

## The Value of Urinalysis in Detection of Abdominal Organ Injuries in Children with Hematuria Following Blunt Abdominal Trauma; A Diagnostic Study

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### Abstract

#### Background

Currently, almost all patients with probable abdominal injury undergo urinalysis in emergency department (ED). The present survey was conducted with the aim of assessing the diagnostic values of urinalysis compare with abdominal computed tomography (CT) scan with contrast for predicting possible intra-abdominal injuries in children affected by blunt trauma.

**Materials and Methods:** The present diagnostic accuracy study was accomplished on patients' less than 16-year-old with blunt abdominal trauma who was admitted to emergency department (ED) and underwent both urinalysis and abdominal CT scan. Demographic and baseline characteristics data, and the results of urinalysis and abdominal CT scan were recorded. Thereafter, screening performance characteristics were calculated.

#### Results

Seventy eligible patients with the mean age of  $7.1 \pm 4.86$  years were enrolled (68.6% male). Screening performance characteristics including sensitivity, specificity and positive and negative predictive values of hematuria were 26.7%, 92.7%, 50.0% and 82.3%, respectively. Positive and negative likelihood ratios were calculated as 3.67 and 0.79, respectively.

#### Conclusion

It is likely that, presence of hematuria has acceptable specificity, but very low sensitivity in comparison with CT scan for prediction of abdominal organ injuries in children with blunt abdominal trauma. Therefore, urinalysis is not useful for screening the presence of organ injuries in this population.

**Key Words:** Abdominal injuries, Children, Emergency Department, Hematuria, Urinalysis.

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## 1- INTRODUCTION

Trauma is the most common cause of death in people aged 1 – 44 years and the third cause of mortality in all age groups. Currently, Trauma is one of the major causes of disability and mortality in children over 1 year old and leads to more than 60% of childhood deaths, more than 90% of which are due to blunt trauma (1-4). According to statistics, abdomen is the third part of body commonly needing surgical intervention following trauma. Blunt trauma is the most common mechanism of abdominal trauma, mainly caused by motor vehicle accidents. Evaluating intra-abdominal injuries in multiple trauma patients is difficult and in most cases, abdominal injury is affected by other injuries. Chest traumas and various retroperitoneal injuries may also happen along with abdominal trauma, which make diagnosing the abdominal injury more difficult (5-7). One of the most important matters when facing multiple or blunt abdominal trauma patients is evaluation of abdominal organ injuries.

Diagnostic methods such as urinalysis, abdominal ultrasonography, computed tomography (CT) scan and surgical interventions such as diagnostic peritoneal aspiration and lavage are used for this purpose. Among these, abdominal and pelvic CT scan with contrast is considered the gold standard, given its high accuracy and few side effects for cost. On the other hand, presence of blood or blood elements in urine has been identified as a factor predicting urinary tract injuries and severity of other organ injuries, and urinalysis is a common evaluation in these patients and further diagnostic measures are taken based on its results, especially presence or absence of hematuria (8-11). Hematuria is neither always related to injury of urinary tract including kidneys, nor always present in blunt traumas causing intra-abdominal free fluid. Some major kidney injuries do not even result in

microscopic hematuria, on the other hand, some intra-abdominal injuries may cause hematuria, even in absence of urinary tract injury (12-14). Currently, almost all patients with probable abdominal injury undergo urinalysis, and since getting samples and doing analysis are time consuming, this may result in emergency department (ED) beds being occupied for hours without a significant result. In addition, in most cases the results of urinalysis are not helpful in determining patients' treatment process and most abdominal injury patients' need for further evaluation could be diagnosed via other methods, such as clinical examination, abdominal ultrasonography, or the physician observing urine appearance, to avoid spending time and money on this test (8, 15). The present study compares the diagnostic accuracy of urinalysis with CT scan in children with blunt abdominal trauma. The aim of this study was comparing the diagnostic value of urinalysis and abdominal CT scan with contrast, as the gold standard, for predicting probable abdominal organ injury in these patients.

## 2- MATERIALS AND METHODS

### 2-1. Study design

The present study is a diagnostic accuracy one carried out prospectively, during March 2015 to March 2016, in Tehran, Iran. The protocol of the study was approved by the ethics committees of Shahid Beheshti University of Medical Sciences (SBMU), and Tehran University of Medical Sciences (TUMS). All the researchers adhered to the ethical principles of Helsinki Declaration for medical research throughout the study.

