The Value of CT in the Detection of Bladder and Posterior Urethral Injuries

Naomi M. Kane[1]
Isaac R. Francis
James H. Ellis

To determine the value of CT in the diagnosis of bladder and posterior urethral injuries, we retrospectively evaluated the CT and urethrocystographic findings in 33 trauma patients with suspected injuries of the lower urinary tract who had both studies in their initial evaluation. In 26 (79%) of 33 patients, results of both examinations were normal. Seven (21%) of 33 patients had bladder injuries (seven—two in one patient) and/or posterior urethral injuries (three) as determined on the basis of urethrocystography. Three patients had extraperitoneal bladder tears as the only injury to the lower urinary tract. Two patients had both extraperitoneal bladder tears and posterior urethral injuries. One patient had both an extraperitoneal tear at the bladder base and an intraperitoneal rupture at the bladder dome. The seventh patient had an isolated posterior urethral injury. All seven bladder injuries were detected with CT. In these cases, CT findings included (1) free intraperitoneal contrast material (one case), (2) focal contrast extravasation (three cases), and (3) paravesical fluid collections that on delayed CT scans revealed contrast accumulation in the fluid, indicating extravasation (two cases). The seventh bladder injury was suspected on CT and confirmed with retrograde urethrography. Only one of three posterior urethral injuries was detected with CT.

Our results suggest that CT is sensitive in the detection of bladder injuries, but not for the diagnosis of urethral injuries.

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Patients with suspected urethral and bladder injuries associated with blunt trauma are usually evaluated with urethrocystography [1–3]. However, CT may be performed before urethrocystography when other abdominal injuries are present. To determine the value of CT in the detection of injuries of the posterior urethra and bladder, we compared the CT diagnoses with those of urethrocystography in 33 trauma patients suspected of having injuries of the lower urinary tract.

Materials and Methods

We retrospectively evaluated the medical records, CT scans, and urethrocystograms in all 33 patients seen during the past 4 years (1984–1988) who had both examinations as part of the initial evaluation for blunt abdominal and/or pelvic trauma. The CT scans were interpreted without knowledge of the urethrocystographic findings.

The age range was 4 months to 57 years (mean, 22 years). There were 22 males and 11 females. Trauma was the result of vehicular accidents ($n = 26$), pedestrian-vehicular accidents ($n = 2$), and crushing or falling accidents ($n = 5$). Pelvic fractures were present in 24 (73%) of the 33 patients.

All CT examinations were peformed with a GE 9800 CT/T scanner (General Electric Medical Systems, Milwaukee, WI); 10-mm-thick contiguous axial sections from the diaphragm through the symphysis pubis were obtained. Both IV and oral contrast media were used. Bolus, dynamic, incremental scans from the domes of the diaphragm through the pelvis were performed. All patients received dilute contrast medium (Hypaque 1.5%, Winthrop-Breon,

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[1] All authors: Department of Radiology, University of Michigan Hospitals, Taubman 2910, Box 0326, 1500 E. Medical Center Dr., Ann Arbor, MI 48109-0030. Address reprint requests to N. M. Kane.

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New York, NY) either orally or by nasogastric tube (500–1000 ml). If a Foley catheter was present, it was clamped before CT was performed. Delayed images through the pelvis were 10-mm contiguous axial sections, typically obtained 15–30 min after initiation of the study.

