

Intravenous Urography in Paediatric and Adolescent Practice

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Summary

Ogunbiyi OA and Nzeh D. Intravenous Urography in Paediatric and Adolescent Practice. *Nigerian Journal of Paediatrics* 1984; **11**:107. A prospective study of intravenous urography was undertaken over a period of 30 months in 640 children and adolescents aged between one week and 16 years. The purpose of the study was to (a) examine the extent of utilization of the procedure in the University College Hospital, Ibadan, (b) assess the prevalence of abnormal findings, using this procedure and (c) make suggestions on the proper utilization of the procedure. The procedure was of great value in the evaluation of patients with abdominal masses, obstructive uropathy and hypertension. It revealed significant abnormal findings in 73%, 79% and 69% respectively, of the patients with these three conditions. In patients with haematuria and recurrent urinary tract infection, significant abnormal findings were revealed in 32% and 21% respectively. The routine use of the procedure in all these conditions seems justified. By contrast, routine use of the procedure is totally unjustified in patients with cryptorchidism, hypospadias, enuresis and non-specified abdominal pains. These conditions constituted about 30% of the patients in the series, but only about 7% of abnormal findings were revealed by the procedure in this group of patients.

Introduction

Radiologists throughout the world are aware of the problems of overusage of radiological facilities within their respective departments. Today, a

carefully-taken history and proper clinical examination of patients by physicians appear to have been replaced by routine requests for radiological studies as well as by elaborate laboratory investigations. It is therefore, necessary to evaluate, from time to time, the increasing number of requests by physicians for radiographic studies of patients. This will help to decide whether what has become an established practice still serves a useful purpose or whether there should be a change or even complete abandonment,

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especially with the realisation of limited resources and trained manpower. Through such evaluations, the value of routine chest radiography in children and adolescents has been questioned.¹ It has also been reported that radiography of the skull in cases of trauma to the skull is of little value.²⁻³ Routine skull radiography has also been shown to be unnecessary and unjustified in children with epilepsy or simple febrile seizures without associated features of neurological dysfunction.⁴⁻⁵ The present prospective study was therefore, undertaken to

- (a) examine the extent of utilization of intravenous urography in the paediatric and adolescent age groups at the University College Hospital (UCH), Ibadan,
- (b) assess the prevalence of abnormalities, using this procedure and
- (c) suggest effective ways of proper utilization of the procedure.

Intravenous urography was chosen because it is a fairly common procedure carried out in children although it is invasive, costly and time-consuming; it is not entirely benign because of its ionizing radiation to the haemopoietic tissues in the pelvic girdle and lumbar spine as well as to the gonads, especially in girls. Furthermore, the contrast medium used for this procedure is a potentially dangerous substance.⁶

Subjects and Methods

The study covered a period of 30 months (July 1980 to December 1982). A record was kept of consecutive intravenous urography performed during this period. The patient's age, sex, ward or clinic, the reason(s) for requesting the procedure and the radiological findings were entered into the record. All the patients were referred from the

various paediatric clinics and wards of the UCH. Repeat and unsatisfactory studies were excluded.

The procedure was usually performed by a resident staff who also reported on the radiographs, but the films and reports were cross-checked by at least, one radiologist. The cases were quite often discussed with one of us, OAO, and at times, with the attending physician, before a final accurate report was issued. The reasons for requesting the investigation included symptoms (e.g. haematuria) signs (e.g. raised blood pressure) or a provisional diagnosis (e.g. Wilm's tumour). In some patients, more than one indication for the procedure was given, but for convenience and to avoid duplication, they were classified under one indication; for example, some children with posterior urethral valves, who also had abdominal masses (hydronephrotic kidneys) and possibly, urinary tract infection were grouped under posterior urethral valves. Similarly, some patients with nephrotic syndrome and hypertension were grouped under nephrotic syndrome.

The urographic findings were classified as (a) normal, i.e. no abnormality detected, (b) abnormal i.e. an abnormality considered relevant to the information on the request form, which did not necessarily imply that the urogram contributed to the patient's management, (c) incidental finding, i.e. an abnormality revealed by the procedure, but which was not clinically evident, e.g. bifid ureter in a patient with hypertension. Anomalies were also classed as major, significant or minor. A major anomaly was regarded as one that could result in loss of renal substance or require surgical correction, e.g. pelvi-ureteric junction obstruction. A significant anomaly was one that posed no threat to renal function or substance, but constituted important clinical information, e.g. a solitary kidney. A minor anomaly was one of no clinical significance, e.g. an uncomplicated duplex collecting system.