### 2-2. Study population

Children younger than 16 years old, who visited ED of the hospitals following abdominal blunt trauma were eligible. To avoid selection bias, all pediatric patients

of both gender, under 16 years old with blunt abdominal trauma, who were presented to ED and both urinalysis and abdominal CT scan was done for them were included. Children who had hematuria due to chronic kidney diseases or cases that were discharged against medical advice before carrying out Para-clinical tests or had incomplete information in their files were excluded. Considering  $r = 50\%$ ,  $\alpha = 1\%$  and  $\beta = 10\%$ , sample size was calculated to be 53 cases.

### 2-3. Data gathering

Data gathering was done using a checklist previously designed by the researchers. Demographic data, trauma mechanism, and results of urinalysis, and CT scan regarding abdominal organ injuries were recorded. To ensure blinding, data were gathered by the emergency medicine physician who did not participate in interpretation of CT scan images and data analysis. Urine sample was sent to laboratory during the first hour of admission, but the interpretation of the CT scan was performed by a radiologist who did not aware of urinalysis results; any organ injuries in CT scan images were considered as abnormal finding. Reporting the blood or red blood cell (RBC) in urinalysis was considered as abnormal finding.

### 2-4. Statistical analysis

Using SPSS-21, descriptive statistics for the studied variables were provided and to assess the diagnostic power of urinalysis, statistical indicators of sensitivity, specificity, positive and negative predictive values and also positive and negative likelihood ratios were applied. To express estimate accuracy, 95% confidence interval (CI) was used and  $p < 0.05$  was considered as significance level. To calculate the statistical indicators, patients were divided into two groups those had microscopic or gross hematuria,

which was exactly the same when patients divided to those had more or less than 30 RBC in their urine (8, 9).

## 3- RESULTS

Seventy children under 16-year-old who visited ED were evaluated. **Table.1** shows the demographic data and baseline characteristics of the participants. Forty-eight (68.6%) of the patients were male. Mean age of the studied population was  $7.1 \pm 4.86$  years. In total, 52 (74.3%) were injured as a result of motor vehicle accidents and others were hurt due to other reasons such as falling or direct trauma. In abdominal examination, 45 (64.3%) patients had normal abdomen, 20 (28.6%) had tenderness and in 5 (7.1%) cases, the abdomen could not be evaluated. In the initial analysis, the result of urinalysis was visible hematuria in 8 (11.4%) patients and microscopic hematuria in 62 (88.6%). Abdominal and pelvic CT scan showed abdominal organ injury in 15 (21.4%) cases, including 10 cases of spleen injuries, 4 cases of liver injuries, and 1 kidney injury.

Evaluation of the relationship between CT scan findings in the studied patients with hematuria and RBC count in their urine sample has been reported in **Table.2**. As can be seen, the correlation between CT scan findings and presence of hematuria was statistically significant ( $p = 0.036$ ). To calculate the statistical indicators, patients were divided into two groups those had microscopic or gross hematuria, which was exactly the same when patients divided to those had more or less than 30 RBC in their urine. As **Table.3** shows, sensitivity and specificity of hematuria compared to CT scan in this study were 26.67%, and 92.73%, respectively. Positive and negative predictive values were also 50%, and 82.26%, respectively. Positive and negative likelihood ratios were 3.67, and 0.79, respectively.

**Table-1:** Demographic data and baseline characteristics of the studied children

Variables	Number (%)
<b>Gender</b>	
Male	48 (68.6)
Female	22 (31.4)
<b>Mechanism</b>	
Car passenger in accident	32 (45.7)
Car-pedestrian accident	20 (28.6)
Falling	15 (21.4)
Direct trauma	3 (4.3)
<b>Abdominal examination</b>	
Normal	45 (64.3)
Tenderness	20 (28.6)
Could not be evaluated	5 (7.1)
<b>Red blood cell count in urine</b>	
5 - 10	50 (71.5)
11 - 30	12 (17.1)
31 - 50	0 (0.0)
> 50	8 (11.4)
<b>Ultrasonography</b>	
Normal	53 (75.7)
Free fluid	17 (24.3)
<b>CT scan</b>	
Normal	55 (78.6)
Abdominal organ injury	15 (21.4)

**Table-2:** Correlation between urinalysis results and computed tomography (CT) scan findings

Urinalysis results	CT scan findings		P-value
	Normal	Abdominal organ injury	
Hematuria			0.036
Visible	4	4	
Microscopic	51	11	
Red blood cell count			0.089
5-10	42	8	
11-30	9	3	
> 50	4	4	

