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ORIGINAL ARTICLE

IS THE ROUTINE USE OF INTRAVENOUS UROGRAPHY STILL JUSTIFIED? FINDINGS FROM A CROSS-SECTIONAL STUDY IN A REFERRAL HOSPITAL IN ADDIS ABABA

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ABSTRACT

Introduction*: Intravenous urography has been the imaging modality of choice for long due to its good spatial resolution and excellent anatomic details of the collecting system of the kidney. The introduction of cross-sectional imaging has challenged the use of intravenous urography as the modality to look for diseases of the collecting system of the kidney. Despite developments in imaging, intravenous urography is still useful in the work-up of some diseases of the collecting system, but ordered by physicians for lots of obsolete indications.*
Objective: *This study was conducted to review the current use of Intravenous Urography by referring physicians.*
Methods*: The study was a cross-sectional study with prospective data collection conducted at the Radiology Department of Tikur Anbessa Specialized Hospital. Data was collected for consecutive six years from 2009-2015 by using a structured questionnaire developed for the purposes of the study. All patients who were sent to the department for intravenous urography examination during the study period were included in the study.*
Results*: The study involved 253 patients who were sent to the department of radiology for intravenous urographic study. Among these, 163 (64.6%) males and 90 (35.4%) female. The mean age for the study population was 31 (SD -17.1) years. The commonest indications for intravenous urography were renal stones (36.8%) and hydronephrosis (30.4%). Hematuria was an indication in five (2.0%) of the patients. Nearly a quarter of them (23.7%) had normal intravenous urography finding.*
Conclusion*: Most of the indications* for intravenous urography *at Tikur Anbessa Specialized Hospital were unjustified and would have been avoided as they were particularly obsolete for pediatric patients. The indications for intravenous urography should adhere to international current standards.*

INTRODUCTION

Intravenous urography (IVU) has long been the primary imaging modality in a number of urinary tract abnormalities. It's ability to provide a panoramic view of the urinary tract, better spatial resolution and ability to provide functional information in addition to structural details has made it a powerful imaging tool and somehow irreplaceable. In 1985 Pollack and Banner, two renowned uroradiologists, remarked that IVU would continue to be used for many years to come(1). However, the value of IVU in the evaluation of various renal tract diseases has been strongly challenged.

In a 1989 prospective study by Hughes and his colleagues ((2) questioned if ultrasound (US) could replace IVU as a preliminary investigation of renal tract diseases by comparing the diagnostic yield of IVU and US for common clinical indications which revealed identical information from the two techniques in 81.4% of cases. Ultrasound plus a plain abdominal radiograph provided more diagnostic information in a further 12.5% of cases, while IVU was more informative in only 6.1%. The authors proposed the use of a scheme of routine urinary tract investigations using ultrasound and plain abdominal radiograph (2, 3).

A study by McNicholas et al. (3) revealed that ultrasound of the renal tract plus a KUB is comparable with IVU in the diagnosis of renal pathology and that pelvic ultrasound was also shown to be useful in detecting unsuspected pelvic pathologies. A similar result was obtained in evaluation of UTI in men (4-7). In a randomized controlled trial (RCT) done by Pfister SA, et al, both IVU and unenhanced helical computed tomography (UNHT) showed comparable sensitivity and specificity. The study also revealed identical direct costs, whereas indirect costs were higher for IVU; moreover waiting time before procedure and duration of procedure were significantly prolonged for IVU (5).

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Though the use of IVU is still justified in some clinical scenarios, its role as a primary imaging modality in the urinary tract is diminishing overtime. It's costliness, high radiation dose, discomfort to patients related with bowel preparation and recognition of risks related with intravenous contrast has made it a less popular imaging tool and induced series of investigations questioning its value. In addition, the advent of newer and better imaging techniques like US, CT and MRI have further limited its use substantially. However, despite current consensus, there is still a strong tendency among physicians to refer patients to radiology units for IVU evaluation. Large numbers of patients, of all age groups are still given daily appointments at our department for IVU. Requests for IVU come from medical interns, general practitioners and even senior physicians. Considering the radiation, risks and the cost and time incurred by a single procedure, it is necessary to study the pattern of utilization of this procedure and assess if it's use is justified.

