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Research Paper

Diagnostic Value of Urinalysis vs Computed Tomography in Kidney and Urinary Tract Bleeding

Saeed Madani[1], Ahmad Kachoie[1], Mostafa Vahedian[2], Mehdi Kazemi[3*], Hoorolnesa Ameli[4], Mohammad Hossein Atarod[5], Zahra Heydari[6]

1. Department of Surgery, School of Medicine, Shahid Beheshti Hospital, Qom University of Medical Sciences, Qom, Iran.
2. Department of Family and Community Medicine, School of Medicine, Spiritual Health Research Center, Qom University of Medical Sciences, Qom, Iran.
3. Department of Internal Medicine, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran.
4. Department of Emergency Medicine, School of Medicine, Shahid Beheshti Hospital, Qom University of Medical Sciences, Qom, Iran.
5. Research Committee, Faculty of Medicine, Qom University of Medical Sciences, Qom, Iran.
6. Clinical Research and Development Center, Qom University of Medical Sciences, Qom, Iran.

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ABSTRACT

Background and Aim: Blunt trauma is a common cause of damage to the kidneys and urinary tract. Timely and accurate diagnosis of these injuries is critical for effective management. Complete urine tests and computed tomography (CT) are crucial diagnostic methods in this field. This study aimed to examine the diagnostic value of complete urinalysis compared to CT scans in the diagnosis of kidney and urinary tract injuries in patients with blunt trauma.

Materials and Methods: This cross-sectional analytical study included patients with blunt abdominal trauma referred to Shahid Beheshti Hospital in Qom City, Iran, in 2018. All CT scans that reported a lack of enhancement or weak contrast in the kidney parenchyma, urinary tract, or renal hematoma were considered positive. All CT scans interpreted by a radiologist were included in this study. The data checklist also recorded the findings of the urinalysis in terms of hematuria. Finally, the sensitivity and specificity of hematuria were compared to those of CT scan findings in diagnosing kidney and urinary tract injuries.

Results: The sensitivity, specificity, positive predictive value, and negative predictive value in cases of microscopic hematuria were 97.6%, 50.8%, 35.04%, and 99.1%, respectively.

Conclusion: The CT scan is the leading and most reliable tool for diagnosing kidney and urinary tract injuries caused by blunt trauma. Complete urinalysis can be used as an initial and complementary evaluation method in the diagnostic process but should not be used alone for clinical decisions. Further research is necessary to improve the diagnostic methods and data processing in this field.

*** Corresponding Author:**
Mehdi Kazemi
Address: *Department of Internal Medicine, School of Medicine, Tehran University of Medical Sciences, Tehran, Iran.*
Phone: *+98 (912) 759 7785*
E-mail: *Mqmehdikazemi@yahoo.com*

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Introduction

Abdominal trauma is the most common cause of death among people younger than 45 years. In cases of blunt trauma, the evaluation and diagnosis of possible intra-abdominal injuries present a challenge for physicians treating these patients [1]. Frequent clinical examinations, aspiration and diagnostic intraperitoneal lavage, ultrasound, CT scans, and biochemical and urine tests are the most common diagnostic measures in such cases [2].

In patients with trauma, clinical examination of the abdomen may not provide accurate information regarding intra-abdominal injuries. This issue is exacerbated in patients with decreased levels of consciousness due to alcohol and drug consumption, head trauma, and unstable hemodynamics [3-5]. An abdominal CT scan with intravenous contrast is a standard diagnostic imaging method that can detect solid organ damage [6]; however, this method cannot be used in patients indicated for emergency laparotomy, those who are restless, those with a history of sensitivity to contrast material, and those with unstable hemodynamics [7, 8].

