OPEN ACCESS

ORIGINAL RESEARCH

The Accuracy of Urinalysis in Predicting Intra-Abdominal Injury Following Blunt Traumas

Anita Sabzghabaei[1], Majid Shojaee[2], Saeed Safari[3], Hamid Reza Hatamabadi[2], Reza Shirvani[2]*

[1]Department of Emergency Medicine, Loghmane Hakim Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
[2] Department of Emergency Medicine, Imam Hossein Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
[3] Department of Emergency Medicine, Shohadaye Tajrish Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

*Corresponding Author: Reza Shirvani; Emergency Department, Imam Hossein Hospital, Shahid Madani Avenue, Imam Hossein Square, Tehran, Iran. Postal code: 1989934148; Tel/Fax: 00982122721155 Email: Rshirvani.md@gmail.com
Received: February 2015; Accepted: April 2015

Abstract

Introduction: In cases of blunt abdominal traumas, predicting the possible intra-abdominal injuries is still a challenge for the physicians involved with these patients. Therefore, this study was designed, to evaluate the accuracy of urinalysis in predicting intra-abdominal injuries. **Methods:** Patients aged 15 to 65 years with blunt abdominal trauma who were admitted to emergency departments were enrolled. Abdominopelvic computed tomography (CT) scan with intravenous contrast and urinalysis were requested for all the included patients. Demographic data, trauma mechanism, the results of urinalysis, and the results of abdominopelvic CT scan were gathered. Finally, the correlation between the results of abdominopelvic CT scan, and urinalysis was determined. Urinalysis was considered positive in case of at least one positive value in gross appearance, blood in dipstick, or red blood cell count. **Results:** 325 patients with blunt abdominal trauma were admitted to the emergency departments (83% male with the mean age of 32.63±17.48 years). Sensitivity, specificity, positive and negative predictive values, and positive and negative likelihood ratios of urinalysis, were 77.9% (95% CI: 69.6-84.4), 58.5% (95% CI: 51.2-65.5), 56% (95% CI: 48.5-63.3), 79.6% (95% CI: 71.8-85.7), 1.27% (95% CI: 1.30-1.57), and 0.25% (95% CI: 0.18-0.36), respectively. **Conclusion:** The diagnostic value of urinalysis in prediction of blunt traumatic intra-abdominal injuries is low and it seems that it should be considered as an adjuvant diagnostic tool, in conjunction with other sources such as clinical findings and imaging.

Key words: Urinalysis; abdominal injuries; abdomen; tomography, X-Ray computed

Cite This Article as: Sabzghabaei A, Shojaee M, Safari S, Hatamabadi HR, Shirvani R. The accuracy of urinalysis in predicting intra-abdominal injury following blunt traumas. Emergency. 2016;4(1):11-15.

Introduction:

Abdominal trauma is the most common cause of mortality in people under 45 years old. In cases of blunt trauma, evaluating and diagnosing the possible intra-abdominal injuries is still a challenge for the physicians involved with these patients (1). Frequent clinical examinations, aspiration and diagnostic peritoneal lavage, ultrasonography, computed tomography (CT), biochemical and urine tests are among the most common diagnostic tools in this regard (2). In trauma patients, physical examination of the abdomen might not give accurate information on the state of intra-abdominal injuries. This problem is even worse in patients with a decreased level of consciousness as a result of using alcohol, drugs, brain trauma, and hemodynamic instability (3-5). Abdominal CT scan with intravenous (IV) contrast media is considered a standard diagnostic imaging and has the ability to diagnose solid organ injuries, accurately (1). Yet, this method cannot be used on patients with emergency exploratory laparotomy indication, restlessness, a history of allergy to contrast material, and hemodynamic instability(6, 7). Urinalysis accompanied by frequent physical examination has been proposed as an initial method for evaluating those affected by blunt abdominal trauma, especially children (8-10). Some of the studies believe that patients with normal urinalysis and abdominal physical examination rarely have intra-abdominal injuries (8, 11, 12). In contrast, another study expressed that the presence or absence of blood in urine is not an accurate and safe tool to predict the existence of intra-abdominal injuries (13). Also other studies have shown that biochemical tests,

evaluating urobilinogen and urine bilirubin accompanied by urinalysis, cannot be an effective tool for abdominal trauma screening in children (14-16). Meaning, despite urinalysis being a valuable diagnostic tool, it might not be efficient in cases of traumatic abdominal injuries (17, 18). Therefore, performing urinalysis when clinical examination and ultrasonography results are normal and the patient does not show any hemodynamic instability or decrease in consciousness, wastes lots of time and resources in the overcrowded trauma centers. In addition, at times the positive urinalysis leads to unnecessary further diagnostic tests. This study was aimed to assess the accuracy of urinalysis in predicting intra-abdominal injuries following blunt traumas.