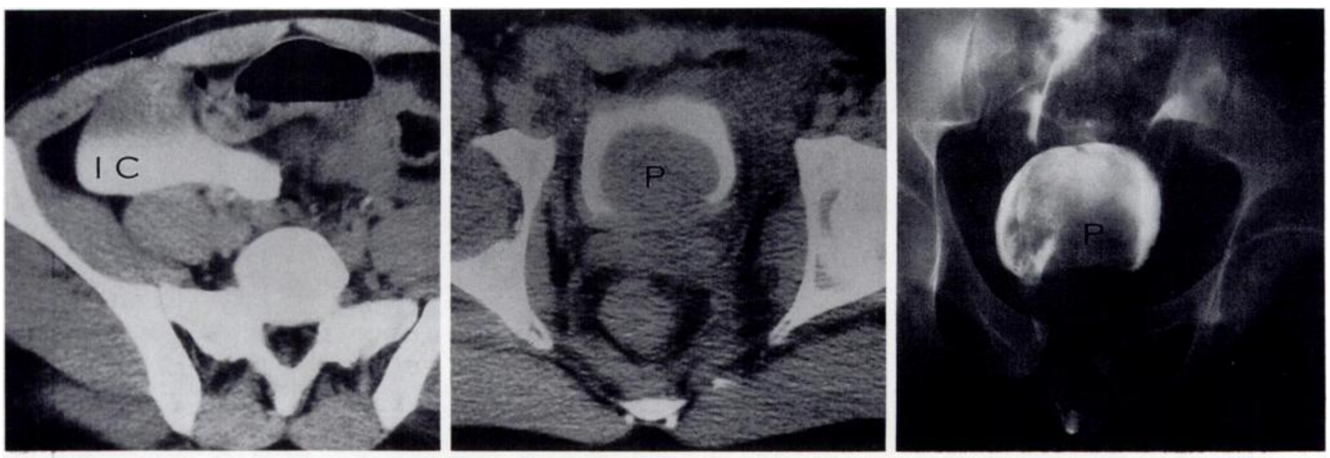
Urethrography in males generally was performed by inserting a Foley catheter into the urethral meatus and partially inflating the balloon in the fossa navicularis. Most studies were performed by using fluoroscopy, with spot films obtained during hand injection of 60% water-soluble contrast material. Cystography was usually performed under fluoroscopic control by gravity infusion of 30% water-soluble contrast material into the bladder via a Foley catheter. If no early extravasation of contrast material was identified fluoroscopically, a minimum of 250–300 ml of contrast material was used to distend the bladder in adult patients. Anteroposterior and, if possible, lateral and oblique radiographs of the bladder were obtained subsequently. A postdrainage film was obtained in all but one patient, who required emergent surgery.

Two of seven patients had surgical confirmation of the radiographic findings. The remaining five patients were managed conservatively with Foley catheter drainage and had radiologic follow-up.

Results

Twenty-six (79%) of the 33 patients had no evidence of bladder or urethral injury shown on either urethrocystography or CT. In the remaining seven patients, seven bladder injuries (two in one patient) and one posterior urethral injury were diagnosed on the basis of both studies. Two additional posterior urethral injuries were shown with urethrocystography, but not with CT.

Three patients had extraperitoneal bladder tears as the only injury to the lower urinary tract. Two patients had both extraperitoneal tears and posterior urethral injuries. One pa-



A B C

Fig. 1.—Intraperitoneal bladder rupture with avulsion of bladder neck.
***A*, CT scan shows free intraperitoneal contrast material (IC).**
***B*, More caudal CT scan shows elevation of bladder with a large soft-tissue mass caused by a blood clot and prostate gland (P). Note dislocation of right hip.**
***C*, Urethrogram shows intraperitoneal contrast material outlining bowel loops, disruption of bladder floor, dislocation of right hip, and pelvic fractures. Filling defect in bladder is blood clot and prostate gland (P).**

A B

Fig. 2.—Extraperitoneal bladder rupture and posterior urethral injury.
***A*, CT scan shows extraperitoneal extravasation of contrast material due to bladder injury (posterior urethral injury not detected with CT). Note extension of contrast material into anterior abdominal wall.**
***B*, Cystogram shows extraperitoneal extravasation of contrast material. A posterior urethral injury also was identified on retrograde urethrogram (not shown).**

tient had both an extraperitoneal tear at the bladder base and an intraperitoneal rupture at the bladder dome. The seventh patient had an isolated posterior urethral injury. All seven patients had pelvic fractures. Three of seven patients had associated visceral injuries identified with CT, including splenic lacerations in two, a mesenteric hematoma in one, and a hepatic laceration in one.

Six bladder injuries were clearly identified with CT. A seventh injury, avulsion of the bladder base from the prostate gland, was suspected (Fig. 1) and later confirmed with retrograde urethrography.

The CT findings included (1) free intraperitoneal contrast material in one patient (Fig. 1), (2) focal extraperitoneal contrast extravasation in three patients (Fig. 2), and (3) low-attenuation paravesical fluid collection, into which contrast extravasation was shown on delayed scans in two patients (Figs. 3 and 4). One patient had bladder base avulsion without extravasation (in addition to an intraperitoneal rupture, Fig. 1).