Results

There were 640 children and adolescents aged between one week and 16 years, who underwent intravenous urography during the period under review. Table I summarizes the clinical indications for the procedure and the number of patients in each group, while Table II shows the indications and number of cases with normal and abnormal urographic findings. In the group of 119 children with abdominal masses, 58 (48.7%) were of renal origin, eight (6.8%) were suprarenal and 53 (44.5%) extra-renal, of which 12 patients were cases of known abdominal Burkitt's lymphoma. Of the 53 extra-renal masses, 32 patients had normal urograms, while the remaining 21 showed either renal ureteric or bladder displacement with varying degrees of obstructive uropathy. Of the 78 cases of nephrotic syndrome, 23 (29.5%) showed bilateral diffuse renal enlargement, while eight showed impaired renal excretion of contrast material. There were 47 normal urograms including two cases of left renal agenesis. Associated uncomplicated bifid collecting system was seen in five patients.

Out of the 52 cases with urinary infection, 41 (78.8%) had normal urograms and 11 (21.2%) had various abnormalities. These abnormalities included a decrease in renal size with blunting of the calyces in five patients and ureterocoeles in two patients in one of whom there were also a left ureterocoele and a double collecting system on the right with ureters opening separately into the bladder. There were two cases of pelvi-ureteric obstruction, one case of bladder diverticulum and another case of a pelvic kidney. Of the 47 patients with non-specific abdominal pains, 44 (93.6%) had normal urograms, while 3 (6.4%) showed either ureteric distension or calyceal dilatation and blunting suspicious of urinary infection. In four cases, there were complicated double collecting systems. Among 44 patients with haematuria but without associated pains, trauma or abdominal mass, 30 (68.2%) had normal urograms and 14 (31.8%) had abnormalities. Of these 14 abnormal-

ities, there were radiographic features consistent with vesical schistosomiasis in 11 patients; one patient had a calyceal cyst or tuberculous cavity, while two had appearances suggestive of papillary necrosis. There were 38 cases of suspected posterior urethral valves and of these, 30 (79%) had abnormal findings consisting of varying degrees of renal, ureteric and vesical changes of obstructive uropathy. Micturating cystourethrogram (MCU) confirmed the presence of urethral valves in all. The kidneys of 23 of these 30 cases were hydronephrotic and two also had associated urachal fistulae. MCU, carried out on the eight cases with normal urograms, confirmed urethral valves in three, while in the remaining five patients, no obstructive lesions were demonstrated. There were also three cases of meatal stenosis with normal urographic findings. Thirty-eight children, (18 males and 20 females), aged between five and sixteen years, underwent the procedure because of enuresis. The urographic findings were normal in all the 38 children, except in two females, aged nine and twelve years, respectively, whose symptoms were long-standing. Both had moderate hydrocalycosis and hydroureters.

There were 22 patients with abdominal trauma and suspected urinary tract involvement. Seven of these 22 patients had evidence of contused kidneys, while 1 had a ruptured bladder. In 14 cases, the radiograph was normal. Included here were three children with traumatic urethral strictures.

There were five cases among gynaecological patients who had vesico-vaginal fistulae (VVF) following childbirth. Urographic studies confirmed the fistula in all the cases; the upper renal tract was normal in all, except in one case, who had fullness of the ureter and renal pelvis with calyceal blunting, a feature compatible with urinary tract infection. All the other patients, with various conditions such as transverse septum, fused labia minora, female pseudohermaphroditism, imperforate hymen etc, had normal urographic findings.