Methods:

This diagnostic accuracy assessment study evaluated urinalysis in predicting traumatic intra-abdominal injuries. Abdominopelvic CT scan with IV contrast was considered as gold standard test. Patients aged 15 to 65 years with blunt abdominal trauma who were admitted to emergency departments of Imam Hossein and Shohadaye Haftome Tir Hospitals, Tehran, Iran between March and September 2013, were enrolled. Women on their menstrual cycle, people with underlying diseases such as cancer or chronic kidney diseases, and people with penetrating abdominal trauma were excluded. Urinalysis and abdominopelvic CT scan with IV contrast were performed for all patients, simultaneously. Demographic data, trauma mechanism (motor vehicle accidents, pedestrian motor crash, or falling), the results of urinalysis (gross appearance, presence or absence of blood in the dipstick, and red blood cell count), and the results of abdominopelvic CT scan were gathered using a pre-designed checklist. All patients were examined with a multi-slice CT scanner (Siemens Medical Solution, USA). A radiologist who was blind to the results of urinalysis and clinical characteristics did interpretation of the patients' CT scan. In addition, a laboratory technician who was blind to the patients' clinical data did urinalysis. In the end, the relationship between the results of abdominopelvic CT scan, and urinalysis was assessed.

The ethics committee of Shahid Beheshti University of Medical Sciences approved this study. In addition, the researchers adhered to the principles of Helsinki Declaration and confidentiality of patient information over the course of the research. Written informed consents were obtained from all patients.

In this study, clear gross appearance of urine was defined as the ability to read a text through the urine-containing glass. In addition, semi-clear urine was defined as urine being a little turbid while a text can still be read through the glass. Semi-turbid and turbid urines were also defined as urines being a little to completely cloudy so that the text could not be read through the glass containing them. Urinalysis was considered positive in case of at least one positive value in gross appearance, blood in dipstick, or red blood cell count. Red blood cell counts were categorized to 0-9, 10-40, and more than 40. Considering 59% sensitivity, 10% specificity and a confidence interval of 95%, the minimum sample size was calculated 93 patients. Data were analyzed using SPSS version 21.0. Screening performance characteristics of urinalysis (sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio (PLR), and negative likelihood ratio (NLR)) with 95% confidence interval (95% CI) in comparison with the results of abdominopelvic CT scan were calculated. $p<0.05$ was considered as the level of significance.

Results:

Finally, 325 patients with blunt abdominal trauma with the mean age of 32.63±17.48 years were evaluated (83% male). Trauma mechanism in 36% was motor vehicle collision. Most patients had clear urine appearance (59.1%), blood negative dipstick (48%), with 0-9 red blood cells per high power field (58.8%). The results from the patients' urinalysis can be found in table 1.

193 (59.6%) patients had normal abdominopelvic CT scan while pelvic fracture were detected in 58 (18%), free abdominal fluid in 37 (11%), kidney damage in 32 (10%), liver damage in 23 (7%), spinal fracture in 22 (7%), and spleen damage in 18 (6%). There was a significant but weak correlation between the gross appearance of urine ($r=0.28$, $p<0.001$), the results of urine dipstick ($r=0.42$, $p<0.001$), and red blood cell count ($r=0.37$, $p<0.001$) and the results of abdominopelvic CT scan.