Urinalysis, along with frequent clinical examination, is recommended as the initial method to evaluate patients undergoing abdominal trauma, especially children [9-11]. Several studies have reported that patients with routine urinalysis and clinical examinations rarely have intra-abdominal injuries [12, 13]. In contrast, other studies have stated that the presence or absence of blood in urine is not a reliable and accurate tool for predicting intra-abdominal injuries [14]. In addition, some studies have shown that biochemical tests, assessment of urinary urobilinogen and bilirubin, and urinalysis are not practical tools for screening abdominal trauma in children [15, 16]. While urinalysis is a valuable diagnostic tool, it may not be efficient in cases of abdominal trauma [17, 18]. Therefore, performing a urinalysis when the clinical examination and ultrasound results are expected, and when patients do not have decreased levels of consciousness or unstable hemodynamics, wastes significant time and resources in busy trauma centers.

In addition, positive urinalysis results in unnecessary diagnostic tests. Considering the importance of early diagnosis of kidney damage in cases of blunt abdominal trauma to facilitate appropriate treatment measures, and since urinalysis is a cost-effective and readily available laboratory test, this study was conducted to "determine the value of a complete urine test compared to CT scan findings in the diagnosis of urinary tract bleeding", with the aim of using the study results.

Materials and Methods

This diagnostic study included patients with blunt abdominal trauma referred to Shahid Beheshti Hospital in Qom City. Using the sample size formula and based on a sensitivity of 27%, a specificity of 93%, and a prevalence of trauma to the right kidney of 44.6%, and the left kidney of 51.8%, derived from the results of a similar study [19] and an error margin of 5%, the estimated number of samples was at least 161 and 280 individuals, respectively. This study utilized a higher estimated number of samples (n=280).

The inclusion criteria included patients who were referred to the emergency department with blunt abdominal trauma and underwent a CT scan of the abdomen and pelvis. The exclusion criteria included patients with urinary infections, pregnant women, patients with a previous history of kidney disease or kidney failure, and patients with incomplete information in their files.

The abdominal and pelvic CT scan findings of all patients were examined in terms of pathological findings. All CT scans that reported a lack of enhancement or weak contrast in the kidney parenchyma, urinary tracts, or renal hematoma were considered positive [20]. All CT scans interpreted by a radiologist were included in this study. Hematuria may present in both macroscopic and microscopic forms. Macroscopic hematuria is a state, in which blood in the urine can be observed with the naked eye owing to changes in appearance. Microscopic hematuria can only be diagnosed using urine tests. It can be detected by urinalysis, which indicates the presence of five or more red blood cells per high-power field (HPF), or through a dipstick test [21]. Urinalysis findings regarding hematuria were also recorded in the data checklist.

Data were analyzed using SPSS software, version 22. Mean±SD were used to describe quantitative variables, and frequency and percentage were used to describe qualitative data. A t-test was used to analyze quantitative variables, and a chi-square test was used for qualitative data. The sensitivity, specificity, and positive and negative predictive values were determined using statistical formulas for a complete urine test. A significance level of <0.05 was considered statistically significant.

Results

This study included 197 men (70.4%) and 83 women (29.6%). The average age of the patients was 32.5±13.05 years. Table 1 presents other studied variables.

The average age of patients (P=0.484), the gender of patients (P=0.314) and the injury mechanism (P=0.418) had no statistically significant relationship with microscopic hematuria (Table 2).

A CT scan of the abdomen and pelvis is the gold standard for measuring the diagnostic accuracy of hematuria in blunt trauma. Of the 280 patients examined in this study, 42 cases had a positive CT scan of the abdomen and pelvis, while 238 had a CT scan of the normal pelvis and abdomen. Microscopic hematuria was observed in 115 patients and macroscopic hematuria was observed in 73 patients. Of the 42 patients with positive abdominal and pelvic CT scans, 41 had microscopic and macroscopic hematuria. Based on the results of hematuria and CT scans, the sensitivity, specificity and positive and negative predictive values for microscopic hematuria were 97.6%, 50.8%, 35.04% and 99.1%, respectively (Table 3).

Table 1. Distribution of patients with blunt trauma based on study variables

Variables		No. (%)
Cause of injury	Motorcycle accident	163(58.2)
Hematuria	Fall	67(23.9)
	Direct trauma	39(13.9)
	Others	11(3.9)
	Microscopic	115(41.1)
	Macroscopic	43(15.4)
	Absence of hematuria	122(43.6)
CT scan	Positive	42(15.0)
	Normal	238(85.0)

CT: Computed tomography.

