Role of the plain radiograph and urinalysis in acute ureteric colic

R Boyd, A J Gray

Abstract

Objective—(1) To determine the accuracy of accident and emergency (A&E) doctors' diagnosis of radio-opaque ureteric calculi on plain abdominal radiographs; (2) to study the predictive value of haematuria with a history suggestive of ureteric colic. **Design**—A prospective study of all patients seen in a three month period with a provisional diagnosis of ureteric colic. Intravenous urography (IVU) was used as the gold standard for diagnosis of ureteric calculi.

Setting—The accident and emergency department and medical unit of a large teaching hospital.

Subjects—60 patients who were admitted with an initial diagnosis of ureteric colic, 51 subsequently undergoing intravenous urography.

Results—A&E doctors achieved a calculated sensitivity of 29% (95% confidence intervals 13% to 49%) and a specificity of 73% (52% to 90%) for identification of renal calculi on plain abdominal radiograph, compared with figures of 68% (48% to 84%) and 96% (78% to 100%) respectively for consultant radiologists. The difference between these results was highly significant ($P = 0.0011$). No patient with a definitive diagnosis of ureteric colic had a negative result for haematuria on urinary dipstick analysis.

Conclusions—A&E doctors are poor at identifying radio-opaque ureteric calculi on plain abdominal radiographs. If haematuria is absent on urinalysis then ureteric colic is an unlikely diagnosis.

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Key terms: ureteric colic; diagnosis; plain x ray; urinalysis

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Renal colic caused by calculi is a common urological condition, occurring in approximately 2% of the western population, with 50% of these patients having recurrent episodes. These patients often present directly to accident and emergency (A&E) departments and are seen initially by relatively inexperienced medical staff. There is frequently a classical combination of symptoms, often associated with microscopic or frank haematuria. The diagnosis is usually straightforward and is substantiated by a variety of radiological tests including plain abdominal films, ultrasonography, and intravenous urography. Intravenous urography is presently accepted as the gold standard

investigation to confirm the clinical diagnosis during an acute episode.¹⁻³ It is accepted practice to include the first of these tests—the plain abdominal film—as a useful and necessary adjunct to aid the early diagnosis of renal colic.³⁻⁵ Previous studies have suggested that up to 90% of all calculi are visualised on plain radiographs⁶ but other studies have given conflicting results.^{7,8}

Only two studies have attempted to compare the presence of haematuria on urinary dipstick analysis against the findings of calculi on intravenous urography (IVU) in patients with acute ureteric colic.^{9,10} To date, the negative predictive value of dipstick urinalysis in the investigation of urinary calculi has not been estimated.

Methods

We studied 60 consecutive patients with a provisional diagnosis of acute ureteric colic admitted from the A&E department of the Royal Infirmary of Edinburgh in the three months from August to October 1994.

Each patient was assessed initially by an A&E doctor (SHO, registrar, or senior registrar with no formal radiological training). Plain abdominal radiographs and urinalysis with Boeringer Mannheim dipsticks were performed before admission on all patients with an initial diagnosis of ureteric colic.

Every plain abdominal radiograph was reported as either positive or negative for radio-opaque calculi independently by both the A&E doctor and a consultant radiologist. Urinalysis was reported as positive or negative for blood. Lastly the intravenous urograms were reported as positive or negative for calculi by a consultant radiologist. The radiologists reported IVU and the plain abdominal films together. The abilities of the two groups of doctors in identifying calculi on plain films were compared using χ^2 and McNemar's tests.

Results

Fifty one of the 60 patients subsequently underwent intravenous urography within 24 hours of admission. One patient was lost to follow up. The remaining eight patients were excluded from further analysis, as an alternative diagnosis was made soon after admission.

Table 1 compares A&E doctors' plain abdominal film interpretation against the intravenous urograph (IVU) result.

This gives a calculated sensitivity of 29% (95% confidence interval 13% to 49%) with a specificity of 73% (52% to 90%) for the A&E doctors' interpretation of the plain abdominal

Table 1 A&E doctors' interpretation of the plain abdominal films

	Positive IVU	Negative IVU
Plain film positive	8	6
Plain film negative	20	17

Table 2 Consultant radiologists' interpretation of the plain abdominal films

	Positive IVU	Negative IVU
Plain film positive	19	1
Plain film negative	9	22

films when compared with IVU. The resultant positive predictive value of the A&E interpreted plain abdominal films for radio-opaque calculi was 57% (29% to 82%).

The radiologists' plain abdominal film reports are compared with the IVU results in table 2. After comparison of the data a sensitivity for the radiologists' interpretation of 68% (48% to 84%) and a specificity of 96% (78% to 100%) were calculated. The positive predictive value for a radiologist reported plain abdominal film was therefore 95% (75% to 100%), with a negative predictive value of 71% (52% to 86%).

A&E and radiology medical staffs' interpretational skills at identifying radio-opaque calculi were compared. A significant difference in skills was found ($P = 0.0011$) using McNemar's and χ^2 analysis.

The final comparison was made between urinalysis positive for haematuria and intravenous urography in table 3. This produced a sensitivity for a positive urinalysis result of 100% (88% to 100%) and a specificity of 32% (21% to 73%). The positive predictive value of haematuria on dipstick was therefore 64% (50% to 80%) and a negative predictive value was 100% (59% to 100%).

Discussion

It is standard teaching and practice to include a plain abdominal radiograph in the initial investigation of acute ureteric colic. This is based on the assumption that the majority of ureteric calculi are visualised.⁴ However, there is little objective evidence to support these conclusions. Two recent studies^{7,8} have suggested that plain radiographs are no better than clinical acumen at identifying patients with acute ureteric colic. Unfortunately all previous studies have involved interpretation of the plain abdominal radiographs by radiologists or urologists rather than by the doctor making the initial assessment in A&E.

Our results for A&E doctors' interpretation of plain films are possibly poorer for a number of reasons. The training of A&E doctors is different from the doctors participating in previ-

ous studies. The plain radiographs may be of lower quality due to lack of bowel preparation and the patient's pain, resulting in movement artefact. Calculi may be too small to be identified on plain radiographs (<2 mm). Our patient population is likely to be different from those examined in other studies, which were retrospective and involved patients with a discharge diagnosis of ureteric colic rather than a presumptive admission diagnosis. However, despite this the need for improved teaching in the interpretation of plain radiographs among A&E staff is clear. Interestingly, the radiologists' reports from our study are better than from other recent studies.^{7,8} This may be because both investigations were reported simultaneously.

All 60 patients were admitted and underwent IVU independently of the plain radiograph result. This suggests that the plain film as a screening investigation should be stopped, since it entails significant costs and substantial radiation exposure with no obvious benefit. Most patients also had a second scout plain film at the time of the IVU to locate the approximate site of obstruction.

The use of the IVU as a gold standard is a potential limitation to the interpretation of our results. We did not allow for false negative IVU results, due to misinterpretation or to the passage of the calculus per urethra. Interobserver variabilities were also not taken into account.

Urinalysis proved to be sensitive but not particularly specific for the identification of calculi. However, it is certainly a far better screening investigation than plain radiographs, being safe, quick, and cheap.

CONCLUSION

The plain radiograph should not be used routinely in the A&E department as a screening investigation for acute ureteric colic. The initial diagnosis should be made by eliciting an accurate history and by the results of urinalysis for haematuria. Subsequent confirmation of the diagnosis should be made by intravenous urography.

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Table 3 Haematuria compared with intravenous urography

	IVU positive	IVU negative
Urinalysis positive for haematuria	29	16
Urinalysis negative for haematuria	0	7