

Role of Ultrasonography in Screening for Urological Malignancies in Patients Presenting with Painless Haematuria

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Abstract

The objective of this study was to determine the efficacy of ultrasonography and urography in evaluating patients presenting with painless gross haematuria for urinary malignancies.

From October 1992 to March 1997, 468 consecutive patients presenting with painless gross haematuria were prospectively investigated. Ultrasonography and urography were performed independently, followed by diagnostic cystoscopy and other relevant investigations.

One hundred and twenty-five urinary malignancies (26.7%) were detected in 122 patients, 85 being carcinoma of bladder (85/468 patients; 18.2%), followed by renal cell carcinoma (25/468 patients; 5.3%). Ultrasonography was significantly more sensitive (83/85; 98%) in the detection of bladder tumours, compared to urography (42/78; 54%) ($P < 0.05$). In the upper tract, there was no significant difference in the sensitivity of lesion detection.

Ultrasonography is more sensitive than urography for diagnosing urological malignancies in patients presenting with painless gross haematuria, where carcinoma of bladder is the commonest pathology. Its utilisation as an initial screening investigation is recommended. Patients diagnosed to be suffering from carcinoma of bladder by ultrasonography should be scheduled directly and promptly for therapeutic endoscopy.

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Introduction

Haematuria of any degree should never be ignored and, in adults, it should be regarded as a symptom of urological malignancy until proven otherwise.¹ Mariani et al,² in their evaluation of 1000 consecutive patients, revealed life-threatening lesions in 9.1% of cases. However, their series consisted of patients presenting with gross as well as microscopic haematuria. More specifically, Britton³ reported that 17% of his patients presenting with painless gross haematuria had an underlying urological malignancy. We believe that patients presenting with painless gross haematuria should be treated as a distinct group so as to avoid an unsatisfactory delay in diagnosis and hence treatment. Many authors employed intravenous urography (IVU) and cystoscopy in the investigation of haematuria.⁴⁻⁶ On the other hand, ultrasonography (US) has been used with increasing frequency for the detection of various genito-urinary

tumours, especially bladder tumours.⁷⁻⁹ Britton³ reviewed the effectiveness of the haematuria clinic and proposed that ultrasonography is probably more preferable in elderly patients.

This study aims to assess the incidence of various malignancies and bladder tumours in patients presenting with painless gross haematuria at a large teaching hospital in Hong Kong, to compare the diagnostic sensitivity and specificity of IVU and US for the evaluation of haematuria, and to clarify the role of ultrasonography in the diagnostic and management pathway in this group of patients.

Materials and Methods

From October 1992 to March 1997, 468 consecutive patients presenting with painless, gross haematuria at Queen Mary Hospital, a large teaching hospital serving a catchment population of about 0.8 million people,

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were prospectively studied. The study group consisted of patients either admitted through the Accident and Emergency Department or referred to the Urology Clinic by other medical practitioners. The study inclusion criteria were painless gross haematuria as a first presentation and chief complaint. Patients with previously evaluated haematuria, known urinary malignancy, trauma, renal colic, known urinary tract calculus and those referred with an established diagnosis were excluded.

Ultrasonography and IVU were performed independently by radiologists unaware of each other's findings. Each ultrasound examination was performed prospectively by either two radiologists or one radiologist together with an experienced ultrasonographer, and a consensus arrived at with regard to the findings and provisional diagnosis in each case. The kidneys and bladder were examined in turn, via the trans-abdominal approach. Particular care was taken to ensure that the bladder was adequately distended prior to the ultrasonography. A curved 3.5 MHz transducer was used, supplemented by a 5.0 MHz transducer to better delineate the anterior bladder wall. A recent plain kidneys, ureters and bladder (KUB) radiograph was made available prior to the ultrasonography.

IVU examination consisted of a standard series of films, including full-length preliminary, five-minute and ten-minute with compression, full length post-compression, filled bladder and post-micturition films. These were supplemented, where necessary, by oblique views, tomography, additional contrast administration and other special views in order to obtain the maximum information. Diagnostic cystoscopy was performed in all patients following imaging. Other basic investigations consisted of full blood count, serum urea, routine urine microscopy and culture, early morning urine for acid fast bacilli (smear with culture results available at subsequent follow-up), and urine for cytology. Other imaging studies such as computed tomography (CT) and magnetic resonance (MR) imaging were performed where indicated. Definitive treatment was planned based

upon the final diagnosis reached. All patients were followed-up regularly in the outpatient clinic, irrespective of the final diagnosis.

Results

There were 350 men and 118 women, with an age range of 20 to 103 years (mean 63 years). In 16 patients, IVU was not performed because of major renal impairment, poor medical status, history of severe contrast reaction or refusal to undergo further imaging after positive diagnosis by ultrasonography, or a combination of these reasons.