Table 1: The results of urinalysis regarding gross appearance, blood in dipstick, and red blood cell count

Urinalysis	Number (%)
Gross appearance	
Clear	192 (59/1)
Semi clear	77 (23/7)
Semi turbid	29 (8/9)
Turbid	27 (8/3)
Blood in dipstick	
0	156 (48)
1	42 (12/9)
2	53 (16/3)
3	40 (12/3)
4	34 (10/5)
Red blood cell count	
0-9 cells/HPF*	191 (58/8)
10-40 cells/HPF	83 (24/3)
40< cells/HPF	51 (16/9)

Table 2: Screening performance characteristics of urine gross appearance in comparison with the results of abdominopelvic computed tomography scan

Characteristics	kidney	Spleen	Liver	Free fluid
Sensitivity	60.6 (42.2-76.1)	66.7 (41.1-85.6)	39 (20.4-61.2)	59.4 (42.2-74.8)
Specificity	61.3 (55.4-66.8)	60.5 (54.8-66)	50 (44.6-55.3)	61.4 (55.5-67)
PPV[1]	15.0 (9.0-22.5)	9.0 (4.9-15.5)	42.8 (22.3-65.5)	16.5 (10.8-24.2)
NPV[2]	93.2 (88.4-96.1)	96.8 (93-98.7)	92.7 (87.8-95.8)	92.2 (87.2-95.4)
PLR[3]	0.17 (0.11-0.26)	0.09 (0.05-0.2)	0.75 (0.40-1.3)	0.19 (0.1-0.3)
NLR[4]	0.07(0.04-0.12)	0.03 (0.01-0.07)	0.07 (0.04-0.1)	0.08 (0.05-0.1)

1. Positive predictive value; 2. Negative predictive value; 3. Positive Likelihood Ratio; 4. Negative Likelihood Ratio.

Table 3: Screening performance characteristics of urine blood in comparison with the results of abdominopelvic computed tomography scan

Characteristics	kidney	Spleen	Liver	Free fluid
Sensitivity	15.9 (10.9-22.5)	8.2 (4.7-13.7)	8.8 (5.2-14.4)	16.5 (11.4-23.2)
Specificity	96.1 (91.4-98.4)	97.4 (93.1-99.1)	94.8 (89.8-97.5)	94.2 (89.0-97.1)
PPV[1]	81.8 (63.9-92.3)	77.7 (51.9-92.6)	65.2 (42.8-82.8)	75 (58.4-87.6)
NPV[2]	51.3 (45.4-57.2)	49.5 (43.7-55.2)	49 (43.2-54)	51 (45.1-56.9)
PLR[3]	4.5 (2.1-9.4)	3.5 (1.42-8.59)	1.87 (0.99-3.5)	3.1 (1.7-5.6)
NLR[4]	0.94 (0.8-1.1)	1.01 (0.9-1.1)	1.04 (0.9-1.2)	0.95 (0.8-1.1)

1. Positive predictive value; 2. Negative predictive value; 3. Positive Likelihood Ratio; 4. Negative Likelihood Ratio.

Table 4: Screening performance characteristics of urine red blood cell count in comparison with the results of abdominopelvic computed tomography scan

Characteristics	kidney	Spleen	Liver	Free fluid
Sensitivity	18.1(9.5-31.3)	10.9 (4.5-22.9)	9.0 (3.3-20.7)	16.3 (8.2-29.3)
Specificity	91.4 (87.3-94.4)	95.5 (92.1-97.5)	93.3 (89.4-95.8)	99.1 (96.7-99.8)
PPV[1]	30.3 (16.2-48.8)	33.3 (14.3-58.8)	21.7 (8.2-44.2)	81.8 (47.7-96.7)
NPV[2]	84.5 (79.8-88.4)	84.0 (79.3-87.8)	83.4 (78.6-87.3)	84 (79.1-87.9)
PLR[3]	0.43 (0.2-0.8)	0.5 (0.24-1.03)	0.27 (0.12-0.62)	4.5 (1.24-16.2)
NLR[4]	0.18 (0.13-0.23)	0.18 (0.14-0.24)	0.19 (0.15-0.25)	0.19 (0.14-0.24)

1. Positive predictive value; 2. Negative predictive value; 3. Positive Likelihood Ratio; 4. Negative Likelihood Ratio.

Sensitivity, specificity, PPV, NPV, PLR, and NLR of urinalysis were 77.9% (95% CI: 69.6-84.4), 58.5% (95% CI: 51.2-65.5), 56% (95% CI: 48.5-63.3), 79.6% (95% CI: 71.8-85.7), 1.27% (95% CI: 1.30-1.57), and 0.25% (95% CI: 0.18-0.36), respectively. In addition, screening performance characteristics of gross appearance, dipstick and red blood cell count in predicting the possibility of intra-abdominal solid organ injuries including liver, spleen, kidney and also presence or absence of abdominal free fluid are shown in tables 2, 3, and 4, respectively.