PATIENTS AND METHODS

This is cross-sectional study with retrospective data collection done at Tikur Anbessa Specialized Hospital (TASH) Radiology Department from January 2009 - May 2015. All patients who were sent to the Department for IVU examination and had the examination done were included in the study. Those patients for whom IVU was not done for various reason as well as those whose images were difficult to interpret for technical reasons were excluded from the study.

Data was collected by using a structured questionnaire developed for the purposes of this study, ontaining demographic variables, clinical indications, ultrasound findings and IVU findings. Data was entered onto and analyzed using SPSS V16. Frequency distributions with proportions were drawn for all study variables. Cross tabulations were used to outline the relationships between variables where relevant. The clinical indications for IVU were compared with the currently accepted standards used in clinical practice.

Demographic data and clinical indications were collected from the IVU investigation request papers and imaging findings were collected directly from the radiographic images. The IVU is done as part of the patients' clinical workup when requested by front line physicians. The study obtained Ethical Clearance from the Department Research and Ethics Committee.

RESULTS

Total number of cases analyzed for this study was 253, of which, 163 (64.6%) were males and 90 (35.4%) females. The mean (SD) age for the study population was 31 ($\pm$17.1) years. The youngest patient was just four months old and the oldest was 71 years of age. Over all the commonest indications for IVU were renal stones (36.8%) and hydronephrosis identified on previous ultrasound study or suspected obstructive uropathy (OUP) (30.4%) (Table 1). Other indications, including post pyelolithotomy, post pyeloplasty stricture, post urinary bladder reconstruction, renal cyst, which were identified on previous ultrasound, urinary bladder (UB) stone, urinary incontinence. Five (2%) of the requests for IVU had no clinical indication written on the request.

Distribution of the clinical indications for age group (Table 2) revealed that most of the IVUs performed for renal stones were done in the second (31.1%) and third decade (21.1%). 77.4% of the IVUs done for abdominal masses were under 10 years of age, the fifth decade was the second peak (6.5%).

Assessment of the IVU findings revealed that 23.7% had normal finding. Among those who had positive IVU findings urinary tract obstruction constituted 47%, of which 30.4% were due to stones and 3.2% were due to ureteric stricture in the rest (13.4%) cause was unidentified (Table 3).

Cross tabulation between age groups and commonest IVU findings revealed that OUP secondary to stones and hydronephrosis of unidentified primary peaked in the second decade, 23.7% % 29.4%, respectively. Intraabdominal mass peaked in the first decade (78.2%). The complete list is shown in Figure 1.

When IVU was done for renal stones detected on US, 18.5% had no abnormal finding identified (Table 4). Positive findings included OUP secondary to obstructive stone (51%) and renal stones (13%). With an indication of suspected OUP (hydronephrosis on previous US), most of the IVUs done had normal findings (33.8%), 27.3% had OUP secondary to stone, 23.4% had OUP of unidentified cause. Among IVUs done for intra-abdominal masses 61.3% had IVU findings suggestive of intraabdominal mass, 16.1% had hydronephrosis, 9.7% had normal findings.

Table 1: Frequency distribution of clinical indications for Intravenous Urography at Tikur Anbessa Specialized Hospital

Indication	Frequency	Percent
Renal stone	92	36%
Hydronephrosis detected on previous ultrasound	77	30.4%
Abdominal mass	31	12.3%
Congential anomaly	10	4.0%
Flank pain	18	7.1%
Other indications	19	7.5%
No indications mentioned	5	2.0%
Total	253	100%

Table 2: Distribution of the three commonest indications of Intravenous urography for the age groups

Age (Years)	Clinical indication		
	Renal Stones on Ultrasound	Suspected Outpatient	Abdominal mass
<10	1(1.1%)	7(9.2%)	24(77.4%)
10 - 19	9(10.0%)	5(6.6%)	1(3.2%)
20 - 29	28(31.1%)	20(26.3%)	2(6.5%)
30 - 39	19(21.1%)	18(23.7%)	0
40 - 49	17(18.9%)	10(13.2%)	1(3.2%)
50 - 59	15(16.7%)	10(13.2%)	2(6.5%)
>59	1(1.1%)	6(7.9%)	1(3.2%)
Total	90(100%)	76(100%)	31(100%)