Of these 468 patients, 125 urinary malignancies (26.7%) were found in 122 patients. These included 25 renal cell carcinomas (RCC), 10 renal pelvis tumours, 2 angiomyolipomas, 3 carcinomas of the ureter and 85 carcinomas of the bladder. Carcinoma of the bladder was the commonest malignant lesion, representing 68% of all tumours detected. Three of the patients suffering from carcinoma of the bladder also had concomitant renal tumours, all of which were RCC.

None of the patients had synchronous multi-focal transitional cell carcinoma (TCC) involving the upper as well as the lower tract at presentation. One patient had a previous nephro-ureterectomy for her renal pelvis TCC and developed an invasive bladder carcinoma at her second year follow-up for which radiotherapy was given. No other new malignant lesions were noted in all the other patients being followed-up in the clinic. Mean duration of follow-up was 28 months (range 2 to 57 months). Table I shows the tumour detection rate by either modality at their first presentation, while Table II demonstrates the degree of correlation of the two modalities.

Ultrasonography detected all bladder carcinomas except in two patients (total = 5) where the presence of massive blood clots obscured the tumour. In one of them, the initial diagnostic cystoscopy also failed to detect the bladder tumour. On the other hand, 46% of 78 patients with bladder tumours were missed on IVU (7 patients in this group did not have IVU). The mean size

TABLE I: UROLOGICAL TUMOURS AND THEIR DETECTION RATES BY UROGRAPHY AND ULTRASONOGRAPHY AT PRESENTATION

Tumour	Total number	IVU detection			US detection		
		Not detected	Suspicious	Definite	Not detected	Suspicious	Definite
Renal cell Ca	25*	1	10	13	1	6	18
Ca renal pelvis	10	2	5	3	1	5	4
Angiomyolipoma	2	1	1	0	0	0	2
Ca ureter	3	0	3	0	0	3	0
Ca bladder	85#	36	23	19	2	7	76

Ca: carcinoma; IVU: intravenous urography; US: ultrasonography

* one patient with renal cell carcinoma refused IVU upon diagnosis made by ultrasonography

seven patients did not have an IVU upon diagnosis of Ca bladder by ultrasonography

TABLE II: CORRELATION BETWEEN ULTRASONOGRAPHY AND UROGRAPHY IN THEIR DETECTION OF URINARY TUMOURS

Tumour	Number	Detection by both	Detection by US only	Detection by IVU only	Lesion missed by both
Renal cell carcinoma	25	22	2 [”]	1	0
Carcinoma of renal pelvis	10	8	1	0	1
Angiomyolipoma	2	1	1	0	0
Carcinoma of ureter	3	3	0	0	0
Carcinoma of bladder	85	42	41 [#]	0	2 [@]

IVU: intravenous urography; US: ultrasonography;

* one patient with renal cell carcinoma refused urography upon diagnosis made by ultrasonography

seven patients did not have an IVU upon their diagnosis of Ca bladder by ultrasonography

@one patient did not receive an IVU because of an apparently normal US and very poor medical condition, diagnosis made by repeat US 4 months later

of bladder tumour detected by US measured 30 mm (range 10 to 60 mm). In the evaluation of upper tract malignancies, US had a similar detection rate compared with IVU. Renal cell carcinoma was the commonest pathology (20% of all malignancies detected) in the upper urinary tract.

In the evaluation of all urological malignancies, the overall comparative sensitivity and specificity between US and IVU are shown in Table III. The sensitivity of US was significantly higher than that of IVU for the detection of bladder tumours (98% vs 54%, $P < 0.05$, Chi-square test). As for the upper tract, the sensitivities of the two imaging modalities did not differ significantly. One renal cell carcinoma, one angiomyolipoma and two renal pelvic carcinoma were missed on IVU, while one RCC and one renal pelvis carcinoma were missed on US. Details of the false-negative imaging diagnoses for upper tract tumours and specific remarks are listed in Table IV. The specificities of the two modalities did not differ significantly for the lower and upper urinary tracts.

Discussion

Ultrasonography carries no radiation hazard, requires minimal preparation in terms of fasting and bowel preparation, and can be conveniently conducted on an outpatient basis. The only essential prerequisite for a successful ultrasound examination is a fully distended urinary bladder. Ultrasonography is also very useful for patients with a significant allergic history and with severely impaired renal function. It can also be employed as preoperative imaging for evaluating the upper urinary tract in occasional situations where patients with severe clot retention require emergency clot evacuation.

