

Saline Instillation Test under Ultrasonography to Diagnose Traumatic Bladder Rupture

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Abstract

Background and Objective: Bladder rupture is still occasionally seen in trauma patients, especially in those with multiple organ injuries. If suspected, a standard diagnostic method is to perform retrograde cystogram. However, this requires that a radiologist be available, and is not applicable in patients with unstable vital signs. A diagnostic procedure that is more readily available is the saline instillation test under ultrasonographic visualization. The aim of the present study was to determine the accuracy of saline instillation test under ultrasonography in diagnosing traumatic bladder rupture.

Methods: A diagnostic study of saline instillation test under ultrasonography was undertaken, using retrograde cystogram, CT scan, and operative findings as standard comparators.

Results: During January 2012 and December 2014, 19 patients were recruited into the present study, consisting of 13 patients with bladder ruptures, one patient without bladder rupture, and six patients with injuries to kidney. We found the saline instillation test under ultrasonography to be accurate, with a sensitivity of 92.3%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 85.7%.

Conclusion: The saline instillation test under ultrasonography for the diagnosis of traumatic bladder rupture has good sensitivity and specificity. It was easy to perform, convenient and fast, and can provide a timely diagnosis, leading to prompt treatment and probably a reduction in complications.

Keywords: Bladder rupture injury, retrograde cystogram, saline instillation test, ultrasonography

INTRODUCTION

Bladder rupture is present in 2% of blunt and penetrating abdominal injuries, mostly related to pelvic fractures¹⁻⁴. Patients often present with suprapubic pain and an inability to void. Clinical signs may include suprapubic tenderness, apparent abdominal distention coupled with hematuria in unconscious patients. Missed diagnosis may occur in a number of patients, especially in those with multiple organ injuries and are unconscious^{4,5,6}, when presenting with abdominal collection after a Focused Assessment with Sonography in Trauma (FAST). This would commonly

lead surgeon to initially consider liver or splenic injuries, rather bladder rupture.

At present there are various ways of diagnosing bladder rupture. The standard procedure is to perform retrograde cystography^{7,8,9}. But this procedure requires the assistance of a radiologist, and may also be limited to patients who are hemodynamically and clinically unstable during transportation to the radiology suite, and thus is not generally applicable.

In contrast, bedside ultrasound diagnosis of traumatic bladder rupture can be performed in the emergency room by a general surgeon, using saline

instillation, which is easy, convenient and fast. Therefore, we decided to determine the accuracy of saline instillation test under ultrasonography in patients with suspected bladder rupture at the emergency room at Saraburi Hospital as well as to review the outcomes, complications and mortality rates associated with traumatic bladder rupture.

METHODS

Data of trauma patients who were admitted to Saraburi Hospital from 1 January 2012 to 31 December 2014 were collected. Inclusion criteria included patients suspected of having bladder rupture with the following symptoms and signs: suprapubic pain and inability to void, coupled with hematuria; suprapubic tenderness, abdominal distention in conjunction with hematuria in an unconscious patient; presence of pelvic fractures, coupled with hematuria; and FAST-detected abdominal collection without associated injuries to other organs, coupled with hematuria. The exclusion criteria included severely injured patients with multiple organ injuries likely to die at the emergency room, and patients with urethral injury.

Data collected consisted of age; gender; type of organ injuries; results of saline instillation test under ultrasonography; standard diagnostic methods to confirm bladder injuries, such as retrograde cystogram, CT scan, or operative findings; type of treatment; infectious complications (urinary tract infection, peritonitis, septicemia); abdominal collection; and treatment outcomes (recovery, persistent leakage, fistula, and death).

All patients underwent a standardized saline instillation test under ultrasonography in the emergency room, performed by the study surgeon. First, per rectal examination for ruling out a high riding prostate gland was done. Then the ultrasound (US) was used to assess the amount of free fluid in all areas of the abdomen. If found, the fluid level was measured in centimeters as a baseline. Next, assessment of solid organ injuries was done, followed by the evaluation of bladder distension, collapse, distortion, or presence of blood clot. After urinary catheter insertion, the US was used to locate the catheter balloon in the bladder, and the size of bladder was measured in centimeters.

