

THE ROLE OF BEDSIDE BLADDER SONOGRAPHY FOR DETECTION OF BLADDER TRAUMA

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ABSTRACT

Objective: To evaluate the role of bedside bladder sonography along with retrograde instillation of saline as a novel diagnostic procedure for suspected bladder trauma. **Material & methods:** Prospective evaluation of all patients with suspected bladder injuries admitted to the Emergency Department of Hasan Sadikin General Hospital, Bandung, Indonesia, from 2010–2013. Suspected urethral injury patients were excluded. Along with routine Focused Assessment Sonography for Trauma (FAST) procedure, bedside bladder sonography was performed concurrently with retrograde instillation of normal saline 350cc through a Foley catheter. The objective of real-time bladder sonogram was to examine the presence of peri-vesical free fluid turbulence and accumulation during saline instillation, which subsequently indicated a suspected bladder perforation. The accuracy of sonographic results were compared with computerized tomography (CT), cystogram or intraoperative findings. Time to diagnosis was recorded. Statistical analysis was performed to evaluate the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy. **Results:** 23 patients met the inclusion criteria. The mean age was 27.21 years old, 87% were males. Based on cystogram or intraoperative finding there are 21 patients have bladder rupture. Among these patients, 14 patients had positive result on bladder sonogram, and all confirmed positive on cystogram and operative finding. Nine patients had negative result on bladder sonogram. While 7 among them have positive result on cystogram or intraoperative finding. Analysis revealed 67% sensitivity, 100% specificity, 100% PPV, and 22.2% NPV. Overall diagnostic accuracy of bladder sonogram was 83.5%. Time to diagnosis were significantly shorter in bedside bladder sonogram compared to CT or cystogram (11.82 ± 2.99 min vs 181.30 ± 88.89 min; $p < 0.05$). **Conclusion:** Bedside bladder sonogram is a useful adjunct procedure for diagnosis of bladder trauma. It is time and cost effective, and can be performed in bed-side emergency setting with acceptable accuracy.

Keywords: Bedside bladder sonography, bladder trauma, retrograde instillation.

ABSTRAK

Tujuan: Mengevaluasi peranan sonografi kandung kemih bedside dengan instilasi retrograde saline sebagai prosedur diagnostik untuk curiga trauma kandung kemih. **Bahan & cara:** Evaluasi prospektif pada semua pasien dengan curiga luka kandung kemih yang terdaftar di Departemen Kegawatdaruratan RSUP Hasan Sadikin Bandung, Indonesia, dari tahun 2010–2013. Pasien curiga luka uretra tidak termasuk. Bersama dengan prosedur rutin Focused Assessment Sonography for Trauma (FAST), bedside bladder sonography dilakukan secara bersamaan dengan instilasi retrograde saline normal 350cc melalui kateter Foley. Tujuan sonogram kandung kemih real-time adalah untuk menguji adanya turbulensi dan perforasi cairan peri-vesical. Keakuratan hasil sonografi dibandingkan dengan computerized tomography (CT), cistogram atau temuan intraoperatif. Waktu diagnosa dicatat. Analisa statistik dilakukan untuk mengevaluasi sensitifitas, spesifisitas, positive predictive value (PPV), negative predictive value (NPV) dan keakuratan diagnosa. **Hasil:** Sebanyak 23 pasien memenuhi kriteria inklusi. Rerata usia adalah 27.21 tahun, 87% laki-laki. Berdasarkan temuan cistogram atau intraoperatif didapatkan 21 pasien dengan pecah kandung kemih. Diantara pasien tersebut, 14 pasien memiliki hasil positif sonogram kandung kemih, dan semua dikonfirmasi positif pada temuan operatif dan cistogram. 9 pasien dengan hasil negatif sonogram kandung kemih. Sementara 7 diantara mereka dengan hasil positif cistogram atau temuan intraoperatif. Analisa membuktikan 67% sensitifitas, 100% spesifisitas, 100% PPV, dan 22.2% NPV. Secara keseluruhan keakuratan diagnosa sonogram kandung kemih adalah 83.5%. Waktu mendiagnosa secara signifikan lebih pendek pada sonogram kandung kemih bedside dibandingkan CT atau cistogram (11.82 ± 2.99 min vs 181.30 ± 88.89 min; $p < 0.05$). **Simpulan:** Sonogram kandung kemih bedside adalah prosedur tambahan yang bermanfaat untuk diagnosa trauma kandung kemih. Menghemat waktu dan pengeluaran, dan dapat dilakukan pada saat kegawatdaruratan bedside dengan keakuratan yang baik.

