Thiol–Disulfide balance in patients with renal colic

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SUMMARY
This study aimed to investigate thiol–disulfide balance in patients with renal colic who were frequently referred to emergency services and also to discuss its potential clinical use.

Blood samples were obtained from 32 patients diagnosed with renal colic before treatment in the emergency department. Then, the serum thiol–disulfide levels were measured using a novel method. The patients also underwent a complete blood count test and renal ultrasonography. The thiol–disulfide values were compared statistically between the patient (those with renal colic) and control groups (healthy volunteers).

The mean native thiol level was significantly less in the patient group than in the control group. In addition, the disulfide/native thiol and disulfide/total thiol ratios were significantly higher in the patient group than in the control group (P < 0.05).

This study found a significant difference in the thiol–disulfide balance of patients with renal colic compared with healthy volunteers. The mean native thiol and total thiol levels decreased in the patient group. It is believed that these markers may be indicative of inflammation in patients with renal colic.

Key words: Oxidative stress, renal colic, thiol–disulfide balance, urolithiasis

INTRODUCTION
Renal colic is a common clinical condition affecting 11% of the population in Turkey (1). Genetic, metabolic, and anatomic factors, besides dietary habits, are involved in the etiology of renal colic. People excrete crystals through the kidney every day. Calcium oxalate and phosphate crystals have an important role in stone formation. These stones constitute a risk for urinary tract obstruction and kidney damage. Cells under stress in the urinary system produce oxygen free radicals. This poses a greater risk of developing kidney damage. As a result, the development of oxidative stress leads to inflammation and damage to the urinary system.

Oxidant and antioxidant parameters have been frequently examined in recent studies (2,3). However, the measurement methods used in these studies are both complex and expensive. The thiol–disulfide balance used in this study could measure oxidative stress both inexpensively and simply by a novel method (4). It is believed that these markers may be indicative of inflammation in patients with renal colic.

MATERIALS AND METHODS
A total of 32 patients diagnosed with renal colic in the emergency department were included in the study. Patients with additional diseases that could cause oxidative stress were excluded from the study. Blood and urine samples were
obtained from these patients before starting treatment. The thiol–
 disulfide levels were measured using the Erel method without
incubating blood samples (4). All patients also underwent renal
ultrasonography in the radiology unit. Analgesics and intravenous
isotonic fluid infusions were used to treat all patients.

The IBM SPSS Statistics version 15.0 was used for statistical
analysis. The Kolmogorov–Smirnov test was used to check whether
a variable was normally distributed. After the one-way analysis
of variance was used to compare normally distributed variables,
the Fisher's least significant difference test was used to compare
groups. After the Kruskal–Wallis test was used to compare non-
normally distributed variables, the Mann–Whitney U test was used
to compare groups. The relationships between numerical variables
were analyzed using the Pearson’s and Spearman’s correlation
tests. A P value <0.05 was considered statistically significant.

The study protocol was approved by the local ethics committee.
Written informed consent was obtained from each patient.

RESULTS

The age distribution and blood values of 32 patients and 36
healthy volunteers included in the study are shown in Table 1.

No statistically significant difference in the mean age was found
between the two groups.

As shown in Figure 1, the mean native thiol level was 403.5 (75.7)
in the patient group and 445.3 (69.2) in the control group (P <
0.001). The mean total thiol level was 451.1±54.1 in the patient
group and 493.8±54.5 in the control group (P = 0.002) (Fig. 2).
The disulfide–native thiol and disulfide–total thiol ratios were
significantly higher in the patient group than in the control group
(P < 0.001).

DISCUSSION

Dynamic thiol–disulfide homeostasis plays a critical role in
organisms. Changes in the thiol–disulfide balance serve as
components for antioxidant protection, detoxification, regulation
of enzymatic activity, and cellular signaling mechanisms (5,6).
Changes in thiol–disulfide homeostasis have been associated
with various diseases, such as DM, cancer, migraine, hyperemesis
gravidarum, and chronic renal failure (7–12). Cysteine and its
derivatives are major thiol–disulfide compounds in the plasma.
As a result, cysteine is important in both structural functions and
redox systems (such as thiol–disulfide changes) (13). Disulfides
such as cysteine are members of thiol-based redox regulation (14).

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control n = 36</th>
<th>Renal colic n =32</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>40.0 ± 10.4</td>
<td>40.3 ± 10.5</td>
<td>0.904</td>
</tr>
<tr>
<td>Native thiol (µmol/L)</td>
<td>445.3 (69.2)</td>
<td>403.5 (75.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total thiol (µmol/L)</td>
<td>493.8 ± 54.5</td>
<td>451.1 ± 54.1</td>
<td>0.002</td>
</tr>
<tr>
<td>Disulfide (µmol/L)</td>
<td>16.6 ± 4.8</td>
<td>25.4 ± 9.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Disulphide/Native thiol ratio (%)</td>
<td>3.6 ± 1.1</td>
<td>6.6 ± 3.1</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Disulphide/Total thiol ratio (%)</td>
<td>3.4 ± 1.0</td>
<td>5.7 ± 2.2</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Native thiol/Total thiol ratio (%)</td>
<td>93.2 ± 1.9</td>
<td>88.6 ± 4.5</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Normally distributed data (parametric data) were expressed as mean ± standard deviation, whereas non-normally distributed data (nonparametric data) were expressed as median (IQR). P values for parametric data were calculated using the Student t test, whereas P values for nonparametric data were calculated using the Mann–Whitney U test. A P value < 0.05 was considered statistically significant.

The patient group included 15 women and 21 men, whereas the patient group included 9 women and 23 men. No statistically significant difference was found between the two groups in terms of gender distribution (in the Pearson Chi-square test P = 0.243).
Although the thiol–disulfide balance could be measured unilaterally until now, it can be measured bilaterally by a novel method developed by Erel et al. (4). This novel study explored the relationship between disease and thiol levels using the aforementioned method in patients diagnosed with renal colic. The total thiol, native thiol, and disulfide levels were measured. It was found that the mean native thiol and total thiol levels were significantly less in the patient group than in the control group.

Oxidative stress has an important role in many diseases (4,15–18). Some studies have shown an increase in oxidative stress in urinary stone diseases in children (19). The fact that oxygen free radicals resulting from renal tubular damage induced by calcium oxalate and calcium phosphate stones increase oxidative stress has been investigated both in tissue cultures and in animal experiments (20). These calcium stones that cause renal colic lead to oxidative stress and cellular damage in the urinary system. Oxygen free radical inhibitors or antioxidants (such as vitamin E, glutathione, and N-acetylcysteine) are extensively used to prevent this situation (21–23). However, a previous study showed that oxidative stress did not significantly increase in patients with renal colic (24). This study found that the thiol–disulfide balance shifted in favor of thiol due to significant elevations in the thiol level. Although many oxidative stress markers have been explored in patients with urolithiasis, the thiol–disulfide balance has not been studied. This was a novel study conducted using the Erel method, a new method in patients with renal colic. Total oxidant level was previously used as an indicator. In addition, high levels of total thiol can be regarded as an indicator of oxidative stress.

This study indicated that antioxidant treatments could be used to prevent renal damage in renal colic. A limitation of the study was that the findings could not be applied in additional diseases such as diabetes mellitus, and hypertension.

REFERENCES