Discussion:

The results of this study show that sensitivity and specificity of urinalysis in predicting intra-abdominal injuries is low. It seems that using urinalysis for predicting traumatic abdominal injuries is not accurate enough. Rapid diagnosis and timely treatment of abdominal traumas is very important and can play an important role in decreasing mortality rates among patients (19-21). Different studies express various, and sometimes contradicting, opinions on the accuracy of urinalysis in blunt abdominal trauma. In a study, Wessel et al. introduced ultrasonography and urinalysis as the optimal tools for an initial evaluation to exclude renal injury following blunt abdominal trauma (22). In addition, Isaacman et al. demonstrated that the prevalence of laboratory abnormalities was low in pediatric trauma patients and recommended a combination of physical examination and urinalysis as a highly sensitive screening tool. They showed that laboratory testing in patients with a normal physical examination and urinalysis rarely identified missed intra-abdominal injury (8). Caparo et al. studied the trauma panels' tests such as sodium, glucose, white blood cell (WBC) count, hematocrit, platelets, prothrombin time, activated partial thromboplastin time, aspartate aminotransferase (AST), alanine aminotransferase (ALT), amylase, lipase, and urinalysis in pediatric patients with blunt trauma. Their results showed that abnormal values for glucose, AST, urinalysis, and WBC count were the most commonly observed. They concluded that routine trauma panels could not be used as a

screening tool in children with blunt trauma (14). In a study by Stein et al. the degree of hematuria did not correlate with the degree of renal injury. Based on their findings, any child with a history of blunt abdominal trauma and any evidence of hematuria should undergo abdominopelvic CT scan for correct diagnosis (23). Kennedy et al. showed that urinary dipstick is a safe, accurate, and reliable screening test for evaluating the presence or absence of hematuria in patients suffering from either blunt or penetrating abdominal trauma (24). Perez-brayfield et al. declared that abdominopelvic CT scan should only be done when the patient's urinalysis shows an red blood cell count of 50 or more (25). Yet, in a study by Keller et al. routine laboratory tests such as urinalysis had little value in the management of injured children (16). In other studies, although urinalysis was valuable in specific patient populations, it showed moderate bias in predicting abdominal injury in traumatic children and was not helpful(17, 18). We can conclude that practically it is not possible to distinguish the patients with intra-abdominal injuries from the others solely using urinalysis.

This study was carried out in centers, which perform urinalysis for most of the patients with possible abdominal trauma, but only the patients that are thought to have a higher possibility of abdominal trauma are scanned. Therefore, maybe the results of this study cannot be generalized. To be able to generalize the results of this study a broader study in multiple centers is recommended.

Conclusion:

The diagnostic value of urinalysis in prediction of blunt traumatic intra-abdominal injuries is low and it seems that it should be considered as an adjuvant diagnostic tool in conjunction with other sources such as clinical findings and imaging.

Acknowledgments:

This article has been extracted from Dr. Reza Shirvani's thesis for achieving his specialist degree in emergency medicine from the Faculty of Medicine at Shahid Beheshti University of Medical Sciences.

Conflict of interest:

None

Funding support:

None

Authors' contributions:

All authors passed four criteria for authorship contribution based on recommendations of the International Committee of Medical Journal Editors.

References:

1. Tan WW, Chen CC, Chiang HJ. The value and role of computed tomography in blunt injury of the abdomen. Zhonghua Yi Xue Za Zhi (Taipei). 1991;48(2):116-20.
2. Feliciano D. Diagnostic modalities in abdominal trauma. Peritoneal lavage, ultrasonography, computed tomography scanning, and arteriography. Surg Clin North Am. 1991;71(2):241-56.
3. Schurink G, Bode P, Van Luijt P, Van Vugt A. The value of physical examination in the diagnosis of patients with blunt abdominal trauma: a retrospective study. Injury. 1997;28(4):261-5.
4. Thal E, Meyer D. The evaluation of blunt abdominal trauma: computed tomography scan, lavage, or sonography? Adv Surg. 1991;24:201-28.
5. Wilson CB, Vidrine Jr A, Rives JD. Unrecognized abdominal trauma in patients with head injuries. Ann Surg. 1965;161(4):608-13.
6. Wening J. Evaluation of ultrasound, lavage, and computed tomography in blunt abdominal trauma. Surg Endosc. 1989;3(3):152-8.
7. Willmann JrK, Roos JE, Platz A, et al. Multidetector CT: detection of active hemorrhage in patients with blunt abdominal trauma. Am J Roentgenol. 2002;179(2):437-44.
8. Isaacman DJ, Scarfone RJ, Kost SI, et al. Utility of routine laboratory testing for detecting intra-abdominal injury in the pediatric trauma patient. Pediatrics. 1993;92(5):691-4.
9. Cotton BA, Beckert BW, Smith MK, Burd RS. The utility of clinical and laboratory data for predicting intraabdominal injury among children. J Trauma. 2004;56(5):1068-75.
10. Köksal Ö, Çevik ŞE, AYDIN ŞA, Özdemir F. Analysis of the necessity of routine tests in trauma patients in the emergency department. Ulus Travma Acil Cerrahi Derg. 2012;18(1):23-30.
11. Marx J, Hockberger R, Walls R. Rosen's Emergency Medicine-Concepts and Clinical Practice: Elsevier Health Sciences; 2013. p. 68.
12. Streck Jr CJ, Jewett BM, Wahlquist AH, Gutierrez PS, Russell WS. Evaluation for intra-abdominal injury in children following blunt torso trauma. Can we reduce unnecessary abdominal CT by utilizing a clinical prediction model? J Trauma Acute Care Surg. 2012;73(2).
13. Raz O, Haifler M, Copel L, et al. Use of adult criteria for slice imaging may limit unnecessary radiation exposure in children presenting with hematuria and blunt abdominal trauma. Urology. 2011;77(1):187-90.
14. Capraro AJ, Mooney D, Waltzman ML. The use of routine laboratory studies as screening tools in pediatric abdominal trauma. Pediatr Emerg Care. 2006;22(7):480-4.
15. Gorchynski J, Dean K, Anderson CL. Analysis of urobilinogen and urine bilirubin for intra-abdominal injury in Blunt trauma patients. West J Emerg Med. 2009;10(2):85.
16. Keller MS, Coln CE, Trimble JA, Green MC, Weber TR. The utility of routine trauma laboratories in pediatric trauma resuscitations. Am J Surg. 2004;188(6):671-8.
17. Olthof DC, Joosse P, van der Vlies CH, de Reijke TM, Goslings JC. Routine urinalysis in patients with a blunt abdominal trauma mechanism is not valuable to detect urogenital injury. Emerg Med J. 2013:emermed-2013-202651.
18. Thorp AW, Young TP, Brown L. Test characteristics of urinalysis to predict urologic injury in children. West J Emerg Med. 2011;12(2):168.
19. Shojaee M, Faridaalaee G, Yousefifard M, et al. New scoring system for intra-abdominal injury diagnosis after blunt trauma. Chin J Traumatol. 2014;17(1):19-24.
20. Shojaee M, Faridaalaee G, Sabzghabaei A, et al. Sonographic detection of abdominal free fluid: Emergency residents vs radiology residents. Trauma Mon. 2013;17(4):377.

21. Alavi-Moghaddam M, Safari S, Najafi I, Hosseini M. Accuracy of urine dipstick in the detection of patients at risk for crush-induced rhabdomyolysis and acute kidney injury. Eur J Emerg Med. 2012;19(5):329-32.
22. Wessel L, Scholz S, Jester I, et al. Management of kidney injuries in children with blunt abdominal trauma. J Pediatr Surg. 2000;35(9):1326-30.
23. Stein JP, Freeman JA, Kaji DM, Esrig D, Eastham J, Ehardy B. Blunt renal trauma 1n the pediatricpopulation: Indications for radiographic evaluation. Urology. 1994;44(3):406-10.
24. KENNEDY TJ, McCONNELL JD, THAL ER. Urine dipstick vs. microscopic urinalysis in the evaluation of abdominal trauma. Journal of Trauma and Acute Care Surgery. 1988;28(5):615-7.
25. Perez-Brayfield MR, Gatti JM, Smith EA, et al. Blunt traumatic hematuria in children. Is a simplified algorithm justified? J Urol. 2002;167(6):2543-6.