Saline instillation was begun by instilling normal

saline solution (NSS) at 7 mL/kg body weight, or approximately 500 mL through the urinary catheter, which was then clamped, and the US was used to check for any fluid leakage from the bladder. By taking 3 dimensional measurements of the bladder at 0, 3 and 5 minutes after instillation as well, any 2 positives of the following 3 criteria would constitute a positive result of the saline instillation test: evident fluid leakage by US; reduction in the size of bladder after instillation; and, increasing abdominal fluid collection (Figures 1 to 3).

The data was described in terms of counts,



Figure 1 Flow leakage from the urinary bladder by the use of saline instillation test in conjunction with real-time ultrasonography, showing increasing abdominal collection



Figure 2 The size of the urinary bladder after NSS instillation at 0 minute.

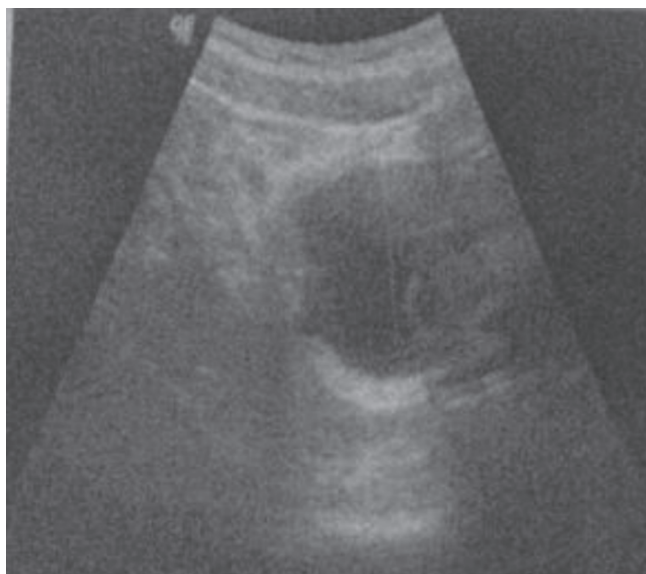


Figure 3 Flow leakage of the urinary bladder by the saline instillation test. The size of the urinary bladder after NSS instillation at 3 minutes, finding that the bladder has decreased in size and changed its shape.

percentage, mean, standard deviation, median and range. The accuracy of the saline instillation test was measured in terms of sensitivity, specificity, and predictive values.

RESULTS

There were 19 patients suspected of having bladder rupture, consisting of 15 men and 4 women. The average age was 32.2 years (± 13.6 years). Patients commonly had abdominal, orthopedic and head trauma (Table 1). There were three pelvic fractures, all of type A. Of the 13 bladder ruptures, 12 was intraperitoneal, and 1 was extraperitoneal. Most patients were injured through motorcycle accidents.

Standard methods of diagnosing bladder rupture in 19 patients included retrograde cystogram in 2 patients, CT scan in 5, and operative findings in 12. From the results of these methods of diagnosis, the saline instillation test under US had a sensitivity of 92.3%, a specificity of 100%, a positive predictive value (PPV) of 100%, and a negative predictive value (NPV) of 85.7% (Table 2).