TABLE 1
Clinical Indications for Intravenous Urography in 640 Children

<i>Indication</i>	<i>No of Patients</i>	<i>% of Total</i>
Abdominal masses	119	18.6
Renal		
— Dronephrosis	26	
— Horse-shoe kidneys	5	
Wilms Tumour	19	
Renal Burkitt's Lymphoma	8	
Supra-renal		
— Neuroblastoma	8	
Extra-renal		
— Burkitt's lymphoma	12	
— Others	41	
Nephrotic syndrome	78	12.2
Cryptorchidism	74	11.6
Urinary tract infection	52	8.1
Abdominal pain	47	7.3
Haematuria	44	6.9
Posterior urethral valves/meatal stenosis	41	6.4
Enuresis	38	5.9
Hypospadias and epispadias	23	3.6
Trauma (+ Traumatic urethral stricture)	22	3.4
Gynaecological	19	3.0
Neurogenic (Spina bifida & myelodysplasia)	14	2.2
Hypertension	13	2.0
Other congenital anomalies	56	8.8
Total	640	100.0

Among 14 patients with neurological abnormalities, there were four cases with neurogenic bladders, hydroureters and hydronephrosis; three cases of meningocele had normal urograms, while six cases of meningomyelocele and one of cord compression had evidence of urinary infection. There were 13 patients with hypertension and in four of these, the study was normal (one was a known case of coarctation of the aorta). Two of these patients had unilateral small, shrun-

ken kidneys with poor function, while the remaining seven had impaired renal function and in four of these, the kidneys were enlarged and were suggestive of either nephrotic syndrome or nephritis.

Table III summarises the findings in 74 patients with cryptorchidism, 23 with hypospadias and 56 other congenital anomalies. Of the 74 cases of undescended testis, 23 were bilateral, 33 unilateral and left sided, 18 unilateral and right sided. All

TABLE II
Clinical Indications and Number of Cases with Normal or Abnormal Urographic Findings

<i>Indication</i>	<i>Normal Findings</i>		<i>Abnormal Findings</i>	
	<i>No of cases</i>	<i>% of Total</i>	<i>No of cases</i>	<i>% of Total</i>
Abdominal masses	32	26.9	87	73.1
Nephrotic syndrome	47	60.3	31	39.7
Urinary tract infection	41	78.8	11	21.2
Abdominal pain	44	93.6	3	6.4
Haematuria	30	68.2	14	31.8
Posterior urethral valves	8	21.0	30	79.0
Enuresis	36	94.7	2	5.3
Abdominal trauma	14	63.6	8	36.4
Gynaecological	14	73.7	5	26.3
Neurogenic bladder (Spina bifida & myelodysplasia)	3	21.4	11	78.6
Hypertension	4	30.8	9	69.2
Meatal Stenosis	3	100.0	—	—

TABLE III
Uroradiographic Findings in Cryptorchidism, Hypospadias and other Anomalies

<i>Condition</i>	<i>Normal Findings</i>	<i>Abnormal Findings</i>		
		<i>Major</i>	<i>Significant</i>	<i>Minor</i>
Cryptorchidism	65	2	1	6
Hypospadias	20	1	—	2
<i>Other congenital anomalies</i>				
Ano-rectal anomalies	18	2	1	—
Ambiguous genitalia + Intersex	8	—	—	—
Multiple congenital anomalies	10	—	—	1
Turner's syndrome	4	—	—	—
Down's syndrome	2	—	—	—
Hydrocoele	3	—	—	—
Congenital hypothyroidism	1	—	—	—
Prune belly syndrome	—	1	—	—
Exomphalos	—	1	—	—
Ectopia vesicae	—	4	—	—

the urograms of these 74 cases were normal except for minor findings including uncomplicated bifid collecting system in six cases, one significant finding of a pelvic kidney and in two cases, an unexplained ureteric dilatation. Normal urograms were obtained from the 23 cases of hypospadias, except for a case each of calyceal cyst and bifid collecting system and one major finding of a ureterocoele.

Among the other congenital anomalies, all the four cases of ectopia vesicae had widely separated symphysis pubis and bladder defects but normal kidneys and ureters. The only case of exomphalos also had bladder defect but normal kidneys. The case of prune belly syndrome had bilateral hydronephrosis and hydroureters and already had a cutaneous ureterostomy. Of the 21 cases of ano-rectal anomalies, 18 had normal urogram. There was a major finding of fused crossed renal ectopia in one case and in two cases, recto-vesical fistulae were confirmed. In all the other cases of various congenital anomalies, no associated renal tract anomalies were found.

