International Business Machines Statistical Package for the Social Sciences 21 software package (IBM SPSS Newyork USA) For the average cost calculations, median (min–max) was estimated; for comparison between the costs, Wilcoxon Rank test was used (for normality of the distribution, samples cannot be standardized and cannot be compared with a standard normal distribution using Kolmogorov–Simirnov test).

RESULTS

A total of 209816 patients were examined in the emergency department of the Kayseri Training and Research Hospital over 6 months. A total 558 patients (0.26%) were diagnosed with drug overdose. Among these patients, 55 patients were evaluated as having acetaminophen intoxication. According to the claims of 19 patients, acetaminophen level was calculated as toxic. However, only five patients' blood acetaminophen level was measured as toxic. Patients with acetaminophen intoxication were hospitalized in the intensive care unit and a 20-h IV NAC treatment was started. Patients were transferred to clinic of internal medicine on the second day and were discharged home on the third day. If these 19 patients had visited the hospital at 1 year ago, their blood acetaminophen levels would be calculated as toxic; these patients would be admitted to an intensive care unit and the same treatment would be administered as that administered to five patients. The average therapy cost according to the declaration of patients was calculated to be 219.4 (205–240) Turkish Liras (TL), and the calculated group therapy cost (including the cost of measuring blood acetaminophen level) was 80.5 (25-250) TL. When comparing the two groups of patients, the cost of measurement group, including the cost of measuring blood levels of acetaminophen, was significantly lower (Table 1).

Table 1. Therapy costs of acetaminophen intoxications according to calculation and measurement**

	Cost		
	According to Calculation Median (min-max)	**According to Measurement Median (min-max)**	**p**
Cost (n=19)	219.4 (205-240) TL	80.5 (25-250) TL	0.001*

TL: Turkish Liras

*0.01

**The costs spent on routine examination and procedures for patients with intoxication are added. The remaining money spent on treatment owing to personal differences was not included in the total cost.

DISCUSSION

Worldwide, it is recommended to measure the blood levels of acetaminophen and to start NAC treatment while the acetaminophen level is above the treatment line (1, 12). At our hospital, blood acetaminophen level is measured, and NAC is administered at above the treatment line. Twenty-hour IV NAC therapy is widely used (1). This therapy regime has also been accepted at our hospital and is being applied. There are many studies regarding acetaminophen poisoning comparing oral and IV NAC treatment in terms of costs, efficacy, or side-effects (15-22). On the other hand, from a different perspective, we found that measuring blood acetaminophen level in developing countries, such as our country, where the blood levels of acetaminophen cannot be measured (cannot be measured at majority of hospitals) has lower cost than the total cost of all suspected poisonings with acetaminophen.

CONCLUSION

Measuring blood acetaminophen level would be more accurate and advantageous in terms of both treatment planning and the cost of therapy in developing countries as in developed countries that have advanced healthcare system.

Ethics Committee Approval: Ethics committee approval was received for this study.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Authors' Contributions: Conceived and designed the experiments or case: HÇ, AİK. Performed the experiments or case: AİK, ŞG, IÇ. Analyzed the data: ŞG, OB, IÇ. Wrote the paper: AV, BK, HÇ. All authors have read and approved the final manuscript.

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