Clinical symptoms and manifestations of bladder rupture were most commonly hematuria, in 13 patients (100%). In patients with hypotension, three patients had other associated injuries, including one splenic

Table 1 Demographics of patients and details of injury

Characteristics and details	Summary (n = 19)
Age, years (mean $\pm$ SD)	32.2 $\pm$ 13.6
Gender: number (%)	
Male	15 (79)
Female	4 (21)
Number of organ injuries: median (range)	2 (1 to 4)
Type of organ injuries: number (%)	
Head injury	6 (32)
Chest injury	4 (21)
Abdominal injury	15 (79)
Kidney injury	5 (26)
Vascular injury	0
Orthopedic trauma	10 (53)
Bladder injury: number (%)	14 (74)
Bladder contusion	1/14 (7)
Bladder rupture	13/14 (93)
Presence of pelvic fractures: number (%)	5 (26)
Type of pelvic fracture: number (%)	
Type A	3/3 (100)
Type B	0
Type C	0
Mechanism of injury: number (%)	
Motor vehicle accident	5 (26)
Motorcycle accident	11 (58)
Body assault	2 (11)
Crush injury	1 (5)

Table 2 Sensitivity, specificity, and predictive values of the saline instillation test under ultrasonography (n = 19)

Outcomes	Bladder rupture	No bladder rupture
Positive Test	12	0
Negative Test	1	6
Total	13	6
Accuracy:	Sensitivity, 92.3%	Specificity, 100 %
Predictive value (PV):	PPV, 100%	NPV, 85.7%

Table 3 Clinical symptoms and manifestation of bladder rupture (n = 13)

Clinical symptoms	Number (%)
Pubic pain	1 (8)
Pubic tenderness	2 (15)
Pelvic ecchymosis	0
Dysuria/ difficulty of voiding	2 (15)
Gross hematuria	13 (100)
Peritonitis	12 (92)
Hypotension/ shock	1 (8)

rupture and three mesenteric tears. In five patients with injured kidneys, the most common manifestation was hematuria, found in all patients. All 19 patients underwent timely treatment, and there were no operative or infectious complications, and no hospital deaths. The median of length of hospital stay was 9 days (range: 7 to 33 days).

DISCUSSION

Bladder rupture is occasionally seen in traumatic injuries, especially from traffic accidents. Traumatic bladder ruptures are often associated with multiple organ injuries, as were such patients admitted at Saraburi Hospital during 2012 and 2014. Some were unconscious on presentation. FAST to investigate the abdomen was performed by the surgeon-in-charge in all cases of suspected abdominal injury. Patients who did not undergo investigation of the bladder may have a missed bladder injury which could affect timely treatment, and may even impact survival.

From recent literature reviews, bladder ruptures are commonly associated with pelvic fractures, in perhaps 70 to 93% of cases^{2,3,4}, and are commonly extraperitoneal^{3,4,10}. At Saraburi Hospital, bladder rupture was found not to be associated with pelvic fractures. Mostly traumatic injuries were a result of crush injury to the lower abdomen, leading to increased bladder pressure causing rupture, often of the intraperitoneal type. Therefore, from this study we recommend the testing of bladder injury in all suspected cases, including those without pelvic fractures.

The present study demonstrated that the saline instillation test under US can diagnose bladder injuries in the emergency room before admission, with satisfactory accuracy. The saline instillation test under US in 19 suspected patients had a sensitivity of 92.3%, a specificity of 100%, and PPV and NPV of 100% and 85.7% respectively. However, some skill and experience are needed to detect such injuries using the US.

We found one patient who had bladder rupture, with clinical findings of hematuria and peritonitis, but negative saline instillation test. On US no leakage was seen, and the bladder did not collapse after NSS instillation, but the patient had increasing abdominal distension and pain. This patient underwent surgery

because of peritonitis. During operation, we found serosal tears of the sigmoid colon, in association with intraperitoneal bladder rupture filled with blood clots. Therefore, in suspected cases of bladder rupture, even if the US showed no bladder collapse, bladder rupture cannot be ruled out because blood clots can interfere with the test results. In such cases, other diagnostic tests such as retrograde cystography or CT cystography might be necessary.

CONCLUSION

The saline instillation test under US visualization for the diagnosis of traumatic bladder rupture was easy, convenient and fast, and could be performed by a general surgeon with acceptable accuracy. It is an alternative to conventional retrograde or CT cystography, especially when the radiologist is not available, and when the patient is clinically unstable.

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