Discussion

Intravenous urography is the standard imaging study of the urinary tract in patients suspected of having urinary tract disease. It is unquestionably, of great value in patients with abdominal masses or obstructive uropathy. In the present study, of the 119 cases of abdominal masses, abnormal findings were revealed in 73 of the cases, using this procedure. Similarly, the procedure revealed or confirmed the diagnosis in 79% of the cases with posterior urethral valves. In studying an abdominal mass, the procedure may reveal the mass as arising from the renal tract or other retroperitoneal structures. By far the commonest causes of palpable abdominal masses in childhood are lesions in the posterior abdominal wall generally and the urinary tract, in particular. Therefore, traditionally, the procedure is usually the first step to be taken in cases of an abdominal mass, especially if the mass is clearly not in the

intestinal tract. The procedure gives information about the urinary tract and the retroperitoneal space by displaying the kidneys, the ureters and bladder, or the displacement of these structures.

It should be noted that the presence, localization and contents of abdominal and pelvic masses are readily revealed by ultrasonography, a non-invasive and non-radiation emitting procedure, which is most suitable for paediatric patients. The valuable role of ultrasonography in the evaluation of abdominal masses in paediatric patients has been highlighted,^{7 8} but it should be emphasized that IVU and ultrasonography have complementary value. While it is now the common and acceptable practice in radiology, that many abdominal masses are first evaluated by IVU combined with ultrasound, there are recent reports that computed tomography (CT) is an excellent and probably better procedure.^{9 10} Other workers^{10 11} claim that combined intravenous urography and ultrasound cannot compete with CT in the demonstration of neuroblastomas, teratomas, various sarcomas and solid pelvic lesions.

In a male child suspected of having obstructive uropathy and posterior urethral valves, non-invasive procedures, including ultrasound should be used, although, as has been shown in the present study, intravenous urography is very useful. These non-invasive procedures would reveal or confirm dilatation of the pelvicalyceal systems in the kidneys and the parenchymal thickness, dilated ureters, vesical wall thickening, sacculation and diverticula. Such procedures should be followed by a micturating cystourethrography which can demonstrate the cause of obstruction.

In nephrotic syndrome, the kidneys are typically large and the pelvicalyceal system normal. Nearly 40% of the cases in the present study had either bilateral enlarged kidneys, or poor contrast excretion, due to impaired renal function with elevated blood urea. It may therefore, be concluded that detailed urographic studies in patients with this condition are

unnecessary; IVU is done in this condition as a prelude to needle biopsy of the kidney, a procedure that may be carried out with radiological control using an intensifier and an intravenous injection of contrast medium or by ultrasonic control and indeed more often, by the latter.

In the present study, intravenous urography was requested for 52 patients with urinary tract infection. The procedure revealed normal renal tract in 78.8% of the patients. The abnormal findings in the remaining 21.2% of the patients were indeed, incidental and minor. Thus, it may be concluded that the procedure is of little value in routine evaluation of children with this problem. However, the procedure is strongly indicated in children with proven recurrent urinary tract infection. In such cases, the procedure should be followed by a micturating cystourethrography which can demonstrate ureteric reflux and any underlying renal tract anomalies. With the increasing use of ultrasonography and radioisotopes in paediatric radiology, a patient with proven infection should be studied with a high resolution ray cysto-urethrogram and a radionuclide renal scan or renal ultra-sound.

Forty-four patients in the present series underwent the procedure because of haematuria and of these, abnormal findings were revealed in 32%. Although this level of abnormal findings was moderate, the procedure was justified, since the abnormal findings were of a major nature. By contrast, using the procedure on patients with non-specific abdominal pains, is considered to be of no value since only in 6% of the patients were abnormal findings revealed by the procedure; these findings were compatible with urinary tract infection. Similarly, in only 5% of the patients with enuresis did the procedure reveal features compatible with urinary tract infection. It has indeed, been reported by others^{12 13} that in this condition, intravenous urography, urodynamic tests and endoscopy are unrewarding and therefore, should not be undertaken routinely unless there is evidence of urinary tract infection,

abnormal physical findings or obstructive symptoms.