A posterior urethral injury was diagnosed on the basis of a CT scan showing focal contrast extravasation within the urogenital diaphragm in one of three patients (Fig. 5). Findings on CT scans in the other two patients with posterior urethral injuries were normal.

Discussion

Patients with suspected injuries to the bladder and posterior urethra are usually studied with urethrocystography. However, because of its value in detecting other more life-threatening injuries, CT may be the first diagnostic procedure performed [2].

In our case of intraperitoneal bladder rupture, CT showed extravasation of opacified urine and the site of the rupture in the bladder dome. Delayed scans were not obtained in this case because the bladder was well distended. Mee et al. [4]

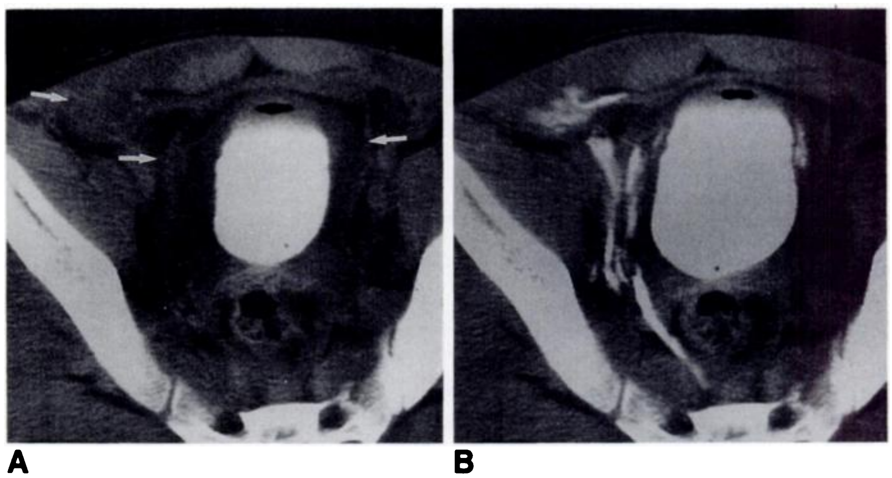


Fig. 3.—Value of delayed CT in detecting extravasated contrast material in patient with extraperitoneal bladder injury.

***A*, CT scan shows a partially distended bladder with several low-attenuation paravesical fluid collections (*arrows*).**

***B*, Delayed CT scan shows extravasation of contrast material.**

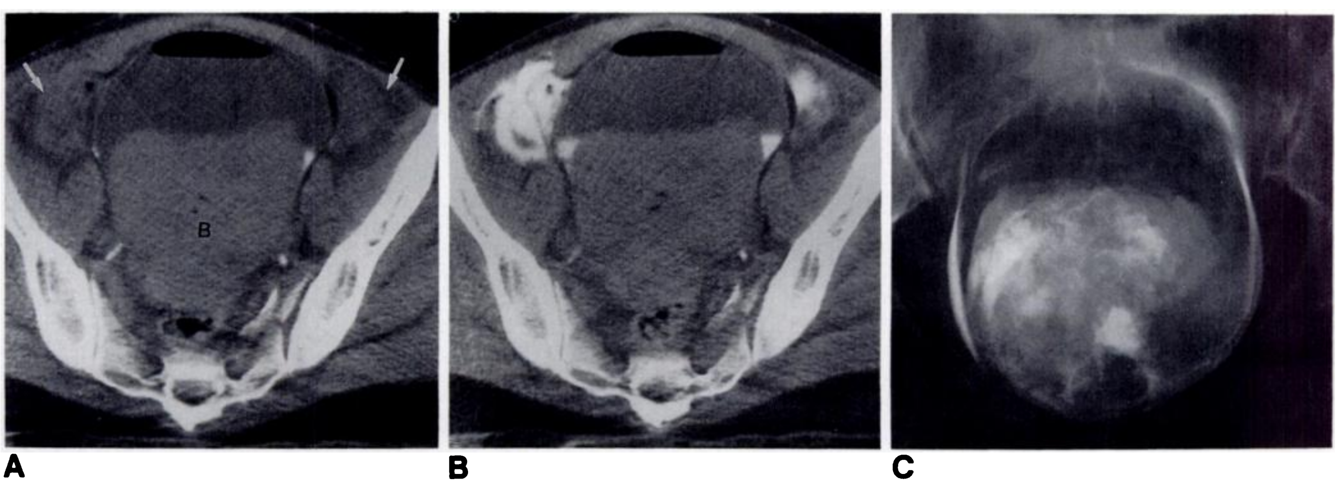


Fig. 4.—Extraperitoneal bladder rupture.