**Table-3:** Diagnostic accuracy of hematuria compared to computed tomography (CT) scan in pediatric patients with blunt abdominal trauma

Parameters	Value (%)	95% confidence interval (%)
Sensitivity	26.67	8.91 – 55.16
Specificity	92.73	81.57 – 97.64
Positive predictive value	50.00	17.44 – 82.55
Negative predictive value	82.26	70.05 – 90.39

#### 4- DISCUSSION

Based on the results of the present study, although presence of hematuria has acceptable specificity, its sensitivity is very low for predicting abdominal organ injury in children with blunt abdominal trauma. In other words, absence of hematuria is not a good reference to dismiss abdominal organ injury, yet its presence can be an indicator of serious injury. Urinalysis is a commonly performed laboratory study for suspected

renal injury, but there is no direct relationship between the presence, absence, or degree of microscopic hematuria and the severity of injury (16, 17). As an example, renal pedicle arterial injuries may be present without causing even microscopic hematuria. However, patients with a systolic blood pressure of less than 90 mmHg and microscopic hematuria have a higher likelihood of significant injury (16). In the present study, the correlation of visible hematuria

with abdominal organ injury was confirmed, which is in line with previous studies indicating the correlation of visible hematuria with presence of abdominal organ injury in children with blunt abdominal trauma (18). However, considering its low sensitivity, also shown in a study by Cotton et al., it seems that using urinalysis in children with blunt abdominal trauma is not efficient (19).

Although urinalysis findings alone have a low sensitivity in prediction of abdominal organ injury, adding other factors could increase its value. Abdominal examination in traumatic children is of great importance. Isaacman et al., in their retrospective study on 285 pediatric trauma patients with abdominal injury, showed that abnormal clinical examination accompanied by urinalysis has 100% sensitivity, 64% specificity, 13% positive predictive value, and 100% negative predictive value (20). Another important factor that may correlate with abdominal organ injury is a Glasgow coma scale lower than 13, mentioned in previous studies (2).

Sensitivity, specificity, positive and negative predictive values were to some extent in line with the results of Holmes et al. studying 107 children with probable abdominal organ injury (2). In the present study, the correlation between abdominal and pelvic CT scan and red blood cell count in the urine sample was not significant. However, the correlation between CT scan findings and type of visible hematuria was significant. In contrast, Holmes et al. had expressed that microscopic hematuria is a predictor of abdominal organ injury in children with blunt abdominal trauma, which was not confirmed in this study (2). In a study, Stein et al. retrospectively evaluated the CT scans of 412 children and they found 48 cases of abdominal organ injury, 25 of which had kidney injury. All those with kidney injury had hematuria, including 17

cases of microscopic and 8 cases of visible hematuria. Therefore, they concluded that all the children with blunt abdominal trauma who show hematuria should undergo abdominal and pelvic CT scan, which is confirmed in the present study (18). Taylor et al. studied 378 children with blunt abdominal trauma and found 256 cases of hematuria, 66% of which were microscopic. They expressed that presence of hematuria and higher numbers of red blood cells in urine significantly correlates with higher risk of abdominal organ injury, yet in cases of symptomless hematuria, the risk of abdominal organ injury can be disregarded. Therefore, they believed that presence and severity of hematuria provide valuable evidence for presence of abdominal organ injury in children presenting with blunt abdominal trauma (21).

#### **4-1. Limitations of the study**

Since in the studied centers most patients with probable abdominal organ injury undergo urinalysis but only those with a higher chance of abdominal organ injury according to the physician's opinion due to severity of accident or unclear findings in other evaluations undergo CT scan, the findings of this study may only be applicable to patients with severe injuries. Performing such studies in a prospective manner with more baseline characteristics assessments like calculation of severity scores and performing analysis in different groups could be more valuable.

#### **5- CONCLUSION**

It is likely that, presence of hematuria has acceptable specificity, but very low sensitivity in comparison with CT scan for prediction of abdominal organ injuries in children with blunt abdominal trauma. Therefore, urinalysis is not useful for screening the presence of organ injuries in this population.

## 6- AUTHOR CONTRIBUTION

All the authors have contributed to drafting/revising the manuscript, study concept, or design, as well as data collection and interpretation.

**7- CONFLICT OF INTEREST:** None.

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