Among the 97 patients with either cryptorchidism or hypospadias in the present series, only 4% had either a major or significant findings, although eight patients also had minor findings consisting of uncomplicated double collecting systems or a calyceal cyst. The present findings are similar to those of other workers.^{14 15} Recognising that some 10% of the general population have upper tract anomalies of varying degrees, using radiographic studies,^{16 17} it is recommended that urographic studies in uncomplicated cases of these two conditions should not be undertaken. Weighed against the costs in both radiobiologic and economic terms, there seems to be little benefit to be derived from subjecting children with cryptorchidism, hypospadias, enuresis and non-specific abdominal pains to intravenous urography. It is noteworthy that in the present study, these conditions constituted 30% of the total number of patients.

It is known that a normal urogram may be as valuable as an abnormal one. However, if the physician considers a particular radiographic investigation to be necessary, such must be requested for, because of the overriding responsibility to the patient, but not on the basis of a probability that it may or may not be helpful. Nevertheless, it is clear that the use of one resource for some patients denies the use of the same or a different one for others. Data, as obtained in the present study, should always be evaluated *vis-a-vis* the value to the patient so that shortcomings can be pointed out. There is no doubt that in order to choose the best and appropriate diagnostic procedure for the patient, there should be a clinico-radiological teamwork. It may not be possible to suddenly change the habits of a lifetime, but efforts should be made to educate medical students and resident staff in particular, on the appropriate and useful diagnostic radiographic procedures to be requested. A reduction

in the number of unnecessary procedures will give the radiologist time to practise better, more interesting and more productive radiology.

References

1. Brill PW, Ewing ML and Dunn AA. The value of routine chest radiography in children and adolescents. *Pediatrics* 1973; **52**: 125-7.
2. Bell RS and Loop JW. The utility and futility of radiographic skull examination for trauma. *N Engl J Med* 1971; **284**: 236-9.
3. Roberts R and Shopfner CE. Plain skull roentgenograms in children with head trauma. *Amer J Roent Rad Ther Nucl Med* 1972; **114**: 230-40.
4. Myejind KI and Vestermark S. Value of routine radiography of the cranium in children with epilepsy. *Excerpta Medica* 1974; **32**: 2.
5. Ogunmekan AO. Routine skull roentgenography in the clinical evaluation of children with febrile convulsion. *Br J Radiol* 1980; **53**: 815.
6. Ansell G. Adverse reactions to contrast agents. Scope of problem (Symposium on contrast media). *Invest Radiol* 1970; **5**: 374-91.
7. Grossman H. The evaluation of abdominal masses in children with emphasis on non-invasive methods. A roentgenographic approach. *Cancer* 1975; **35**: 884-900.
8. Stuber JL, Leonidas JC and Holder TM. Abdominal Ultrasonography in Pediatrics. *Amer J Dis Child* 1975; **129**: 1096-101.
9. Leonidas JC, Carter BL, Leape L, Ramenofsky ML and Schwartz AM. Computed tomography in diagnosis of abdominal masses in infancy and childhood: Comparison with excretory urography. *Arch Dis Childh* 1978; **53**: 120-5.
10. Kuhn JP. CT in the evaluation of paediatric abdominal abnormalities. *Critical Reviews in Diagnostic Imaging* 1981; **16**: 125-80.
11. Cremin BJ and Mervis B. Paediatric abdominal computed tomography: the technique and use in neuroblastomas and pelvic masses. *Br J Radiol* 1983; **56**: 291-8.
12. Kendal AR and Karafin L. Editorial: Enuresis. *J Urol* 1973; **169**: 137.
13. Kass EJ, Diokno AC and Montealegre A. Enuresis: Principles of management and result of treatment. *J Urol* 1979; **121**: 794-6.
14. Noble MJ and Wacksmann J. Screening excretory urography in patients with cryptorchidism or hypospadias: A survey and review of the literature. *J Urol* 1980; **124**: 98-100.
15. Fallon B, Welton M and Hawtrey C. Congenital anomalies associated with cryptorchidism. *J Urol* 1982; **127**: 91-3.
16. Leary FJ, Myers RP, Breen LF and Hartman GW. The value of excretory urography as a screening test in asymptomatic patients. *J Urol* 1972; **167**: 850-1.
17. Noe HN and Patterson TH. Screening urography in asymptomatic cryptorchid patients. *J Urol* 1978; **119**: 669-70.

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