Kata kunci: Sonografi kandung kemih bedside, trauma kandung kemih, instilasi retrograde.

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INTRODUCTION

Urinary tract injuries occur in 10–15% of blunt and penetrating abdominal trauma and 15% of all pelvic fractures are associated with concomitant bladder or urethral injuries.¹ Bladder injury incidence comprise almost 2% of the entire urinary tract trauma. Ninety percent of bladder trauma are caused by pelvic fractures. Of all bladder injuries, 60-85% are from blunt trauma and 15-40% comes from penetrating injuries. The most common blunt trauma mechanism are motor vehicle collisions (87%), falls (7%), and violence assault (6%). Bladder injuries caused by penetrating injury are most frequently due to gun shot wounds (85%) followed by stab wound (15%).² Prompt recognition of bladder rupture is important due to the high mortality rate and infectious complications associated with this injury. Signs and symptoms of urinary bladder rupture include lower abdominal pain and tenderness, dysuria or inability to void, and gross hematuria. Even when all these signs and symptoms are present, the diagnosis of a bladder rupture may still be delayed secondary to concomitant urethral distracting injuries or hemodynamic instability.^{1,3}

The current gold-standard for diagnosis of traumatic bladder rupture include CT or cystogram, but these imaging modalities may only be performed in stable patients. On the other hand, sonograms are readily available in emergency bed-side settings, since Focused Assessment with Sonography for Trauma (FAST) has become a routine procedure.⁴ Nowadays sonography is a valuable diagnostic modality in suspected abdominal and pelvic trauma. The acronym FAST was selected at the 1997 International Consensus Conference to name the diagnostic ultrasound scan performed during the initial assessment of trauma patients. FAST is a valuable manner in trauma setting and has advantages of being safe, rapid, inexpensive, noninvasive and portable.⁵ To date there are only 2 limited report of using bedside ultrasound to diagnose a suspected bladder rupture, Wu TS et al and Kareem T & Topno that evaluated the bladder sonogram in diagnosis of bladder trauma.

OBJECTIVE

This study aimed to evaluate the role of bedside bladder sonography along with retrograde

instillation of saline as a novel diagnostic procedure for suspected bladder trauma.

MATERIAL & METHODS

Prospective evaluation of all patients with suspected bladder injuries admitted to the Emergency Department of Hasan Sadikin General Hospital, Bandung, Indonesia, from year 2010–2013. Suspected urethral injury patients were excluded. Along with routine FAST procedure, bedside bladder sonography was performed concurrently with retrograde instillation of sterile normal saline 350cc through a Foley catheter. It was performed by senior chief of urology resident in our centre and consulted to urology trauma consultant. The presence of inadequate or absence distention of the bladder, free-fluid turbulence in peri-vesical and accumulation into intra peritoneal space during retrograde bladder instillation subsequently indicated bladder rupture. Free-fluid turbulence and accumulation into intraperitoneal space which indicated intraperitoneal rupture is a significant finding to determine intra or extraperitoneal bladder rupture.

The accuracy of sonographic results were compared with CT-cystogram or conventional cystogram in stable haemodynamic patients, and intraoperative findings in unstable patients. Time to diagnosis was recorded. Statistical analysis was performed to evaluate the sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and diagnostic accuracy.

RESULTS

Twenty three patients met the inclusion criteria. The mean age was 27.21 years old, 87% were males. Most caused by motor vehicle accidents (86.9%) and 43.4% associated with pelvic fracture. One case due to iatrogenic caused by obstetric surgery. 22 patients were underwent for explorative laparotomy. Based on cystogram or intraoperative finding there are 21 patients have bladder rupture, 50% were intra peritoneal bladder rupture. Among these patients, 14 patients had positive result on bladder sonogram, and all confirmed positive on cystogram and operative finding. Nine patients had negative result on bladder sonogram. While 7 among them have positive result on cystogram or intraoperative finding. We evaluate and compare

Table 1. 2x2 Diagnostic test table.

Sonographic finding	Cystogram findings/intraoperative	
	Bladder rupture (n)	Without bladder ruptur (n)
Positive (n)	14	0
Negative (n)	7	2

sonographic results with CT, Cystogram or intraoperative finding using 2x2 diagnostic test table.