Table 3: frequency distribution for Intravenous urography findings at Tikur Anbessa Specialized Hospital

Finding	Frequency	percent
No abnormality detected	60	23.7
Renal stone	15	5.9
OUP* due to stone	77	30.4
OUP* due to stricture	8	3.2
OUP* of unknown cause	34	13.4
Intraabdominal mass	23	9.1
Ectopic kidney	11	4.3
Unilateral non visualized kidney	15	5.9
Others	10	4
Total	253	100

Figure 1: Top three intravenous urographic findings of patients at TASH

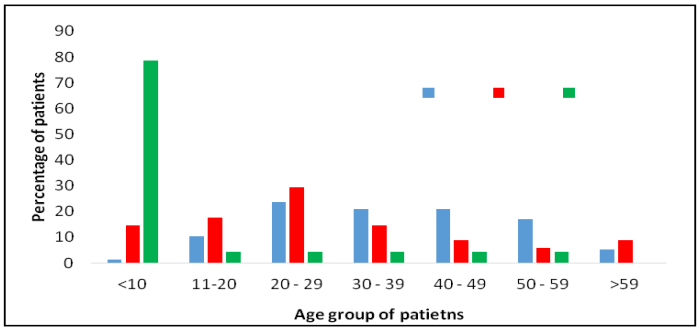

Table 4: Cross tabulation between top three clinical indications and IVU findings

Clinical indication	Intravenous urography findings									
	No abnormality	Renal stone	Obstructive uropathy 2° to stone	Obstructive uropathy 2° to stricture	Hydronephrosis: cause unknown	Mass	Ectopic kidney	Non visualized	other	Total
Renal stones on previous ultrasound	17 (18.5%)	12 (13%)	47 (51%)	4 (4.3%)	5 (5.4%)	1 (1.1%)	2 (2.2%)	1 (1.1%)	3 (3.3%)	92 (100%)
Suspected obstructive uopathy (hydronephrosis on previous ultrasound)	26 (33.8%)	-	21 (27.3%)	3 (4%)	18 (23.4%)	2 (2.6%)	-	4 (5.2%)	3 (4%)	77 (100%)
Abdominal mass	3 (9.7%)	-	-	-	5 (16.1%)	19 (61.3%)	-	3 (9.7%)	1 (3.2%)	31 (100%)

DISCUSSION

The indication for IVU has undergone radical changes worldwide. Its use is currently limited to few genitourinary conditions. An alternate approach to initial evaluation of patients with flank pain and suspected ureteral stone is a combination of KUB and US, which showed comparable sensitivity and specificity with IVU (8-12). However, considering cost and safety, the former is considered better initial investigative tool than IVU. This approach is particularly useful in settings where CT is not widely available.

Radiographic evaluation of hematuria has been a controversial issue among scholars. Though there are numerous causes, the aim of imaging in patients who present with hematuria is to exclude or diagnose early urinary tract neoplasms. The prevalence of microscopic hematuria in asymptomatic patients is 2.5%, and frequently no cause is identified (13). Even though there is no threshold at which malignant neoplasm can safely be ruled out, imaging is not recommended in this group of patients. On the other hand, macroscopic hematuria requires complete evaluation of the upper and lower urinary tract to exclude neoplasia (14).

According to European society of urogenital radiology Guideline patients with painless hematuria are stratified into different risk groups; IVU is recommended in medium risk groups if ultrasound and cystoscopy are negative (15). Previously IVU used to be routinely done for evaluation of palpable abdominal mass. That role of IVU is now superseded by better imaging modalities. Initial evaluation of abdominal masses should be with ultrasound followed by abdominal CT or MRI (16-19).