***A*, CT scan shows large intravesical blood clot (B) and low-attenuation extraperitoneal fluid collections (*arrows*). Note sacral fractures.**

***B*, Delayed CT scan shows extravasation of contrast material into paravesical fluid collection.**

***C*, Cystogram shows subtle extravasation of contrast material.**

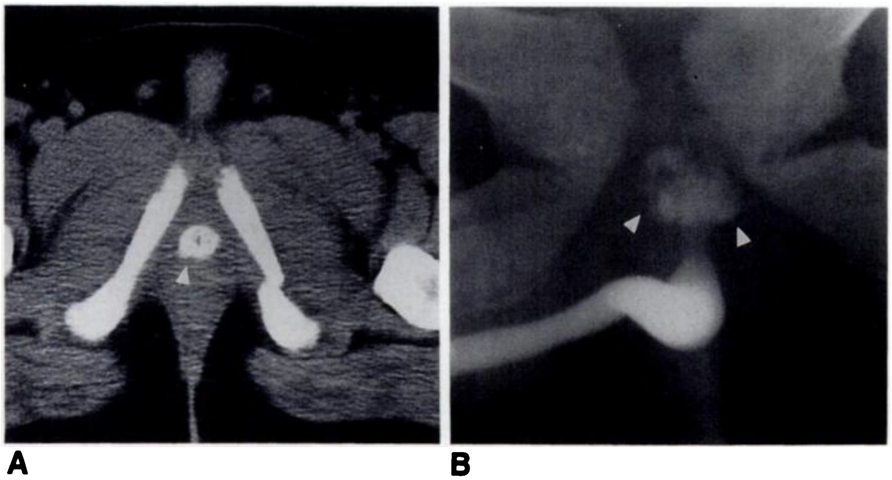


Fig. 5.—Contained posterior urethral tear.
A, CT scan shows extravasated contrast material (*arrowhead*) within urogenital diaphragm. Foley catheter is in place. Ischial fracture is seen also.
B, Urethrogram confirms presence of a posterior urethral tear (*arrowheads*).

reported two cases of bladder rupture in which the cystographic findings were abnormal and the CT findings were normal or equivocal. In neither case, even though free intraabdominal fluid was identified, were delayed CT images obtained, nor was time allowed to distend the bladder adequately on the CT study [4].

Sufficient distention of the contrast-filled bladder is required to detect bladder injury with CT. Delayed CT scans in two patients enhanced the detection of extraperitoneal extravasation. Delayed CT scans ensure that sufficient contrast material reaches the bladder and allow the bladder to be distended adequately. Also, delayed scans help to differentiate unopacified bowel loops adjacent to the bladder from small fluid collections associated with bladder rupture. These small extraperitoneal fluid collections can be subtle on cystography, especially in severely injured patients when only one projection can be obtained.

In our small series, only one of three posterior urethral injuries was detected with CT. In this case, focal extravasation occurred in the urogenital diaphragm. This injury would have gone undetected if scans had not included the entire perineum. The other two posterior urethral injuries were not detected with CT even though the appropriate scans were obtained. In these cases, the Foley catheter may have stented the leak, or the internal sphincter was intact.

In conclusion, we think that detection of bladder and posterior urethral injuries with CT can be improved by doing the following: (1) the Foley catheter, if present, should be clamped before scanning begins; (2) all patients with retroperitoneal, extraperitoneal, or intraperitoneal fluid collections should have delayed CT scans of the pelvis to identify the type and site of contrast extravasation and detect occult injuries; and (3) scans should continue through the perineum to the level of the ischial tuberosities to ensure complete evaluation of the urethra.

Our results in a small group of trauma patients suggest that CT may be as sensitive as cystography in detecting bladder injuries, but urethrocystography is superior to CT in the detection of urethral injuries.

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