Analysis revealed 67% sensitivity, 100% specificity, 100% PPV, and 22.2% NPV. Overall diagnostic accuracy of bladder sonogram was 83.5%. Time to diagnosis were significantly shorter in bedside bladder sonogram compared to CT or cystogram (11.82 ± 2.99 min vs 181.30 ± 88.89 min; $p < 0.05$).

DISCUSSION

Injuries involving the lower urinary tract are commonly seen after blunt trauma and are often associated with severe multiple injuries. Bladder injuries constitute one of the most common urological injuries in trauma patients. With the combined efforts of many surgeons, a standard approach to bladder injuries has been gradually established over the last twenty years. This approach includes using a retrograde cystogram, which is almost 100% sensitive, as a standard diagnostic tool for bladder rupture, and a simple urethral catheter drainage alone, which is usually successful for the management of most extraperitoneal bladder ruptures.⁶

Patients with suspected bladder injuries due to blunt trauma are usually evaluated with retrograde cystography, which when correctly performed is nearly 100% accurate. However, computerized tomography (CT) of the abdomen and pelvis may be performed before cystography when other abdominal injuries are suspected. Abdominal CT, in general, is inferior to the retrograde cystogram as a method of detecting bladder injury, unless CT cystography is used as an adjunct to CT. Recent data reported various accuracy rate between 60–95%, and all conclude that CT has inferior rate compared with retrograde cystogram.⁶⁻⁸ although these modalities carry high accuracy rate, their utility is limited by the resources, staff available, and need for stable haemodynamic.

On the other hand, sonograms are readily

available in emergency bed-side settings, since Focused Assessment with Sonography for Trauma (FAST) has become a routine procedure.⁴ Nowadays sonography is a valuable diagnostic modality in suspected abdominal and pelvic trauma. The acronym FAST was selected at the 1997 International Consensus Conference to name the diagnostic ultrasound scan performed during the initial assessment of trauma patients. FAST is a valuable manner in trauma setting and has advantages of being safe, rapid, inexpensive, noninvasive and portable.⁵ The use of ultrasound for abdominal trauma was first described by Kristensen and colleagues in 1971. Some studies reported high accuracy of ultrasound in diagnosis of abdominal trauma, sensitivity varies between 89–96%, with accuracy between 98–99%.^{4,5,9,10}

Bladder sonography concurrently with routine FAST on trauma patient with suspected of bladder injury comes as a new modality for rapid and bed-side setting in diagnosis of bladder rupture. There were only limited data that reported the usefulness of bladder sonography for diagnosis of bladder trauma.^{1,3} Kareem and Topno¹ reported sensitivity 90% and PPV 100% of bladder sonograms for diagnosis of bladder trauma in 22 patients suggestive bladder injury. In our study revealed 67% sensitivity, 100% specificity, 100% PPV, and 22.2% NPV. Overall diagnostic accuracy of bladder sonogram was 83.5%. We have lower in sensitivity compared with Kareem and Topno's result.¹ But in predictive positive value and specificity, sonography has high accuracy. The presence of inadequate or absence distention of the bladder, free-fluid turbulence in peri-vesical and accumulation into intra peritoneal space during retrograde bladder instillation subsequently indicated bladder rupture, and it has strong suggestive value. At this point, it would not be prudent to use ultrasound to rule out bladder rupture, as it can miss subtle bladder wall injuries and slow-leaking rupture. Diagnosing a bladder rupture via bedside sonography can accelerate care and help tailor further diagnostic



Figure 1. Sonography on bladder trauma patient, the red arrow showing intraperitoneal rupture.

Bedside sonogram can be used as a quick and safe adjunct to the history and physical examination, meanwhile providing useful data in a timely fashion. In our study, time to diagnosis were significantly shorter in bedside bladder sonogram compared to CT or cystogram (11.82 ± 2.99 min vs 181.30 ± 88.89 min; $p < 0.05$). Unfortunately, performing conventional retrograde cystography or CT Scan in our centre, needs more time due to administration procedure and limited resource. Large-scale studies, and more research should be directed towards highlighting the benefits and limitation of this novel sonography application.

CONCLUSION

Bedside bladder sonogram is a useful adjunct procedure for diagnosis of bladder trauma. It is time and cost effective, and can be performed in

bed-side emergency setting with acceptable accuracy. In patients at risk for bladder rupture, bedside ultrasound findings can be used to help make the diagnosis and expedite patient management.

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