Out study reported here included 253 patients, 163 (64.6%) males and 90 (35.4%) females. The mean (SD) age for the study population was 31(±17.1) years; their age ranged from 4 months -71 years. The clinical indications for IVU were compared with currently accepted standards mainly that of the American college of radiology (ACR) practical guidelines for the performance of IVU, ACR criteria for evaluation of abdominal mass and evaluation of hematuria (16, 18, 19). Recommendations of published research works has also been referred (17, 20). According to these guidelines the indications of IVU should be: i) evaluation of suspected or known ureteral obstruction, ii) when road map for endourological procedures is required, iii) assessment of suspected congenital anomalies, iv) prior to renal transplantation, and v) work up of hematuria.

Our study revealed that renal stones detected on prior ultrasound (36.8%) were the commonest indication followed by suspected OUP (30.4%) and evaluation of abdominal masses (12.3%). Compared against the currently accepted protocols, the most frequent indications for IVU at TASH, namely evaluation for renal stones is unjustified.

In acute flank pain or ureteric colic unenhanced helical CT is currently the gold standard (5,6). Where CT is not available a combination of KUB and U.S has been proved to have comparable sensitivity and specificity with IVU in evaluation of acute flank pain (9,10). Considering the cost, time delay and added radiation dose from IVU the former is considered the preferred approach (11).

Similarly, renal stones are best detected with ultrasound and in the absence of colic or other compelling indication, they do not warrant IVU. Patlas M, et al.

Comparing US alone Vs Unenhanced helical computed tomography (UHCT) in detecting ureteral stones. The sensitivity and specificity of the two in their study were 93% and 95% vs 91 and 95%, respectively. Though both were equally good, considering cost and radiation risks they suggested that US should be employed first and CT reserved for when US is non -diagnostic or unavailable. However, the false negative rates for US could be high (10). Technical issues, inability to detect small stones and failure to provide functional information could be serious limitations (21). Though addition of KUB could solve some of these problems, whenever there is discordance between the two, IVU would be necessarily used (22).

Abdominal mass, which should be evaluated with cross sectional imaging alone is the other indication for which IVU is unnecessarily done. Among the patients for whom IVU was done for abdominal mass the majority (77.4%) were below the age of 10yrs. While evaluation of abdominal mass with IVU is unjustified in any age group, children pose a greater problem because of their increased vulnerability to radiation. It is also known that the radiation dose from IVU could reach to a level known to increase the probability of stochastic effect. Ultrasound should be the initial imaging modality in evaluation of palpable abdominal mass, followed by contrast enhanced CT, which would establish the diagnosis and allow staging (19).

Suspected OUP, congenital anomalies and work up of hematuria are the indications for which IVU is rightly done in our study. However, these constituted only 36.4% of all the indications for IVU. Overall, our study revealed that more than half of the IVUs performed at TASH during the study period were for unjustified indications. Additional 2% had no clinical indication mentioned. The authors believe that this is not acceptable by any standard. Apart from the radiation and contrast risk to patients and delay in management, the financial loss that such unjustified procedures incur, especially in a resource poor setting could be disabling.

Lack of a standard guideline could be one of the major reasons for inappropriate utilization of IVU at the hospital.

Requests for IVU come from nearly all speciality departments at the hospital and the ordering physicians range from medical interns to senior physicians. Besides, there is usually no way of proving if the requests are genuinely coming from the "physician" who requested the investigation. Another important contributing factor IVU could be lack of screening of requests at the department.

Conclusion and recommendation: In summary, more than half of the IVU done at TASH during the study period had unjustified indications compared with the current standard, evaluation for renal stones and abdominal masses being the foremost indications for which IVU is ordered unnecessarily. Considering the cost, time consumed, delay in treatment and safety issues, the use of IVU should be judicious and in keeping with current standards. This is particularly more important in pediatric patients because of the increased vulnerability of this group to radiation related long term risks.

To minimize and if possible eliminate the number of unnecessary IVU examinations, the authors recommend the following:

- Consensus criteria based on internationally accepted standards on the utilization of IVU should be developed by responsible departments at the institution. Joint sessions and/or a forum should be prepared to this end.
- There should be clear regulation as to who should order IVUs.
- Ordering physicians should fill out requests completely, clearly stating justification for the procedure and other relevant information.
- Requests for IVU should be screened at department of radiology for appropriateness of indications.

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