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Table 2. Distribution of study variables in patients with blunt trauma based on hematuria

Variables		Mean±SD/ No. (%)			P
		Normal	Microscopic	Macroscopic	
Age (y)		32.4±13.0	32.7±13.06	32.7±13.06	0.848
Sex	Male	88(72.1)	76(66.1)	33(76.7)	0.314
	Female	34(27.9)	39(33.9)	10(23.3)	
Cause of injury	Motorcycle accident	71(58.2)	67(58.3)	28(58.1)	0.418
	Fall	27(22.1)	32(27.8)	8(18.6)	
	Direct trauma	18(14.8)	14(12.2)	7(16.3)	
	Others	6(4.9)	2(1.7)	3(7.0)	

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Table 3. Distribution of abdominal and pelvic CT scan findings according to the hematuria in patients with blunt trauma

Variable		No. (%)				P
		No Hematuria	Microscopic	Macroscopic	Total	
CT scan	Positive	1(0.8)	26(22.6)	15(34.9)	42(15.0)	0.001
	Normal	121(99.2)	89(77.4)	28(65.1)	238(85.0)	
Total		122(100)	115(100)	73(100)	280(100)	-

CT: Computed tomography.

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Discussion

The results of this study showed that hematuria has high sensitivity and specificity in patients with blunt abdominal trauma. Considering the high negative predictive value of hematuria, paying attention to the absence of hematuria in patients with blunt abdominal trauma in the emergency room can predict kidney injuries in these patients, and the absence of hematuria can rule out kidney and urinary tract damage with high certainty. The evaluation of every trauma patient in the emergency room includes assessing and providing initial support of the airway, breathing, and blood circulation, as well as recording the initial vital signs. After obtaining the initial history and examination of the patient, blood tests, such as hematocrit, creatinine, and urinalysis, are necessary to diagnose microscopic hematuria, assess the initial condition in terms of the amount of blood loss, and evaluate the initial function of the kidneys [17].

Based on previous studies, CT scans are more likely to reveal abdominal injury with hemodynamic shock, abdominal guarding, hematoma, or anemia [18, 22]. To reduce mortality in these patients, timely and accurate diagnosis is necessary to start treatment as soon as possible. Urine analysis in children is not a good predictor of kidney damage due to blunt trauma [23]. However, according to studies, this test can be helpful in adults. In the study by Kennedy et al., none of the 1038 patients suspected of having kidney injury who did not have hematuria on urinalysis exhibited kidney damage. Moreover, none of the 100 patients with negative dipstick results showed secondary kidney lesions [24]. Other studies have indicated the importance of a negative hematuria test in predicting kidney damage, especially pedicle damage [25].

Studies have also highlighted the importance of macroscopic hematuria, as its specificity was 93.8% in some studies and 81.2% in the present study [19]. Therefore, evident hematuria is a criterion for admitting patients to the surgery department for observation and evaluation via CT scan. Although a CT scan is the standard measure for patients with blunt or penetrating renal trauma who have stable hemodynamics, studies indicate that microscopic hematuria is not a reason for systematic imaging in blunt abdominal trauma patients with stable hemodynamics [26]. Also, a study by Perez-Brayfield et al. showed that a CT scan of the abdomen and pelvis should be performed only when the number of red blood cells is greater than 50 per high-power field (HPF) in urinalysis [27].

Conclusion

According to our study, hematuria has a high negative predictive value for kidney and urinary tract damage in patients with blunt abdominal trauma, and the sensitivity of hematuria is high. In other words, the absence of microscopic and macroscopic hematuria in these patients can rule out kidney and urinary tract damage with high certainty. This can help avoid unnecessary imaging, especially CT scans of the abdomen and pelvis when the patient is hemodynamically stable.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Ethics Committee of Qom University of Medical Sciences (Code: IR.MUQ.REC.1398.139).

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Authors' contributions

All authors contributed equally to the conception and design of the study, data collection and analysis, interception of the results, and manuscript drafting. Each author approved the submission of the final version of the manuscript.

Conflict of interest

The authors declared no conflict of interest.

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