The 18.2% incidence of bladder tumours in this series is higher than many other reported series with a

TABLE III: DIAGNOSTIC VALUE OF ULTRASONOGRAPHY AND UROGRAPHY FOR ALL UROLOGICAL MALIGNANCIES

Imaging	Level		Sensitivity (%)	Specificity (%)	Accuracy (%)
US	Upper	tract	95	99	99
	Lower	tract	98	97	97
IVU*	Upper	tract	90	95	95
	Lower	tract	54	98	90

US: ultrasonography; IVU: urography

* IVU was not performed in 16 patients

TABLE IV: LIST OF UPPER TRACT IMAGING FALSE-NEGATIVE DIAGNOSES

Imaging modality	Pathology	Remarks
1. IVU	2.5 cm RCC	Concomitant RCC and CA bladder, both detected on US; IVU missed both lesions
2. IVU	2 cm TCC renal pelvis	Abnormal soft tissue shadow and clots noted on US; no definite filling defect on IVU
3. IVU	2 cm angiomyolipoma	Multiple small angiomyolipomas with typical US appearances, largest measured 2 cm
4. us	Bilateral RCC	Dense acoustic shadows from stones obscured the US image; diagnosis of RCC could not be made despite noting liver secondaries
5. IVU and US	1.5 cm TCC lower pole pelvis	Tiny lower pole lesion missed by both modalities; suspicious cytology led to repeat imaging studies and diagnosis

US: ultrasonography; IVU: urography; RCC: renal cell carcinoma; TCC: transitional cell carcinoma; Ca: carcinoma

mixed population of microscopic and macroscopic haematuria.²⁻⁶ This emphasises the important point that patients presenting with painless gross haematuria should be regarded as a distinct group with a relatively high chance of having an underlying malignancy. In this patient group, investigation and management work-up should be both prompt and accurate. Intravenous urography had previously been regarded as the “gold standard” of investigation,¹⁰ but ultrasonography is being employed with increasing frequency.^{7-9,11,12} In this series, ultrasonography proved to be significantly more sensitive in the detection of lower urinary tract malignancies.

Ultrasonography accurately detected all cases of bladder carcinoma except in two patients with clot retention. This is highly significant bearing in mind that carcinoma of the bladder was the commonest pathology in the series. It could be argued that the diagnosis could have been made anyway on a subsequently performed cystoscopic examination. The patient would then suffer a substantial delay between the IVU examination and the

diagnostic cystoscopy, should the former investigation happen to be negative (sensitivity 54% only). In such a situation, therapeutic intervention can only be scheduled when the presence of a bladder tumour is confirmed during a diagnostic cystoscopy session.

On the other hand, a positive ultrasonography study (sensitivity 98% for bladder tumour detection), if performed as the initial investigation, would almost always provide the answer, with saving of time and expense. The therapeutic session could then be arranged immediately, based on a confident ultrasound diagnosis. Similarly, should the lesion in the upper tract be detected ultrasonographically, a CT scan could be arranged accordingly, obviating the need for an IVU. Currently, many urology clinics, especially in large teaching institutions, are equipped with ultrasound machines. This relatively simple and non-invasive investigation should be regarded as part of the "clinical" examination.

No concomitant upper tract transitional cell carcinoma was detected in the present series of patients suffering from carcinoma of the bladder. Of the three patients who had concomitant upper tract tumours (all RCC), the renal tumours were readily detected by ultrasonography. In general, synchronous upper tract tumours occur in a small percentage of patients with lower tract disease. The incidence is even lower in cases of well- to moderately-differentiated single-focus bladder cancer.¹¹ In view of the low incidence of synchronous upper tract tumours (0.3%), Goessl et al¹³ recently suggested that routine IVU was unnecessary at first diagnosis of bladder cancer.

Sporadic upper tract urothelial tumours are also uncommon.¹⁴ In this series, the detection rate of these tumours by either IVU and ultrasonography are essentially similar. The single case of upper tract TCC missed by both imaging modalities was detected by urine cytology only. On the other hand, it is well documented that small renal tumours less than 2.5 cm in size can be missed by IVU.¹² It is therefore difficult to recommend one modality over the other as far as imaging of the upper urinary tract is concerned. For patients with recurrent haematuria despite negative imaging, it would be advisable to proceed to alternative forms of imaging.¹⁵ These would include CT, MR imaging or angiography, but cost-benefit considerations and marginal increase in diagnostic yield need to be taken into account. For persistent gross haematuria, repeat ultrasonographic scan is another recommended alternative.

Although there was a false-positive lower tract ultrasound diagnosis in 12 patients, no undue concern was raised as radiologists tend to err on the side of caution in diagnosing bladder tumours. The false-positive diagnoses only led to an earlier than usual cystoscopy in these 12 patients. With increasing confidence in the reliability of ultrasonography, together with rapid ac-

cess to this imaging facility, the policy of omitting a diagnostic cystoscopy in patients with positive ultrasonographic diagnosis of bladder carcinoma is recommended. Therapeutic intervention could also be scheduled directly. Whether all these efforts in minimising the delay in diagnosis would contribute towards improving the long-term prognosis remains to be seen.¹⁵ It is clear, however, that a rapid diagnosis and prompt intervention provides much satisfaction to both the patient and the clinician.

Our results indicate that ultrasonography is an accurate imaging modality in the detection of urinary malignancies in patients presenting with painless gross haematuria. Therapeutic cystoscopy should be scheduled with minimum delay, based on a positive ultrasonographic diagnosis. We suggest that ultrasonography should be employed as the primary investigation modality in this group of patients.

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